Boxborough Public Safety Facility
502 + 520 Massachusetts Avenue
Boxborough, MA

MEP/FP Feasibility Study
Basis of Design

Narrative Date: May 20, 2016

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1.0 BACKGROUND

Thompson Consultants, Inc. has developed this initial Basis of Design Report to inform the Town of Boxborough and others of the assumptions being made in the preparation of the Mechanical, Plumbing, Fire Protection and Electrical Contract Documents for the new Public Safety Facility being proposed for 502 and 520 Massachusetts Avenue, Boxborough, MA. In line with the scope of work, this document explores the technical feasibility of the proposed building program and defines the relevant design codes and standards in parallel with defining the assumptions about design loads and system selections.

The project is for the construction of a new two story, approximately 29,739 square foot building for the Town's Police and Fire Departments.

The design of any MEP system is based on the criteria established for the specific occupancy of the facility. Flexibility to adapt to the changing needs of the programs within the specific occupancy must also be addressed, but may be limited by the project budget and schedule.

The MEP design will be developed to address the safety, comfort and convenience of the building occupants in support of the specific uses as outlined during programming, as well as providing reliable sustainable and efficient operation of the facility.

2.0 CODES AND STANDARDS

CODES AND REFERENCE STANDARDS

All systems are reviewed in accordance with the following list of reference standards and codes:

A. International Building Code (IBC)

B. International Mechanical Code

C. Massachusetts State Building Code 780 CMR

D. Massachusetts State Plumbing and Fuel Gas Code 248 CMR

E. Massachusetts Department of Public Health WEB based check-lists and reviews.

F. Massachusetts Department of Environmental Protection (DEP)

G. Massachusetts Fire Prevention Code 527 CMR

H. National Fire Protection Association, specially:

1. NFPA 13: Installation of Sprinkler Systems
2. NFPA 20: Standard for the Installation of Fire Pumps
3. NFPA 22: Standard for the Installation of Water Storage Tanks for Fire Protection
4. NFPA 24: Installation of Private Fire Service Mains
5. NFPA 25: Inspection, Testing and Maintenance of Water Based Fire Protection Systems
6. NFPA 30: Flammable and Combustible Liquids Code
7. NFPA 70: National Electrical Code
8. NFPA 72: National Fire Alarm Code
9. NFPA 90A: Shafts and Vertical Duct Separations,
10. NFPA 101: Life Safety Code

I. Town of Boxborough Fire Department Requirements

J. Town of Boxborough Inspectional Services Department Requirements

K. Factory Mutual (FM)

L. Standards of Underwriter's Laboratories (UL)

M. Massachusetts Water Resources Authority (MWRA)

N. American Society of heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

O. ASHRAE Standard 62.1-2013 Ventilation for Acceptable Indoor Air Quality

P. American National Standards Institute (ANSI)

Q. Occupational Safety and Health Administration (OSHA)

R. Environmental Protection Agency (EPA)

S. American Society of Testing Material (ASTM)

T. National Electrical Manufacturer's Association (NEMA)

U. Institute of Electrical and Electronic Engineers (IEEE)

V. National Electrical Testing Association (NETA)

3.0 FIRE PROTECTION PROPOSED SYSTEM MODIFICATIONS

A. System Overview

Provide a fully automatic wet sprinkler system throughout the building unless noted otherwise.

Building does not require a standpipe system as the highest finished floor elevation is less than 30 feet above finished grade in accordance with the International Building Code.

All spaces within the building to be protected with sprinkler coverage to provide a fully protected building. An addressable fire alarm system to be provided under electrical package and to work in conjunction with the fire protection system.

B. Wet-Pipe Fire Sprinkler System

Building to be protected throughout with wet-pipe type sprinkler system using quick response sprinklers throughout. System to be hydraulically sized to ensure a minimum or 7 psi at the most remote sprinkler head.

Sprinkler System Design Densities:

Public Areas, Holding Cells and Offices: Light hazard occupancy, 0.10 GPM/sf over the hydraulically most remote 1500 sf, including a 100 gpm hose stream allowance. Maximum head spacing 15'x15'. With ceiling heights in these areas below 20' in height adjustments can be made in accordance with NFPA 13 to reduce the most remote area.

Mechanical Rooms, Sally Port and storage rooms: Ordinary Hazard Group 1, 130 sf/head, 0.15 GPM/sf over the hydraulically most remote 1,500 sf, including a 250 gpm hose stream allowance. With ceiling heights in these areas below 20' in height adjustments can be made in accordance with NFPA 13 to reduce the most remote area.

Fire Apparatus Bays: Ordinary Hazard Group 2, 130 sf/head, 0.20 GPM/sf over the most hydraulically remote 1,500 sf., including a 250 gpm hose stream allowance.

Sprinkler Zones:

Building to be zoned for sprinkler coverage by floor.

Each zone control to consist of a supervised isolation valve, check valve, flow switch, and test and drain assembly.

Test valves for each zone shall be located to be accessible, and their discharge lines are to be directed outside the building to a safe location. All test valves shall be at the remote ends of the systems to facilitate system flushing.

Water Supply:

There is no public water supply available at this location. Water supply is limited to an on-site drilled well of insufficient capacity to meet the fire demand for this building. In order to meet the needs of this building a below grade water storage tank will be installed. Currently the tank size is estimated at 39,000 gallons to meet the anticipated fire demand for both sprinklers and hose stream allowances required by NFPA 13, Standard for the Installation of Sprinkler Systems. A water storage tank can be built into the foundation of the building below the auxiliary spaces of the Apparatus portion of the building. A tank that can hold 5 feet of water in that space will provide a water supply of approximately 42,000 gallons.

An automatic staring fire pump will take suction from the tank and supply water to the automatic sprinkler system and provide for the required 250 gpm hose stream allowance for a period of 60 minutes.

Sprinkler Heads:

Sprinkler heads to be fully recessed, quick response style in areas with suspended ceilings.

Holding cells shall be protected using “Institutional” grade sprinklers that are tamper resistant.

Sprinkler heads in mechanical space and other areas without hung ceilings shall be upright or pendent as required by location.

Sprinkler heads to be provided above and below ductwork and equipment 48” and wider. Additionally, sidewall sprinkler protection will be provided to protect the space below each open overhead door.

All sprinkler heads exposed to accidental breakage shall be outfitted with a cage protector.

Sprinkler System Valves:

Fire department pumper connection shall be a 5” Storz connection as required by the local Fire Department.

All shut-off valves to be UL listed and be equipped with supervisory tamper switches. These switches along with the flow switches shall be monitored by the building fire alarm system.

C. Sprinkler Protection Areas

The following assumptions are made with respect to various spaces at this time until dictated otherwise by programming:

- Elevator Shafts/Elevator Machine Rooms – Wet sprinkler system
- Generator Room – Wet sprinkler system
- Main Server Room – Wet sprinkler system
- Main Electrical Room – Wet sprinkler system
- Mechanical spaces – Wet sprinkler system
- Office/Common areas – Wet sprinkler system
- Tel-data – Wet sprinkler system
- Sally Port & Apparatus Bay – Wet sprinkler system

4.0 PLUMBING PROPOSED SYSTEM MODIFICATIONS

A. Systems Overview

Provide domestic water systems including, cold water, hot water, hot water recirculation and water heating equipment, zoned for proper distribution and control in each of the major building areas. With the capacity of the on-site well unknown at this time a water storage tank with 450 gallons of useable potable water and pump will need to be provided to meet the flow requirements of the emergency showers.

New underground storm and sanitary drainage piping will be required for the site. Trench drains are to be provided in the Sally Port and Apparatus Bays. These drains shall be connected to a gas and oil interceptor as required by the Massachusetts State Plumbing Code.

Roof drainage will be provided for the building to convey storm water from the roofs, through roof drains and rainleaders connected to underslab drainage lines that will discharge to the exterior of the building through flared discharge outlets provided by the General Contractor. Overflow drainage will be accommodated via scuppers provided by the General Contractor. A secondary roof drainage system will not be provided.

Sanitary waste piping system will be provided to collect waste discharge from sanitary fixtures through a series of waste and vent stacks. Floor drains will be provided outside of each lock up cell and will be independently piped to the exterior of the building in accordance with 105 CMR, 470.000 Maintenance and Construction of Lockup Facilities.

All below slab sanitary lines serving holding cell plumbing fixtures shall be 6-inch cast iron pipe. Oversizing greatly reduces the possibility of intentional blockages in the sanitary line. The waste stacks will collect below grade and discharge to the on-site septic system. Vent stacks will collect as feasible and will discharge through the roof, at a minimum distance of 25 feet from any air intake.

B. Plumbing Fixtures

General: Plumbing fixtures are to be mounted in accordance with plumbing code, and industry standards. Fixtures designated as "accessible" are to be mounted in accordance with the regulations of the Massachusetts Architectural Access Board (MAAB) and the Americans with Disabilities Act Architectural Guidelines (ADA). A percentage of water closets, urinals, lavatories, drinking fountains and showers, as required by MAAB and ADA, shall be made accessible.

Water Closets:

Commercial grade, white vitreous china, wall hung, low flow not exceeding 1.6 GPF, with exposed, manually operated, flush valve, and open front white plastic seat and self-sustaining check hinge. Fixture to be mounted on commercial grade, floor supported chair carrier.

Urinals:

Commercial grade, white vitreous china, wall hung, 0.5 GPF, with exposed, Manually operated, flush valve. Fixture to be mounted on commercial grade, floor supported chair carrier.

Lavatories:

Public Toilet Rooms: Commercial grade, white vitreous china, wall hung fixture, with front overflow. Fixture to be provided with chrome plated sensor operated faucet, open grid drain, supplies with stops, and "P" trap. Those fixtures designated as accessible, are to have the exposed water and waste piping below the counter insulated.

Staff Locker Rooms: Commercial grade, white vitreous china, self-rimming lavatories with commercial grade gooseneck faucets with 4-inch wrist blade handles and laminar flow spout. Fixture to be provided with open grid drain, supplies with stops, and "P" trap. Those fixtures designated as accessible, are to have the exposed water and waste piping below the counter insulated.

Sinks:

Lunch Room Sink: Self-rimming double bowl stainless steel, and acid resistant type to be installed with commercial grade chrome plated swivel faucet with hand spray function.

Med Clean/Decon Room: Stainless steel, floor mounted double bowl scullery sink with integral drain board, foot pedal control and hose spray.

Showers:

Staff showers are to be constructed in-place and be equipped with Pressure balanced, single handle mixers. Shower heads to be commercial grade, adjustable type. Handicap accessible showers to be equipped with shower head mounted on wall slide bar, with flexible supply hose.

Detainee Shower: Stainless steel, penal ware shower stall with ligature resistant controls and showerhead.

Electric Water Cooler:

Commercial grade, wall hung, dual-height, stainless steel finish, with integral compressor.

Janitor's sinks:

Floor mounted, mop service basins, molded plastic composition, with stainless steel grid drain. Provide with chrome plated mixing faucet, bumper guards on basin rim, and stainless steel wall splash guard.

Other Plumbing Fixtures:

Emergency Shower/Eyewash: Provide as necessary for areas handing chemicals. Unit shall be a combination type, free standing and supplied with tempered water to meet OSHA and ANSI standards or 70 to 90 degree water at a flow rate of 30 gallons per minute for a period of 15 minutes.

Security (Penal Ware): Provide one piece stainless steel combination water closet and lavatory unit for each holding cell with ligature resistant design. Unit is to be specifically engineered and designed for use in secure and correctional facilities.

C. Domestic Water Distribution

Water Supply Piping Systems:

Cold Water: Cold water supply system to enter the building, from the underground main from the on-site well system. Service entrance to be equipped with a water backflow preventer. The water main shall be sized to serve all building areas. Domestic cold water piping to be distributed throughout the building, and serve all fixtures and equipment requiring service, and be provided with isolation valves to provide zone control of the system.

Hot Water: Hot water supply system shall be generated by a gas-fired domestic high-efficiency water heater, and distributed to those fixtures requiring hot water. Hot water circuits with a developed length of more than 50 feet from the water heater or a hot water supply main, shall be provided with a re-circulation piping loop, to maintain the water temperature. Hot water delivery temperatures shall be as follows:

Designation	Description	Operating Temperature
HW	Domestic Hot Water	120 Deg. F.
TW	Emergency Tempered Water	70-90 Deg. F.
	Public Lavatory Faucets (Tempered at faucet)	115 Deg. F.
	Showers (Tempered at Mixing Shower Valve)	112 Deg. F. (Maximum)

Hot water re-circulation: Hot water supply piping shall be re-circulated from the remote ends of the system, and returned to the water heaters, to maintain system temperature. Re-circulation loops to be provided with bronze bodied circulator pumps, operated by immersion aqua-stats.

Tempered water supply: In order to provide tempered water (70-90 Deg. F.) at all emergency fixtures in the building point of use mixing valves, sized to accommodate the anticipated flow or

the emergency fixture that it serves will be installed. Hot water to the mixing valve shall be supplied from the buildings, hot water recirculation system.

Boiler Make-Up Water Supply: The supply water for boiler make-up water shall be equipped with reduced pressure principle backflow preventers. All piping on the discharge side of these backflow preventers is the responsibility of the HVAC contractor.

Water Supply Equipment:

Backflow preventers: Reduced pressure principle devices, with test ports and vented intermediate chamber. These devices will be ASSE listed and Mass. Code approved. Drip from vented chamber to be discharged over floor drain.

Domestic water heaters: Unit shall be commercial grade, storage type, gas-fired, with integral operating controls. The central water heating system will consist of high efficiency water maker and storage tank, located in the Plumbing and Fire Protection Room. The unit will supply hot water to all domestic water fixtures requiring hot water.

Wall hydrants: Shall be provided at 100 foot intervals around the building. Units shall be non-freeze type, equipped with loose operating key, and located approximately 18 inches above finished grade. Units shall be PDI listed, and be complete with integral vacuum breaker.

Hose Bibbs: Shall be chrome plated, wall mounted, with integral vacuum breaker, and loose key handle. They shall be located in each toilet room, and all rooms containing a floor drain.

Mixing/Tempering valves: Bronze bodied, thermostatically controlled, adjustable valves, manufactured specifically to maintain outlet temperatures, at varying flows, for domestic water systems. Valves to be two-stage (high-low) flow type, for temperature maintenance across the full flow range. Units shall be wall mounted, bronze finish and be equipped with inlet and outlet thermometers.

Emergency Shower/Eyewash water tempering valves: Bronze bodied, thermostatically controlled, adjustable valves, manufactured specifically to maintain outlet temperatures, at varying flows, for emergency tempered water systems. Units shall be wall mounted, bronze finish and be equipped with inlet and outlet thermometers, and internal safety by-pass feature to allow cold water flow, upon valve failure.

Electronic Water Control to detention fixtures: Provide an electronic water control system, that is computer based to allow remote water control and monitoring of all water supplies for the penalware fixtures that can isolate individual fixtures.

Water Supply Insulation:

Insulation will be applied to cold water, hot water, hot water re-circulation, and horizontal storm drain piping. It will be continuous through supports and include a vapor retarding jacket.

Exposed piping under fixtures designated for use by the handicapped shall be insulated with pre-molded insulation kits.

Insulation shields to be placed to protect insulation at pipe hangers.

D. Sanitary Waste

Waste and Vent Piping:

Piping to be designed to collect liquid wastes from all plumbing fixtures and drains requiring waste connections. Horizontal collection of the vertical stacks to be primarily below the first floor slab, to minimize the potential for interference with work of other trades.

Building sewer will exit the building and connect to the site sanitary sewer system by gravity and discharge into the on-site septic system provided by the General Contractor.

System to include atmospheric venting system, to maintain trap seals, with vent terminal through the roof, located not closer than 25 feet from any fresh air intake, or operable window.

Trap primer systems will provided at all floor and trench drains to make-up water to fixture and drain traps where necessary to maintain liquid trap seals

Waste Piping Specialties:

Floor drains: Cast iron body construction, heavy duty grade, PDI approved. Those for use in toilet rooms and other finished spaces shall be have rough bronze exposed finishes. Those for use in mechanical rooms and other unfinished spaces to be all cast iron.

Trench drains: Cast iron body construction capable of withstanding vehicle traffic or H20 loading shall be provided in the Apparatus Bay and the Sally Port. Grates shall be removable cast iron to allow for cleaning and service.

Oil, Gas and Grease Interceptor: An oil, gas and grease interceptor, independently vented through the roof of the building with two 4-inch vent lines shall be provided to accept the waste from the trench drains installed in the Apparatus Bay and the Sally Port.

Waste Piping Insulation:

Waste piping conveying cold condensate, and other cold liquids, shall be insulated similar to storm piping systems, to prevent condensation.

E. Rain Water Drainage

Rain Water Drainage Systems:

System to be gravity drainage type and collect the discharge from all roof, plaza and deck drains. Rain leaders will discharge via under slab piping and discharge into the site drainage system as provided by the General Contractor.

F. Other Plumbing Systems

Natural Gas Systems:

Service Entrance: Provided by the gas supplier, from a connection in the street to the service entrance location on the outside of the building, in proximity to the Fire Protection and Plumbing room. Service piping shall include a meter and regulator, provided by the gas company.

The gas pressure at the outlet of the meter/regulator installation, provided by the gas supplier to be: 7 inches, Water Column. Based on present programming and future expansion, the anticipated natural gas load will include connections for domestic hot water heating, gas fired high-efficiency boilers, gas fired makeup air units and infrared gas fired heaters at each overhead door in the Apparatus Bay and Sally Ports.

Distribution and Piping: Provide complete distribution system within the building, to serve all fixtures and equipment that requires gas service. System shall include manually operated, shut-off valves, positioned at each connection to equipment, and the provide service shot-off for mains and branch lines in the overall system.

Valves: Shut-off valves: Those sized 1/2 inch to 2 1/2 inch shall be bronze bodied ball valves. Those sized 3 inches and larger shall be steel construction lubricated plug style.

5.0 HVAC PROPOSED SYSTEM MODIFICATIONS

A. Outdoor Design Conditions

	Summer	Winter
AHU Cooling / Heating Coils	88 F db/ 74 F wb	9 F db
Exterior Envelope Conditions	88 F db/ 74 F wb	9 F db
Exterior Wind Assumptions	15.2 MPH	17.3 MPH

B. Indoor Design Conditions

	Summer	Winter
Staff / Admin Areas	74 F db	70 F db
Detention Area	74F db	70 F db
Lobby / Common	74 F db	70 F db
Fitness Area	74 F db	70 F db
Mechanical Rooms	105 F db	50 F db Min
Electric Room	85 F db	50 F db Min

Humidity (Tolerance):	Summer	Winter
Staff / Admin Areas	50%	0%
Detention Area	50%	0%
Fitness Area	50%	0%
Lobby / Common	50%	0%
Mech / Elec Rooms	Ambient	Ambient

C. Outdoor Air Ventilation

Minimum outside air will be introduced as required by the greater of ASHRAE Standard 62.1-2013, "Ventilation for Acceptable Indoor Air Quality", International Mechanical Code, or the requirement to make up exhaust air.

D. Heat Generation/Heat Generating Systems

Hot Water Boilers:

Two gas fired, high efficiency condensing hot water boilers of approximately 1200 MBH, will be located in the Mechanical Room as well as two hot water pumps and provide re-heat water for the building perimeter radiation and supplemental heat. The boiler shall have minimum of 95% combustion efficiency. Return water to the boilers will be a max. temperature of 100°F with a 40°FΔT. Venting will be direct PVC vented to the outdoors. Boilers shall be as manufactured by Patterson Kelly, Camus or DeDietrick.

The five bay garage shall contain gas-fired infrared heaters to be located at the bay entries. The heaters are vented direct through the roof.

E. Cooling Systems

Refrigerant Compressors and Condensers:

Provide multiple integral variable refrigerant flow (VRF) air cooled condensing sections, nominal 80 tons of cooling distributed throughout the facility. The compressors shall be contained above the ceiling and the air cooled condensing units (ACCU) shall be on the exterior of the building. All units over 23 tons shall have multiple refrigeration circuits. The section shall be factory piped, wired, and ready for charge with R-410a. DX coils shall be selected for dual circuit applications. Each compressor shall be equipped with a variable frequency drive (VFD) which includes a built-in phase loss detector, crankcase heater function and anti-short cycling. Exterior enclosure of the ACCU's shall be capable of withstanding 2000 hour salt spray exposure per astm b117, mounted on an equipment curb 18" above the roof. Anti-vibration isolation shall be installed between the ACCU enclosure and the curb. Condenser coils shall be copper tube and consist of an aluminum alloy fin construction. Assembled condenser coils shall be leak tested and pressure tested at 650 psig (4482 kpa). System design shall be head pressure control type, compressors and condenser fans shall modulate to maintain +/-0.2f set-point system designed with hot gas bypass. All condenser fans shall have 7 blades and constructed in aluminum with a 6" bellmouth height for low noise application.

The following components are compulsory and must be included in the ACCU: a liquid line temperature relief device, pressure transducers, a liquid line shutoff valve, suction shutoff valve, suction line accumulators and compressor oil. The following safety devices are also compulsory and must be included in the ACCU: compressor lockout protection for internal or external overload, low pressure protection, high pressure protection, compressor reverse rotation protection, loss of charge protection, and low suction superheat protection. Controls shall

include: automatic compressor lead/lag control, compressor minimum run time (3 min) and min. Off time (3 min), capacity control with variable speed compressors, and alarm relay out to indicate when the unit is in alarm condition. Interior and exterior units based on Mitsubishi.

F. HVAC Distribution

Central System:

The system will be a packaged Dx cooling Air Handling Unit (AHU) with gas fired reheat manufactured by Trane, Carrier, or York. There will be one 2,500 CFM outdoor unit supplying the required outdoor air (O.A.) to each space/zone. There will also be a gas-fired make-up air unit for the apparatus bay. This unit will be sized to complement the Plymovent exhaust system connected in the five bays.

Air handling units casings shall be 2" double wall construction with galvanized interior and painted metal exterior. Fiberglass insulation in the panel shall be provided. Provide stainless steel cooling coil casing and drain pan. Unit to be rated for 3% leakage at the full operating flow and static pressure. Unit to be supported from a housekeeping pad and continuous base rail. Prefilters to be 45% efficiency. Final filters to be 90% efficient.

Dampers with integral air measuring shall be provided for all minimum outside air dampers and supply and return air dampers. The basis of design is Ruskin, AMS50. The complete AMS unit is factory assembled and tested to provide accurate setpoint monitoring at all times. The unit comes standard with a honeycomb airflow straightener, pressure sensing station and a high performance glass-on-silicone pressure transducer. The sensing blades are extruded aluminum with a clear anodize finish. The pressure transducer output signal is field selectable and can be routed to a Building Automation System (BAS) for continuous monitoring of the flow. The output signal is proportional to CFM.

Central Air Distribution System:

The required O.A. shall be distributed from the AHU at medium pressure (4" min) through vertical risers and horizontal distribution mains at each floor to local air distribution terminal units with Dx coils for zone cooling and heating temperature control.

Low pressure supply air shall be distributed from the air distribution terminal units to ceiling supply air diffusers.

All return air shall be low pressure.

All supply air ductwork shall be fully insulated.

Hydronic Distribution Systems:

Heating Hot Water System: Heating hot water will be distributed throughout the Building by means of two heating hot water pumps (one and a standby) located in the Mechanical Room.

The pumps will be end suction type mounted on inertia bases with a fully grouted pump base. Each pump will be sized for approx. 50 gpm and will be controlled by a VFD. The pumps will each operate at 50% capacity. The system will be designed with 2-way control valve and a differential bypass valve located in the system.

Provide one liquid chemical bypass type feeder complete with valves and fittings which shall be connected across each hot water heating system pump set.

Provide an expansion tank to handle the required working pressure from the hot water loop system. The tanks shall be provided with gauge glass with tri-cocks and drain, tank drain, charging valve and mounting saddles or cradles.

The apparatus floor shall contain an in-floor radiant heating system. The system shall be fed from the central boilers as a separate zone through a plate and frame heat exchanger. The radiant floor system shall contain a distribution header, pumps, controls and a glycol filling station.

Special Exhaust Systems:

Toilet Rooms / General Exhaust: One Dedicated exhaust fan will be located in the roof and handle the general toilet rooms, Break Room, Kitchenette, and J.C. Closets on each level.

The Sally Port and Apparatus Bays shall be equipped with a carbon monoxide exhaust system by Plymovent.

Mechanical room ventilation will be via intake louvers and wall mounted prop fans.

The Detaining Area will be exhausted via ductwork with a dedicated exhaust fan located on the roof.

G. Other HVAC Systems

Unitary Air Conditioning Equipment:

Dedicated split systems will be designed for the Server/E911 room .The unit will be located on the exterior of the building and sized for the total load plus an additional percentage for future load. The size of each unit will be based on the selected equipment to be installed.

The Locker / shower rooms shall be provided with a Heat Recovery Unit (HRU) sized for the locker rooms and holding areas.

The Sally Port and Apparatus bays shall each be provided with infrared gas fired heaters.

Supply diffusers, return registers, and/or exhaust registers on the first and second floors serving secure areas shall be a security grade device with tamperproof fasteners as required. The face plate and sleeve enclosure shall be a minimum of 12 gauge hot rolled steel and welded

together. The face plate shall be perforated with 5/16" diameter holes staggered 60 degrees in any direction.

The Elevator Machine Room shall be vented into the Elevator Shaft and discharged at roof level per current codes.

The Main Electrical Room shall be conditioned as required based on heat gain to the space.

Air Coils:

Cooling Coil Section: Evaporator coils shall be multi-row type fabricated from 5/8 inch OD seamless copper tubing mechanically bonded to rippled and corrugated aluminum fins. Coils shall be factory leak tested at 315 psig under water. The evaporator coil circuiting shall be fed with an adjustable thermal expansion valve (one per refrigerant circuit) with an external equalizer. The evaporator coil shall be circuited for a combination row/face split so that entire coil surface is always active.

A mastic-coated primary drain pan shall be provided with the cooling coil and extend beyond the leaving side of the coil and underneath the cooling coil connections. The drain pan shall be connected to a threaded drain connection extended through the unit base. Units shall be provided with a secondary mastic coated drain pan connected to the primary drain pan.

Coils will have a maximum finned height of 42". Provide intermediate, stainless steel drain pans extending the entire finned length of the coil. The intermediate pans will have copper drop tubes to guide condensate to the main drain pan. Drains shall not cascade from one drain pan to the next. All intermediate drains to terminate at the bottom sump.

H. Other Terminal and Packaged Units

Unit heaters shall consist of a heating element with centrifugal fans driven by an electrical motor, filter, and where semi or fully recessed, they shall be flanged on four sides. They shall be capable of delivering the indicated heat emission with entering air at 60 degrees F. Each unit shall be provided with manual on-off switch and two-speed selector switch.

I. HVAC Instrumentation and Controls

HVAC Control Systems:

The building will be controlled by a standalone Direct Digital Control (DDC) system with an Operator Workstation complete with full color graphics. The DDC system will be connected via network to the BAS temperature control systems.

J. Systems Testing, Adjusting and Balancing

Piping Systems Testing, Adjusting and Balancing:

The piping systems testing, adjusting and balancing will be performed by an Air Balancing Contractor certified by either Associated Air Balance Council (AABC), or National Environmental Balancing Bureau (NEBB).

Air Systems Testing, Adjusting and Balancing:

The air systems testing, adjusting and balancing will be performed by an Air Balancing Contractor certified by either Associated Air Balance Council (AABC), or National Environmental Balancing Bureau (NEBB).

6.0 ELECTRICAL PROPOSED SYSTEM MODIFICATIONS

A. Electrical Service and Distribution

Normal Electrical Service:

The service electrical transformer will be furnished, installed, owned and maintained by utility company, and located adjacent to the building near the building main electric room. The transformer will be of the pad- mounted type with primary voltage rating to match utility company distribution voltage in the area, and a secondary voltage of 208/120 volts, 3Phase, 4Wire. The transformer will be sized by the utility company based on load data provided by the Design Team.

Concrete pad for new pad-mounted transformer is provided by the Contractor per the utility company standard.

Two 4 in. PVC conduits for the primary feeder installation from the utility power riser pole, or manhole, to the pad-mounted transformer shall be provided by the Contractor. The conduits shall be installed in the concrete encased duct bank per the utility standard. Pre-cast concrete manholes if required for primary cable field installation shall be also provided by the Contractor.

Utility company will provide primary feeder cable from the riser pole to the pad-mounted transformer including terminations on the both ends.

Secondary service feeders of the copper conductors shall be installed underground in the concrete encased 4" PVC conduits, from the pad-mounted transformer to the main electrical switchboard located in the electrical room.

Building Electrical Design Load:

Electrical load is based on the preliminary design data for the new addition:

LOAD	**AREA (SF)**	**VA/SF**	**kVA**
Lighting	29,793	1.5	49kVA
Receptacle	29,793	2.5	75kVA
Equipment	29,793	3.0	89kVA

Mechanical	29,793	8.0	238kVA
Total	29,793	15.0	447kVA

Total recommended electrical service size is 1200A 208/120V 3Ph 4W based on the following calculation:

Total Load = 447 kVA

Total Amps = 447 kVA/.36kV = 1241 A x 1.25 = 1551 A

Normal Electrical Switchboard:

The main electrical switchboard will be fully metal enclosed, dead front, front accessible standard NEMA1 indoor type assemblies rated at 208Y/120 volt, 3 phase 4 wire with main protective device, feeder devices, distribution sections, service entrance SPD device rated at least 120 kA per mode, and digital metering unit to monitor voltage, current, power factor and demand kW.

Main Switchboard Rating: 1600 Amps. Main protective device is an fully-electronic molded case circuit breaker 100% rated, with solid state tripping capable of adjusting long time, short time, and instantaneous characteristics.

Feeder protective devices are individually mounted fully-electronic molded case circuit breakers. Devices are front removable and load connections are front and side accessible.

Main switchboards short circuit rating is 65,000 amp RMS.

Normal Electrical Power Distribution:

Electrical distribution equipment will be provided to support lighting, power and mechanical loads throughout the building.

The Main Electrical room on the Mezzanine level of the Apparatus Bay will house the 208Y/ 120 Volt, 3 Phase, 4 Wire Main Switchboard (MSB) which will be provided with the following equipment:

- Section 1 – Utility Metering, SPD and Main Circuit Breaker
- Section 2 – Distribution section for feeding lighting and receptacle utilization panelboards
- Section 3 – Distribution section for feeding the mechanical equipment loads

The main electrical room will also contain:

- A 250 Ampere, 84 pole branch circuit panel for lighting and receptacle branch circuits.
- Fire Alarm Control Panel
- Optional Standby Power Automatic Transfer Switch (ATS) and distribution panel.

From the main switch board (MSB) individual feeders will be routed throughout the building to utilization panelboards which will serve lighting and receptacle circuits in the building. There will be on one the first floor and two on the second floor.

Normal Electrical Branch Circuit Panelboards:

Each utilization panel board shall be rated 208Y/120 Volt, 3 Phase, 4 Wire with a 250 A main circuit breaker. Panelboard shall be provided with a SPD device with surge current rating 80 kA per mode

Electrical branch circuit panelboards will be dead-front type with thermal-magnetic molded case circuit breakers. Panelboards will be provided with copper phase and neutral busses and copper equipment ground bus. Neutral bus 200% rated shall be specified for the each receptacle panelboard. All panelboards will be Underwriters Laboratories (UL) listed and labeled, and comply with NEMA standard PB1 for panelboards. The panelboards shall be rated 22KAIC.

There will be three panel boards fed from the MSB, one will be in the Main Electrical room, one will provided on the first floor and one will be on the second floor.

Enclosed Safety Switches:

Individual heavy-duty type switches in NEMA 1 for indoor and NEMA 3R for outdoor applications will be provided where equipment disconnecting means are required in accordance with 527 CMR, Massachusetts Electrical Code.

Normal Electrical Branch Wiring:

In general, wiring will be insulated conductors installed in metal conduit or metallic tubing run concealed in the finished areas or exposed in the unfinished areas such as a penthouse, mechanical and electrical rooms. Minimum conduit size will be 3/4 inch.

Metal clad MC type cable may be used for branch circuit wiring above suspended ceiling with a maximum whip 6 ft. from a junction box and in dry wall partitions.

All conductors will be copper , 75 degree C insulation, type XHHW or THHN/THWN rated 600 volt. Minimum wire size for power and lighting circuits will be # 12 AWG. Control wiring conductors will be # 14 AWG.

Underground conduits or conduits installed under concrete slab shall be PVC Schedule 40. Conduits exposed to weather will be rigid steel and painted.

Duplex receptacles and toggle switches will be heavy duty, specification grade, rated 20 Amp – Gray in color with brushed stainless covers – panelboard and circuit number engraved in the cover plate.

B. Emergency Power

A packaged engine-generator system will be provided to supply power to the Fire Pump, the Emergency Branch (life safety), the Critical Operations Power System (COPS)and the Optional Standby Branch loads upon loss of the normal electric utility power source. The Emergency loads include egress and exit lighting, and a fire alarm system. The COPS system shall provide power to lighting, receptacles and mechanical equipment in the Designated Critical Operations Areas (DCOA) located throughout the building as well as the E911 server room and equipment. The Optional Standby loads shall consist of lights, receptacles and mechanical equipment in other parts of the facility the Owner determines require standby power.

The generator unit shall start automatically on loss of normal power and transfer to the generator power system within 10 seconds.

Preliminary estimated load:

Fire Pump (25 hP)	25 kVA
Emergency Branch (.5 VA/SF) (29, 793 gsf)	16 kVA
COPS System (10VA/SF) (7,000 gsf)	70 kVA
Optional Standby Branch (2VA/SF) (29,793 gsf)	59 kVA
TOTAL:	170 kVA

System shall consist of a diesel-fired generator set rated at 200 kW/250 kVA 0.8pf 208/120V, 3Ph, 4W in an outdoor weather protective sound attenuated enclosure, automatic transfer switches, emergency and standby panelboards, feeders and branch circuit wiring. Diesel generator set shall be furnished with an integral skid-mounted diesel fuel tank sized for 72 hour operation without re-fueling @ 100% load. Fuel tank shall be of double-wall construction and shall be furnished with leak detection system and fuel fill alarm.

The unit will be located adjacent to the rear of the building mounted on a pad at the rear of the apparatus bay and the exhaust stack will need to extend up above the roof line. Next to the unit

there will be a plug-in connection for a portable generator in the event the facility generator fails.

Emergency and Critical Operations Power System (COPS) power distribution equipment including ATS's, panelboards and feeders shall be installed in 2-hour fire-rated closets and shafts in compliance with the requirements of 527 CMR, Massachusetts Electrical Code. The use of 2-hour fire-rated MI cable will be utilized for feeders run outside of a 2-hour fire-rated enclosure.

Emergency & COPS Electrical Power Distribution:

Emergency and COPS electrical distribution rooms are provided to support the system distribution equipment and the local lighting, power and mechanical loads throughout the building. The following 2- hour fire rated rooms shall be provided:

Apparatus Bay Mezzanine – The room shall contain the following:

- 300A Manual Transfer Switch to select between the facility generator and the roll-up generator connection point.
- 300A Automatic Transfer Switch (COPS)
- 300A 208/120V 3Ph 4W 42Pole Distribution Panel (COPS)
- 100A Automatic Transfer Switch (Emerg.)
- 100A 208/120V 3Ph 4W 42Pole Panelboard (Emerg.)

The COPS and Emergency panelboards shall be provided with a SPD device with surge current rating 80 kA per mode.

Emergency Electrical Branch Wiring:

Wiring will be insulated conductors installed in metal conduit or metallic tubing run concealed in the finished areas or exposed in the unfinished areas such as a penthouse, mechanical and electrical rooms. Minimum conduit size will be 3/4 inch.

Wiring will be insulated conductors installed in metal conduit or metallic tubing shall be used for branch circuit wiring above suspended ceiling with a maximum whip 6 ft. from a junction box and in dry wall partitions.

All conductors will be copper, 75 degree C insulation, type XHHW or THHN/THWN rated 600 volt. Minimum wire size for power and lighting circuits will be # 12 AWG. Control wiring conductors will be # 14 AWG.

Underground conduits or conduits installed under concrete slab shall be PVC Schedule 40. Conduits exposed to weather will be rigid steel and painted.

Duplex receptacles and toggle switches will be heavy duty, specification grade, rated 20 Amp – RED in color with brushed stainless covers – panelboard and circuit number engraved in the cover plate.

COPS Electrical Branch Wiring:

All branch circuit wiring within the DCOA shall be provided from a COPS sub-panel within the DCOA boundary. If branch circuit wiring to a DCOA are originates from a sub-panel located outside of the DCOA the branch circuit wiring shall be MI cable.

Wiring will be insulated conductors installed in rigid metal conduit or intermediate metal conduit. Minimum conduit size will be 3/4 inch.

A maximum whip (MC Cable) of 4 ft. will be allowed from a junction box to light fixtures.

All conductors will be copper, 75 degree C insulation, type XHHW or THHN/THWN rated 600 volt. Minimum wire size will be # 12 AWG.

Underground conduits or conduits installed under concrete slab shall be PVC Schedule 40.

Duplex receptacles and toggle switches will be heavy duty, specification grade, rated 20 Amp – BLUE in color with brushed stainless covers – panelboard and circuit number engraved in the cover plate.

Optional Standby Power Electrical Distribution

Optional Standby power electrical distribution equipment will be co-located in the Normal power Main Electrical room on the Apparatus Bay Mezzanine level and will consist of the following equipment:

- 300A Automatic Transfer Switch (OS)
- 300A 208/120V 3Ph 4W 42Pole Distribution Panel (DPOS)

The elevator shall be powered directly from the COPS Distribution Panel.

A utilization panel board rated 208Y/120 Volt, 3 Phase, 4 Wire with a 150 A main circuit breaker shall be provided with a SPD device with surge current rating 80 kA per mode and be located on the second level adjacent to the normal power panel.

C. Lighting

Interior Lighting:

Illumination Levels and Fixture Types:

Location	Illumination Level	Notes
Main entrance lobby	25 FC	LED down lights, supplemented with decorative fixtures.
Private offices, small conference rooms	40 FC	2'x 2'or 2' x 4' LED recessed lensed troffers, or indirect suspended luminaries.
Open office areas	40 FC	2'x 2'or 2' x 4' LED recessed lensed troffers, or indirect suspended luminaries.
Large conference rooms, training rooms, squad rooms	40 FC	Indirect suspended luminaires utilizing dimmable LED, dimmable LED wall washers.
Mechanical, electrical rooms and unfinished spaces	20 FC	Fluorescent strips, pendant
Vehicle storage and sally ports	50 FC	1' x 4' Surface mounted LED or Fluorescent fixtures with vandal resistant acrylic wraparound lenses, gasketed and sealed for damp location
Stairways	20 FC	Wall-mounted direct/indirect fixtures
Holding/booking, surveillance, interview room and cells	40 FC	1' x 4' recessed LED or Fluorescent fixtures with vandal resistant lenses, tamperproof hardware, gasketed and sealed for damp location

General ambient lighting illumination level of 40 FC in the office areas will achieve minimum glare and comfortable brightness level.

Interior lighting fixtures will utilize LED technology to the fullest extent possible, with fluorescent lamp fixtures used only as needed by the space needs. Fixtures will be selected that will offer the maximum rebate value from the utility company. Fluorescent fixtures will be energy-saving T5 lamps and electronic ballasts. Ballasts – electronic, 120 volt, sound rating Class A, input harmonic distortion of 10% or less.

Exit signs and egress lighting will be connected to the emergency power distribution system to provide illumination level required by Code for emergency egress in a case of normal power failure.

Lighting in the Designated Critical Operations Areas (DCOA) will be connected to the local Critical Operations Power System (COPS) to provide continued illumination in the mission critical areas in the event of a normal power failure.

Lighting control will be achieved using line-voltage switches and dimmers, and ceiling and/or wall-mounted occupancy or vacancy sensors.

Exterior Building and Site Lighting

Exterior building lighting shall be provided at the building exits and around the perimeter of the building adequate to supplement the site lighting. The fixtures shall utilize LED technology and be night-sky approved.

Pole-mounted site lighting shall be provided throughout the parking area. The site lighting shall utilize LED night-sky approved fixtures on 16 ft. poles. The site lighting fixtures shall be capable to withstand a wind load of 100 mph with gusts to 133 mph.

Exterior and site lighting will be photocell and/or time switch controlled. Lighting level shall be approximately 2FC. minimum maintained.

D. Fire Alarm System

Detection and Fire Alarm:

Analog addressable, non-coded, Class A supervised type fire detection and alarm system shall be provided to meet the requirements of the Massachusetts Building Code, NFPA-72, NFPA-90A, Americans with Disabilities Act and local fire department requirements. Fire alarm system shall consist of a fire alarm control panel, annunciator, addressable smoke and heat detectors, manual pull stations, audible and visible alarm signals, connections to automatic fire suppression systems, and a city master box for transmitting alarm signals to the local fire department.

The system shall be as manufactured by Simplex, Notifier or Edwards.

Fire alarm control panel shall provide an alarm and annunciation capability in case of activation of any manual fire alarm station, smoke detector, heat detector, duct smoke detector, sprinkler water flow switch or fire suppression system.

Audible speakers and visual high intensity strobes alarm devices shall be installed per NFPA-72.

Addressable type duct smoke detectors will be installed in supply and return air ducts as required by NFPA-90A.

System type smoke detectors shall be provided in the main electrical room, electrical closets, data/telephone rooms, mechanical rooms, elevator machine room, elevator lobbies, at the top of the stairways, in the corridors, lobby, and entry vestibules.

Carbon monoxide detectors will be provided in the dorm portion of the second floor as well as in mechanical spaces with natural gas fired equipment.

System type heat detectors shall be provided in the Apparatus Bay and the Sally Port vehicle storage areas.

Fire suppression systems shall be tied to the fire alarm control panel.

E. Other Electrical Systems

Lighting Protection:

The lightning protection system shall be designed and installed in accordance with NFPA 780, Standard for Installation of Lightning Protection Systems. System shall consist of the roof mounted air terminals, grounding conductors, down leads, ground rods and bonding conductors. Upon completion, the system shall be provided with a Underwriters Laboratories (UL) Master Label

Grounding:

All exposed, non-current carrying metallic parts of electrical equipment, the raceway system, and the neutral conductor of the wiring system will be grounded in accordance with the Electrical Code.

A ground bus will be provided in the main electrical room. It shall terminate electric service grounding conductor to the main switchboard ground bus, grounding electrode conductors to the water service pipe and building structural steel, and a conductor to ground bus in the communication closets.

Separate copper equipment grounding conductor with green outer jacket will be installed with all feeder and branch circuits.

Grounding cable connections to structural steel, grounding rods and other grounding cables will be of the thermal fusion type. Grounding rods will be copper clad steel, 5/8-inch diameter.