BUILDING SYSTEMS NARRATIVES

MEP-FP NARRATIVE

4.1.2 – 09d

NORTHEAST METROPOLITAN REGIONAL VOCATIONAL SCHOOL

SCHEMATIC DESIGN NARRATIVE

I. FIRE PROTECTION

A. General:

1. All occupiable and accessible areas of the building will be protected with a complete combination standpipe and wet suppression sprinkler system.

2. Work shall be performed using the “Method “B” Shared Design” process, from a “Fully Engineered” “design” set of documents which outlines the system and requires the Fire Protection Contractor to provide the “installation” set of documents, in conformance with the design criteria as set forth in the bid documents. Works shall be performed in accordance with the Building Code, NFPA, and the Local Authority.

B. System Requirements and Criteria are as follows:

1. Complete combination standpipe and hydraulically calculated, automatic overhead, wet suppression sprinkler systems, providing proper coverage to all areas of the new high school building. Dry sprinkler system for interior spaces if any that would be subject to use for storage as a loading dock or for any similar activity.

2. Eight inch dedicated/primary sprinkler water service which shall be extended from the site water main to all devices, equipment and heads. A six inch water service is to also be planned for each satellite building to be protected with a fire suppression system. (PIV if required). (Note: All dedicated site water piping, fire hydrants, etc., are required by law to be installed by a licensed Sprinkler Contractor.).

3. Double check type backflow preventor with supervised valves, repair kit, certified test and DEP permit for each of the building service entries.

4. Building fire department connections. Two shall be planned at this time based on the overall high school size and site configuration. Each fire department connection shall be located as to ensure access by the fire department and a fire hydrant located within 100 feet of each connection.

5. Based on new water flow tests information obtained on 6/25/2021, preliminary hydraulic calculations have been completed to verify that a fire pump system will be required to support the proposed fire suppression system.

6. Alarm check valves, valves and all piping, hangers, sprinkler heads and accessories. Three (3) alarm check valves anticipated per sprinkler zone requirements for the main high school building. An alarm check valve will also be required for each satellite building requiring a fire suppression system.

7. Based on the overall building area, each major building segment with an area not to exceed 52,000 SF per floor will be fed via a separate alarm check valve/system riser. Each of these risers are to supply a combination fire sandpipe and sprinkler system.

8. The fire standpipe system within a building segment will generally consist of a standpipe riser to be located in each required exit stairway and where otherwise required by code such as at the stage and at remote area of building segments that can't be reached with a 200 foot hose from a required hose valve connection. Each standpipe riser is to supply a hose valve per floor.

9. The sprinkler system within each building segment will start from one of the required fire standpipe risers with a control valve assembly for each floor.

10. Fire standpipe and sprinkler system zoning is to be consistent with the project phasing.

11. It is anticipated that the majority of the sprinkler floor control valves and of the fire department hose valves will need to be of the pressure reducing valve type and will need to be installed with the required drain assemblies and system to allow future testing.

C. Specific Program requirements are as follows:

1. In general, the building will be designed as a light hazard occupancy and therefore a sprinkler spacing not exceed approximately 196 SF for all academic, administration and common area type spaces. Assume 150SF or less due to space configuration.

2. Shop type areas as the following spaces: Automotive, Automotive/Body, Metal Fabrication, Plumbing, Electrical, Carpentry, Electrical, HVACR, Robotics and Automation will need to be designed as ordinary hazard group 2 and therefore sprinkler spacing not to exceed 120 SF. Assume 100 SF due to space configuration and irregularities. The more stringent requirements are to also apply to the following building spaces: kitchen, mechanical and utility rooms, storage rooms and similar spaces.

D. Specific requirements for this option:

1. Since the building is to consist of entirely new construction, it is anticipated that the project phasing should not affect the fire protection system. However, It will be important to confirm that the existing fire protection water supply can be maintained for the existing high school building until the building structure can be demolished.

II. PLUMBING

A. General:

1. All work shall be performed in strict accordance with the State Building Code, the State Plumbing and Fuel Gas Codes, the plumbing inspector and all Local Codes and Ordinances.

2. Sustainable Design Intent: Compliance with project requirements intended to achieve a certification and rating, measured and documented according to the LEED for Schools Green Building Rating System, of the US Green Building Council.

B. System Requirements and Criteria are as Follows:

1. Six inch primary domestic water service to 10 feet-0 inch outside building wall for the new high school building. Three inch domestic water service for the Amenities Building and the same for the Fitness Building. Based on new water flow test data (6/24/2021) and based on the proposed site configuration, a domestic booster pump system will be required for the main high school building.

2. A new natural gas service is being coordinated to be brought to the site. For the new high school, a new natural gas system is to be provided for the new Science Rooms, for the new heating plant, for the new Culinary classrooms and Restaurant and for the new domestic hot water heating plant with work beginning at the gas company meter. Each of the major gas system components such as Science Room gas outlets shall each be supplied with a dedicated gas system to be fed via a gas sub-meter that shall also be monitored via the building automation system. The intent of this measure is to help achieved a certain LEED rating.

3. Internal storm water roof drainage systems from all flat roof areas, consisting of roof drains and all rainwater piping and accessories to points 10 feet outside of the building walls. It is to be assumed at this time that where building roof areas will need to be provided with a secondary roof drainage system that requirement will need to be addressed by the use of scuppers to be specified under the architectural scope. This will need to be verified based on input and coordination with the Architect.

4. Complete sanitary, waste and vent system connecting to all fixtures and inlet connections and running to points 10 feet outside of the building walls.

5. Dedicated tempered water system including master mixing valve and dedicated tempered water circulation system to supply all emergency shower and eyewash units with a non-stagnant system for the science classrooms and for the vocational tech areas. A separate system will need to be fed off of each of the (3) larger planned domestic hot water systems.

6. Dedicated special waste piping system serving Science Rooms and related areas susceptible to receive non-conventional waste and this system is to consist of:

   a. Central pH neutralizing and monitoring system. The project goal is to confirm if a monitoring system will be adequate for a single classroom out of the (2) sets of stacked science classrooms. This will need to be verified with the school programmer and local plumbing inspector.

7. Reduced pressure backflow preventers on hot and cold water supply to the Science Classrooms. This dedicated system is to also include a circulation system with an integral hot water maintenance system.

8. Dedicated "grease waste" piping system from the Kitchen area and from the Culinary area and the restaurant to 10 feet outside building wall, for continuation by Site/Civil from the site grease tank/interceptor. One central grease trap for the kitchen and a separate one for the Culinary area since these spaces are located

apart. Refer to the Kitchen and Culinary areas for the extent of the plumbing work required to support the intended equipment. Provide allowance for two interior grease interceptors to support kitchen and restaurant. Provide allowance also for floor drains to support the intended equipment.

9. Domestic hot water shall be set up to be generated by gas fired hot water systems for the high school. Each set up shall have a mixing valve, all accessories and devices and a building pumped recirculation loop. Each Major building area will be supplied by a separate hot water system: At this time, (3) such systems are planned for the high school main building.

    a. Plumbing fixtures that are located too far away from the hot water systems described above will need to be supplied by separate point-of-use water heaters wherever feasible.

    b. Each satellite building is to also include their own system.

    c. The Fitness building is planned to be supplied with a gas fired system since the anticipated load is to be substantial.

10. Compressed-Air Systems

    a. Furnish and install an industrial grade compressed air system for each of the shop areas: One system to handle the shop areas of the academic wing and another system is to handle the Auto Shop areas.

    b. Furnish and install a medical grade compressed air system to handle the dentistry area.

    c. Each system shall be a duplex system with a separate receiver, air dryer, and all required pre and after filters.

11. Vacuum Systems

    a. Furnish and install a medical grade system to handle the dentistry area.

    b. System shall be a duplex system with separate receiver.

12. Complete interior sanitary, waste, vent, gas, cold water, 120°F hot water, 140°F hot water and two recirculation piping systems.

13. Main water meter with monitoring via building automation system. A sub-meter for each major system including the following: Kitchen, domestic hot water system. This measure is to be implemented to help achieved a certain LEED rating.

14. Plumbing fixtures and trim, all new, commercial grade and high efficiency types for an anticipated approximately 40 percent water saving to help achieved a certain LEED rating: 1.28/1.1 GPF dual flush water closets, 1/8 GPF urinals, 0.35 GPM lavatories, 1.5 GPM showers, 1.5 GPM Kitchen faucets, etc.

15. Freezeproof wall hydrants around the perimeter of all construction.

16. Drains, hose bibbs, valves, fittings, hangers and all miscellaneous pipeline accessories, including seismic support requirements.

17. Cleaning and testing of all fixtures, equipment and piping systems.

18. Disinfection of all domestic water piping systems.

19. Waste outlets to accept HVAC condensate and sprinkler waste discharges.

20. Insulation of all domestic water piping, roof drain bodies, storm water piping, water cooler drain piping and all exposed piping at handicapped fixtures.

21. All floor drains shall be provided with automatic trap primers.

22. Include allowance for floor drainage and hose bibbs in all mechanical type spaces and large toilet rooms (with two or more fixtures).

23. It is to be assumed that the following shops will be required to be provided, at a minimum, with a compressed air system to serve all required equipment and outlets, handwashing sink, a service sink, and all other required plumbing connections: Carpentry, Electrical, Robotics, and Automation, Metal Fabrication, Automobile, Auto Body, Plumbing, and HVAC/R. Some of these shops might be able to be supported from a single system. This will need to be verified.

24. It is to be assumed that according to current state elevator code, elevator pits will be required to include a drainage system. The system is to consist of a pit floor drain to discharge via gravity and is to be extended to the building sanitary system. At this time, we are proceeding under the assumption that each drain will discharge via an oil separator prior to the connection into the sanitary system

25. The Auto Body and the Automotive Shops will need to be provided with a dedicated floor drainage system that will need to be extended to a gas/oil separator system to be located outside the building. This requirement is to also apply to all other shop areas that are to allow entry of vehicles within the interior shop area.

26. A dedicated tempered water system shall also be planned to serve each of the emergency shower/eyewash unit required in the various shops noted above.

27. To satisfy the high school building requirement, (2) separate domestic hot water systems will be required. Each system is to consist of (2) gas fired storage type condensing type water heaters, each rated for 300 gallons storage and 800 MBH input. Remote isolated type spaces will be supplied each by smaller electric type storage unit as manufactured by A.O. Smith DSE series. This requirement also applies to the Amenities Building.

III. HEATING, VENTILATING, AND AIR CONDITIONING

A. Executive Summary:

The MSBA had several comments on the Preferred Schematic Report submission. The design team responded to these comments. The following is a summary of how these comments have been addressed:

1. Refer to sustainability paragraph in the Heating, Ventilating, and Air Conditioning section of this narrative and the LEED score card for credits being pursued including Building Level Energy Metering and Optimize Energy Performance.

2. A life cycle cost analysis has been provided as part of this submission to summarize the financial impacts of the proposed building systems. The design team will specify an intuitive controls system to balance the complexity of the proposed systems with the staff responsible for maintaining the facility.

3. The design team reviewed operations and maintenance of the HVAC systems with district maintenance personnel on June 8, 2021. A training program will be included in the construction documents for pre and post occupancy training by the construction team.

B. General:

1. Systems are based on all electric heating and cooling for a large portion of the facility based on air-cooled variable refrigerant flow (VRF) systems.

2. A hot water boiler system is provided for pre-heating of outside air in rooftop air handling units, as well as heating at entrance vestibules, stairways, exit doors, loading dock, and utility spaces.

3. Air conditioning systems are all air-cooled.

C. Hot Water Heating System:

1. Provide three gas-fired condensing hot water boilers equal to Veissmann Vitocrosal Model 300 Series 3.0.

2. Provide a pre-engineered Category 4 AL29-4C stainless steel vent system for each boiler. Provide direct combustion air to each boiler from an exterior louver.

3. Each boiler shall be provided with a constant volume primary boiler water circulation pump.

4. New boiler system shall include manufacturer's boiler hot water reset controls and sequencing system.

D. Air-Source VRF Heat Pump Systems:

1. Units shall be variable refrigerant flow (FRF) air-source DX heat pump units serving all rooftop air handling units.

2. Multiple system modules shall be provided to meet capacity.

3. Units shall be capable of providing continuous heating down to -4 deg. F.

4. Units shall be capable of providing a changeover between heating and cooling as needed.

E. Pump Packages:

1. Provide three vertical inline variable flow hot water primary distribution pumps, each with a variable frequency drive. Units shall be equal to Grundfos. Each pump shall be sized for 100% capacity of the boiler being served.

2. Provide three variable flow hot water secondary distribution pumps, each with a variable frequency drive, mounted on a factory assembled packaged pump skid. Units shall be equal to Grundfos. Each pump shall be sized for 50% capacity with one pump as a stand-by.

F. Piping:

1. The following piping distributions shall be provided:

   a. Hot water primary distribution for boiler system in main mechanical room.

   b. Hot water secondary distribution from boiler system in main mechanical room to all rooftop air handling units and all heating terminals including cabinet unit heaters, unit heaters, radiant floors, and panel radiators.

2. All main distribution piping 2-1/2" and larger shall be Schedule 40 carbon steel with welded joints or mechanical couplings equal to Victaulic. Piping 2" and less shall be Type L copper with mechanical coupling joints equal to Pro-Press.

3. Provide fiberglass pipe insulation with all service jacket on all piping to meet the MA energy code. Generally 1-1/2" thickness required.

G. Classrooms, Vocational Classrooms, and Athletics:

1. Classrooms and support spaces shall be served by rooftop dedicated outside air ventilation supply air systems. Units shall be 100% outside air with total energy recovery wheels, MERV 8 and MERV 14 filters, and recirculation dampers. Cooling and primary heating shall be provided with a DX coil and remote VRF (variable refrigerant flow) heat pump condensing units. A hot water preheat coil shall be provided for preheating of outside air under low ambient temperature conditions. Supply and exhaust fans shall be variable speed with variable frequency drives.

2. Outside ventilation air shall be delivered to each classroom by connection to a VAV terminal unit. Ventilation air shall be ducted to ceiling diffusers or the inlet of each VRF fan coil unit.

3. Exhaust air shall be from a ceiling exhaust grille controlled by a VAV exhaust terminal.

4. Ventilation supply air to each classroom shall be controlled by a space carbon dioxide sensor.

H. Administration Area:

1. Provide a new variable refrigerant flow (VRF) heating and cooling system with ducted ceiling concealed fan coil units serving each zone. Locate heat recovery condensing unit on the roof and provide refrigerant piping distribution including branch selector boxes to serve each fan coil unit.

2. Provide a roof mounted energy recovery ventilator for ventilation air to all administration spaces. Provide variable volume supply ductwork distribution connected to the fan coil unit return air duct. Exhaust air shall be connected to ceiling diffusers in each space.

I. Cafeteria/Kitchen/Culinary:

1. Cafeteria and Culinary shall be provided with a variable air volume rooftop air handling unit with DX cooling coil, remote VRF condensing units, hot water heating coil, economizer damper section, MERV 8 and MERV 14 filters and supply and return fans with variable frequency drives.

2. Main kitchen air handling unit shall be 100% makeup air units with recirculation capability interlocked with kitchen hood exhaust operation. Units shall have a DX cooling coil and hot water heating coil and remote VRF condensing units. Provide with mixing dampers, filters, and supply and return fans with variable frequency drives.

3. Provide kitchen hood exhaust fans for main kitchen and Culinary kitchen. Fans shall be variable speed and interlocked with kitchen hood variable exhaust flow control system.

J. Auditorium, Stage, and Gymnasium:

1. Provide separate single-zone variable air volume rooftop air handling units with DX cooling coil, remote VRF condensing units, hot water heating coil, economizer damper section, MERV 8 and MERV 14 filters, energy recovery wheel, and supply and return fans with variable frequency drives.

K. Cosmetology and Auditorium/Gym Lobby:

1. Provide separate multi-zone variable air volume rooftop air handling units with DX cooling coil, remote VRF condensing units, hot water heating coil, economizer damper section, MERV 8 and MERV 14 filters, energy recovery wheel, and supply and return fans with variable frequency drives.

2. Supply air shall be delivered to each zone by a VAV terminal unit ducted from the main supply duct to diffusers in each space.

3. Return air shall be duct from the return main to return grilles in each space.

L. Shops:

1. Trade shops shall each be provided with an indoor heating and ventilating unit. All units shall have hot water heating coil, economizer mixing damper section, MERV 8 and MERV 13 filters, variable speed supply fan with VFD, and energy recovery wheel.

2. H&V unit outside air shall be interlocked with exhaust system operation wherever possible.

3. Systems shall serve the following trade shops:

a. Electrical Technology

b. HVAC Technology

c. Metal Fabrication

d. Plumbing & Pipefitting

e. Carpentry

f. Auto Collision

g. Auto Technology

M. Satellite Concessions Building and Maintenance Building:

1. Provide energy recovery ventilator for Women's and Men's Rooms and concession space exhaust air and ventilation air. Unit shall be ducted for exhaust and outside air with connections to exterior louvers. Provide electric heating coil in the supply air for tempering.

2. Provide electric space heating units in each space: Women's, Men's, Concession, and Janitor's Closet.

N. Satellite Athletics Building:

1. Provide ducted energy recovery ventilator for Women's and Men's Team Rooms, toilet rooms and coach offices for exhaust air and ventilation air to each space. Unit shall be ducted for exhaust and outside air with connections to exterior louvers. Provide electric heating coil in the supply air duct for tempering.

2. Provide electric space heating units in each space: team rooms, toilet rooms, coach offices, garage space, maintenance office and elevator vestibules.

3. Provide ductless split heat pump system for elevator machine room and offices.

O. Ductwork:

1. Ductwork systems serving spaces for ventilation, air conditioning, or heating shall be provided for the following:

   a. Classroom dedicated outside air systems with central supply and exhaust distribution to each zone.

   b. Rooftop air handling units serving dedicated areas with supply and return ductwork.

   c. Supply and exhaust systems for energy recovery ventilators.

   d. Local zone supply and return air ductwork for VRF fan coil units.

   e. Local supply and return air ductwork distribution for trade shops.

2. All concealed supply ductwork shall be insulated with 2-inch duct wrap, R-6 minimum.

P. Specialty Exhaust Systems:

1. Provide separate dedicated exhaust systems including ductwork and exhaust fans to serve the following listed uses;

   a. Laser cutter

   b. 3D Printers

   c. CNC machines

   d. Art kilns with hoods and dedicated makeup air system

   e. Dark room sink with hood.

   f. Woodshop with outside dust collector

g. Vehicle exhaust

h. Paint spray booths with dedicated makeup air system

i. Welding booths

j. Welding benches

k. Science fume hoods.

l. Cosmetology stations

Q. Ductless Split heat pump Systems:

1. Provide separate dedicated ductless split cooling and heating systems including indoor fan coil unit and roof-mounted heat pump condensing unit to serve the following listed uses;

a. MDF room

b. IDF rooms

c. Elevator machine rooms

R. Automatic Temperature Controls:

1. Automatic temperature controls for building shall be direct digital DDC control building automation system (BAS) with web access interface. System shall be open protocol BACnet.

2. Manufacturer's controls for air-source heat pumps and boilers shall be integrated with the BAS via BACnet interface.

3. All VRF and ductless split system manufacturer's controls shall be integrated with the BAS through a BACnet interface.

4. All air handling units shall be provided with a DDC controller by the automatic temperature controls (ATC) sub-contractor. All field devices for unit operation shall be provided by the ATC sub-contractor.

5. Unitary controllers shall be provided for all terminal cooling and heating equipment including fan coil units, unit heaters, fin-tube radiation, fans, etc.

S. Sustainability:

1. The HVAC systems will be designed to support the following LEED v4 pre-requisites and credits:

a. WE Credit Cooling Tower Water Use, EA Prerequisite Minimum Energy Performance, EA Prerequisite Building-Level Energy Metering, EA Prerequisite Fundamental Refrigerant Management, EA Credit Optimize Energy Performance, EA Credit Advanced Energy Metering, IEQ Prerequisite Minimum Indoor Air Quality Performance, IEQ Credit Enhanced Indoor Air Quality Strategies, and IEQ Credit Thermal Comfort

2. Refer to the LEED scorecard for quantity of points being pursued for each credit.

IV. ELECTRICAL

A. Demolition:

1. Project consists of phased demolition and phased construction.

2. Scope of work

a. New electric service from Wakefield Municipal Gas and Light (WMGL) primary services.

b. Current existing utility primary service, transformation and secondary service to main switchboard including main switchboard will be maintained per phasing schedule.

c. New and existing panelboards feeders, mechanical equipment feeds, and branch circuits as required to maintain existing equipment per phasing schedule.

d. All required existing services shall be maintained for the complete operation of existing systems within existing school buildings to be maintained until the scheduled date of demolition of the existing building. Upon substantial completion, coordinate with the respective utility company and include all work required for the removal of all existing utility services including power, telephone, cable TV, and fire alarm services.

e. Phased demolition/construction enabling shall include:

1) New feeders from existing sources to maintain existing equipment to remain under respective phases.

2) Relocation and extension of existing feeders to maintain existing equipment to remain under respective phases.

3) Removal of existing equipment, feeders, and branch circuitry to be demolished remain under respective phases.

4) Existing fire alarm system shall be kept operational during phasing. Provide any additional equipment and wiring to maintain existing fire alarm system under respective phases.

5) Main Electric Service:

6) Primary service infrastructure for WMGL overhead lines from Hemlock Street shall drop down riser poles for Athletic Building and new School Building.

7) New school building primary service shall extend underground from riser pole via 4–5-inch PVC conduits with rigid steel conduit sweeps and 6’ x 10’ manholes spaced 200 feet on center to main electric utility pad.

8) Two precast concrete electric utility pads shall be provided with 5-inch inch PVC conduits with rigid steel conduit sweeps for two MV switches and 2-2,500 kVA pad mount transformers provided by WMGL at School Building.

9) New Athletic Building primary service shall extend underground from riser pole via 2–5-inch inch PVC conduits with rigid steel conduit sweeps to main electric utility pad.

10) A precast concrete electric utility pad shall be provided with 2-5-inch PVC conduits with rigid steel conduit sweeps for a 500 kVA pad mount transformer provided by WMGL at Athletic Building

11) Provide pre-formed concrete ductbanks using PVC conduits with rigid steel conduit sweeps from electric utility pad to Main Electric Room.

12) Secondary services at new School Building will be run underground from new pad mounted transformers via PVC conduits with rigid steel conduit sweeps to two main switchboards with Kirk Key interlock, each sized at 3,000A, 480/277V, 3 phase, 4 wire, 65 kAIC

13) Secondary services at new Athletic Building will be run underground from new pad mounted transformer via PVC conduits to main switchboard at 1200A, 480/277V, 3 phase, 4 wire, 65 kAIC.

14) Secondary cold sequence utility metering will be provided at all electric service locations per WMGL standards. A dedicated telephone line shall be provided for WMGL metering.

15) Main Owner's solid state check meter will be provided, equivalent to Eaton IQ Analyzer with associated gateway communication hardware.

16) Provisions for measurement and verification of power will be provided via CT's and electronic sub-meters equal to Eaton IQ220M 3 phase kWh, and demand meter at 25 locations. Meters shall be MS/TP daisy chained to a gateway for BACnet communication to BAS system.

B. Normal Distribution System:

1. Main switchboard will be provided with surge protection (SPD) and ground fault protection on main and feeder devices.

2. Distribution system will consist of conduit and wire feeders run from switchboard to panelboards and larger mechanical equipment. Panelboards and dry type transformers will be located in electric closets throughout the building.

3. Surge protection will be provided in all 120/208-volt receptacle panelboards.

4. Provisions for a distribution system for future photovoltaic systems of 249kW capacity consisting of conduit and wire feeders will be provided. Space for inverters and conduits will be provided for PV systems.

5. Provisions for a distribution system for future electrical vehicle service equipment (EVSE) consisting of 3-inch conduit via handholes to exterior service locations with precast concrete pads for exterior 75kva transformers and panel boards mounted in NEMA 3R enclosures at each location, 2 inch conduits to serve future dual-charger charging stations each in a total of 5 locations with 4 EVSE locations at School Building and 1 EVSE location at Athletics Building.

C. Emergency Distribution System:

1. An exterior, ground mounted, self-contained sound attenuated diesel emergency generator, as manufactured by Caterpillar, Cummins, or Kohler, rated at 350kw 480/277V,3 phase 4 wire will power the following:

   a. Emergency/Life Safety: egress lighting and exit lighting in corridors, assembly areas, toilets, and stairwells.

   b. Standby: Miscellaneous systems will include kitchen walk-in coolers and freezers, telephone system, security system, IT head-end, IT cooling systems, fire alarm system, one boiler, and associated circulator pump and controls.

   c. Fire Pump

   d. Domestic Water Booster.

2. Separate automatic transfer switches will be provided for emergency and non-emergency standby loads. Automatic transfer switches shall be ASCO 7000 series, Russelectric RMTD series.

3. Circuit breakers for emergency services shall be installed in barriered compartments on generator.

4. Emergency feeders run outside two-hour electric rooms and shafts, and not under floor slab, will utilize type MI (mineral-insulated) cables.

5. A fully rated load bank circuit breaker shall be provided to test the generator at full load.

D. Lighting:

1. Luminaires will be primarily light emitting diode (LED) with high efficiency drivers, with 0-10V control protocol. All luminaires will be suitable for respective utility rebate incentives.

2. Selected luminaires in corridors, interior rooms, stairs, and places of assembly will be wired to emergency generator to provide minimum code required light levels.

3. Illuminated LED type exit signs will be wired to emergency generator and located in all paths of egress and places of assembly.

4. Luminaires will be primarily high efficiency LED source. Gymnasium lighting and high ceiling spaces will use dimmable LED source with local controls for glare control.

5. Classroom luminaires will be pendant linear direct/indirect with high efficiency LED source.

6. Selected luminaires in classrooms, corridors, interior rooms, stairs, and places of assembly will be wired to emergency power panels. Generally, every third luminaire in the corridors will be wired to the emergency system.

7. Outdoor egress lighting will be building mounted with LED source controlled by photocell and programmable lighting controls.

8. Roadways and parking lots will have LED pole mounted luminaires in type II, III, IV light distributions mounted on aluminum poles. Luminaires will be high cut-off/dark sky friendly fixtures with no light spill at property lines. Pole mounted fixtures shall have wireless communication for network control-based dimming. All exterior lighting will be tied into the building low voltage lighting control system.

9. Luminaires will be enclosed and gasketed in Carpentry, Culinary Arts, Kitchen, and Gym Locker areas.

10. Provide stage lighting system and controls in Auditorium and Television Studio.

11. Provide theatrical lighting system with luminaires, blue dome system, distribution equipment and controls for Auditorium and Television Studio.

12. House lights and theatrical lighting shall be integrated with respective control systems for flexible control.

E. Lighting Controls:

1. A networked low voltage lighting control system will be provided for common areas such as corridors, Shops, Athletic Building, Concessions, Cafeteria, Gymnasium, and other areas not controlled by vacancy/ occupancy sensors. Local low voltage override switches will be provided. Manufacturers include Encellium, Lutron Vive, and Wattstopper.

2. Vacancy/Occupancy sensors will control lighting in the majority of spaces including classrooms, offices, and utility type spaces.

3. Classrooms will have 4 zones of lighting control for enhanced educational atmosphere. Scenes will include general, focused, presentation and programable additional scene.

4. Daylight harvesting will be employed Gymnasium, Café, Media Center, Stairwells, Offices, and other spaces with substantial day lighting.

5. Vacancy sensors will be employed in corridors using long range infrared sensors (approximately 90-foot range) to turn off two of every three corridor luminaires. The remaining luminaires will be wired to the emergency system, and key switched with listed emergency bypass relays.

F. Plug and Process Load Controls:

1. A networked plug and process control system integrated with the lighting control system will be provided for classrooms, offices, break rooms, and common areas such as corridors, Shops, Athletic Building, Concessions, Cafeteria, Gymnasium and other areas interfaced to lighting control vacancy/ occupancy sensors. Local low voltage override switches will be provided. Manufacturers include Encellium, Lutron Vive, and Wattstopper.

2. Loads with stand-by losses such as battery chargers, water coolers and vending machines will be controlled via time schedules based on hours of building operation.

G. Auditorium:

1. A professional theatrical lighting system will be provided including luminaires, stage plug-in boxes, complete dimming system with portable dimming controls. Manufacturers include ETC, Strand and Phillips.

2. Power and control wiring will be provided for all Auditorium and Stage equipment including electric winches, projection screens, and lifts.

H. LEED v4:

The Electrical systems will be designed to support the following LEED v4 pre-requisites and credits:

1. Green Vehicles credit in the Location and Transportation category will be included.

2. Light Pollution credit in the Sustainable Sites category will be included.

3. Building Level Energy Metering credit in the Energy and Atmosphere category will be included.

4. Advanced Energy Metering credit in the Energy and Atmosphere category will be included.

5. Renewable Energy Production credit in the Energy and Atmosphere category will be included.

6. Interior Lighting credit in the Indoor Environmental Quality category will be included.

I. Convenience Power:

1. Duplex receptacles will be provided throughout the building in quantities to suit space programming.

2. Duplex receptacles will be split wired and controlled via occupancy sensors in offices, computer labs and open office furniture systems to reduce plug loads by 50 per cent to comply with applicable energy codes.

3. Receptacles will be provided in classrooms at teacher's desk, TV outlet, and for computers.

4. Duplex receptacles for cleaning will be provided in corridors at 50 feet on center and in other large spaces.

5. Single heavy-duty receptacles will be provided for special equipment.

6. Duplex receptacles equipped with USB ports shall be located in all assembly and student gathering spaces.

I. Fire Alarm

1. A non-proprietary manufacturer automatic, fully supervised, analog addressable, voice evacuation system will be provided with following:

2. Manual pull stations at exit doors (with tamperproof covers).

3. Audible/visual units in corridors, classrooms, and places of assembly (ADA approved).

4. Visual units in conference rooms, meeting rooms, and small toilets.

5. Smoke detector coverage will be provided in corridors, stairwells, Electric Rooms and Closets, Telephone/IT Rooms and closets, and rooms with substantial computer equipment.

6. Smoke detectors will be located in elevator lobbies and machine rooms for elevator recall.

7. Carbon monoxide detector coverage will be provided in all locations with fossil-fuel fired appliance locations in mechanical spaces including boilers, water heaters, Bunsen burners at Science Labs and childcare areas. Local annunciation shall be by sounder base at carbon monoxide detector location.

8. Carbon monoxide detector alarm strobes will be provided with green lens and located in central monitoring location, such as Admin areas for annunciation of alarms. Alarms shall provide a supervisory annunciation at fire alarm control panel and summon Fire Department.

9. Smoke duct detectors in HVAC units over 2,000 CFM, and within 5 feet of smoke dampers.

10. Connections to sprinkler water flow and valve supervisory switches.

11. Connections to smoke and fire dampers, and fire suppression systems in kitchen and culinary areas.

12. The system will utilize networked transponder panels as required in lieu of booster panels.

13. 60-hour battery back-up.

14. 24 VDC magnetic hold open devices at smoke doors.

15. The School, Maintenance and Athletic Buildings will have a radio master box, exterior beacon, fire alarm transponder cabinet, annunciator panel, pull stations, audio/visual signals, and connections to sprinkler flow alarm and tamper switches, interconnected to main system serving school.

16. Radio master boxes shall be as manufactured by Sig Com.

17. Exterior beacons shall be located at front and rear entrance and at select exit doors per Wakefield Fire Department.

18. 25 percent spare capacity shall be provided in FACP for notification appliance circuits (NAC's).

19. Wiring will be run in minimum 3/4-inch EMT with red markings.

20. Connection to fire suppression systems.

21. Leased phone line connection to UL Central Station will be provided.

22. Knox boxes and exterior beacon will be provided.

J. Antenna Systems

1. A bi-directional amplifier and antenna system will be provided to serve Wakefield Fire Department and Police Department radios.

K. Telephone/Cable TV Services:

1. An underground conduit system with 4foot X 6foot manholes spaced every 200 feet will be provided for each service.

L. Town Fiber Optic Service:

1. An underground conduit system with 4foot X 6foot manholes spaced every 200 feet will be provided for service.

M. Technology will be provided per Technology section.

1. Four, 4-inch underground service conduits will be provided for Verizon service cables and CATV into MDF.

2. Two, 4-inch conduits will be provided to each IDF from MDF with #6 ground wire in each conduit wired to ground bus in each IDF.

3. Telephones, handsets, cables, outlets, and telecommunications equipment will be provided under separate contract.

4. Empty conduits and outlet boxes will be provided for telephone and data system wiring and jacks.

5. Eight NEMA 5-20R twist lock quads will be provided in each IDF on 20A circuits (dedicated) wired to generator standby power.

6. Basket tray will be provided above corridor ceilings and ladder tray in all IDF and MDF spaces.

7. Two 2-inch sleeves shall be provided through all walls from corridor into rooms within the school for Telecom wiring.

8. A cable tray assembly shall be provided in all corridors, with perimeter ladder tray in all IDF and MDF spaces.

N. Integrated Intrusion, Access Control, CCTV, and Alarm System:

1. Addressable intrusion alarm system will include magnetic switches on perimeter doors, motion sensors in all perimeter rooms on first floor with susceptible access from grade and interior doors at high value locations. Motion sensors will be provided in first, second, third and fourth floor corridors. System will have secure-access zoning. Zoning will be provided to suit all proposed off hours usage

including community programs. All required raceways, outlet boxes, and power shall be provided.

2. CCTV coverage will be provided at main and secondary entries as well as other entries to be used by students, staff or for off hours community programs, including but not limited to parking lots, athletic fields, gymnasium, auditorium, and educational programs.

3. CCTV coverage will be provided in cafeteria and all interior corridors.

4. Exterior CCTV coverage will be provided to cover the entire perimeter of the building.

5. Power for intrusion alarm system will include 120V circuits on generator standby power to exterior CCTV cameras.

6. Access control via card access system with all raceways and outlet boxes will be provided at all exterior doors and MDF and IDF rooms.

7. CCTV system will be IP based with minimum 30-day recording capacity. System will be web based to allow viewing by Wakefield Police Department and as manufactured by Honeywell NetAXS, Access Control; Exacqvision, Security Camera Software; Go2Blu, Emergency Alert System.

O. Photovoltaics System

1. Provisions for a roof mounted (fully ballasted) photovoltaic system, rated at 249 kW capacity, based on 5% of total energy consumption will be provided.

2. Photovoltaic system provisions will include enclosures and raceways for energy production metering.

P. Sustainable Features:

1. Provisions for roof mounted (fully ballasted) photovoltaic system.

2. Provisions for Electric Vehicle Service Equipment (EVSE) for charging of electric vehicles.

3. Full cutoff LED site luminaires with networked wireless control with dimming capability to reduce energy consumption and light pollution on site and surrounding areas.

4. Building Level Energy Metering to track building peak demand and to allow for trending of building operation to reduce energy demand charges.

5. Provisions for Advanced Energy Metering with meter management software to track local energy consumption and trending of building operation. System will identify high use areas and provide information to inform strategies to reduce energy consumption.

6. Networked lighting control system for interior and exterior lighting to monitor lighting power consumption and adjust consumption levels based on time-of-day usage.

7. Networked plug and process load (PPL) control system to meet energy code requirements and reduce power consumption from unused devices and loads in unused areas.

Q. Seismic Restraints:

1. Electrical components and systems will be designed to resist seismic forces as determined in accordance with provision of 780 CMR 1612.7, Massachusetts State Building Code, Ninth Edition.

R. Testing:

1. Owner-selected independent testing company will provide acceptance testing of work of this Section.

S. Demolition

1. Project consists of phased construction and phased demolition. Refer to Architectural and Civil documents for phasing and enabling requirements.

T. Work by Others:

1. Following items will be provided under other Sections:
   a. Concrete work.
   b. Painting.
   c. Cutting of masonry.
   d. Scaffolding above eight feet.
   e. Telephone equipment and cable.
   f. Temperature control wiring.
   g. Motors.
   h. Flashing.
   i. Excavation.

U. Guarantee:

1. Work of this Section will be guaranteed for period of one year.

END OF SECTION 26 00 00

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June 17, 2021

Northeast Metropolitan Regional Vocational High School
Life-Cycle Cost Estimate
Executive Summary

Included herein is a life cycle cost estimate for the proposed new Northeast Metropolitan Regional Vocational High School in accordance with the requirements of MGL Chapter 149 Section 44M and per MSBA design development guidelines. This estimate is provided for the HVAC and Plumbing systems.

STUDY INPUTS

- It is assumed that the District's initial cost will be paid in the form of a municipal bond over a period of 30 years. The interest rate used to determine annual payments is based on 1.95% for the initial municipal bond and 3.5% for the future partial system replacement. The actual rates may differ.
- The study length is based on 30 years, which is consistent with the finance period.
- The discount rate for the cost of money is set at 0.25%.
- The cost for a partial system replacement in year 20 is based on 20% of the initial system cost.
- The initial cost to the district for the HVAC and Plumbing systems is $17,488,178 after 50% MSBA reimbursement based on cost estimates. This cost is included in the overall bond financing for the project. This study does not include the total finance costs for the overall construction, only the HVAC and Plumbing portion.
- The estimated annual energy cost is $688,842 ($1.75 per SF) for the total electric and gas utility cost. Actual costs may vary based on actual utility rates, building use, operation and climatic factors. An escalation rate of 3.5% is applied annually.
- Estimated annual maintenance costs are based on an estimated cost for an annual service contract by a local maintenance and service provider. Costs are based on $118,087 ($0.30 per SF) with a 3.25% annual escalation rate. Actual cost will depend on a final negotiated annual maintenance and service contract with a third party following the completion of construction.
- Salaries for maintenance and operations, supplies, or residual values have not been included.

STUDY RESULTS

- Cash flow details for principal and interest are provided based on equal payments. These payments are included in the general construction loan.
- The actual total life-cycle cash flow value for the 30-year period is $74,521,656 with a total present worth life cycle cost of $71,250,293.
- The portion of the life cycle cost related only to operating cost is $42,845,815 with a present worth value of $40,971,056 over the 30-year period.

Prepared by:
Bala Consulting Engineers

Sean P. Sullivan, P.E.
Senior Mechanical Engineer

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Lifecycle Summary

Project: Northeast Metropolitan Vocational High School 6/17/2021
Prepared By: Bala

NE Metro High School- LCCE for HVAC and Plumbing

30 year life-cycle cost estimate for HVAC system finance and operating costs.

Type of Analysis	Public Sector Lifecycle Analysis	
Type of Design Alternatives	Independent	
Length of Analysis	30	yrs
Discount Rate	0.25	%

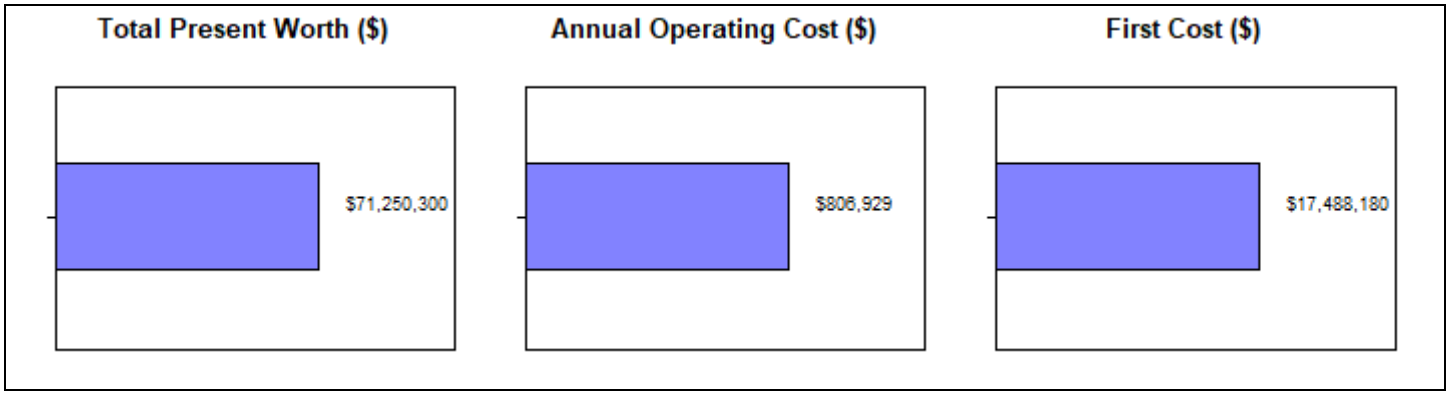


Table 1. Executive Summary

Economic Criteria	Best Design Case for Each Criteria	Value ($)
Lowest Total Present Worth	Life Cycle Cost Estimate for HVAC and Plumbing	$71,250,295
Lowest Annual Operating Cost	Life Cycle Cost Estimate for HVAC and Plumbing	$806,929
Lowest First Cost	Life Cycle Cost Estimate for HVAC and Plumbing	$17,488,178

Table 2. Design Cases Ranked by Total Present Worth

Design Case Name	Design Case Short Name	Total Present Worth ($)	Annual Operating Cost ($/yr)	First Cost ($)
Life Cycle Cost Estimate for HVAC and Plumbing		$71,250,295	$806,929	$17,488,178

Cash Flow Details

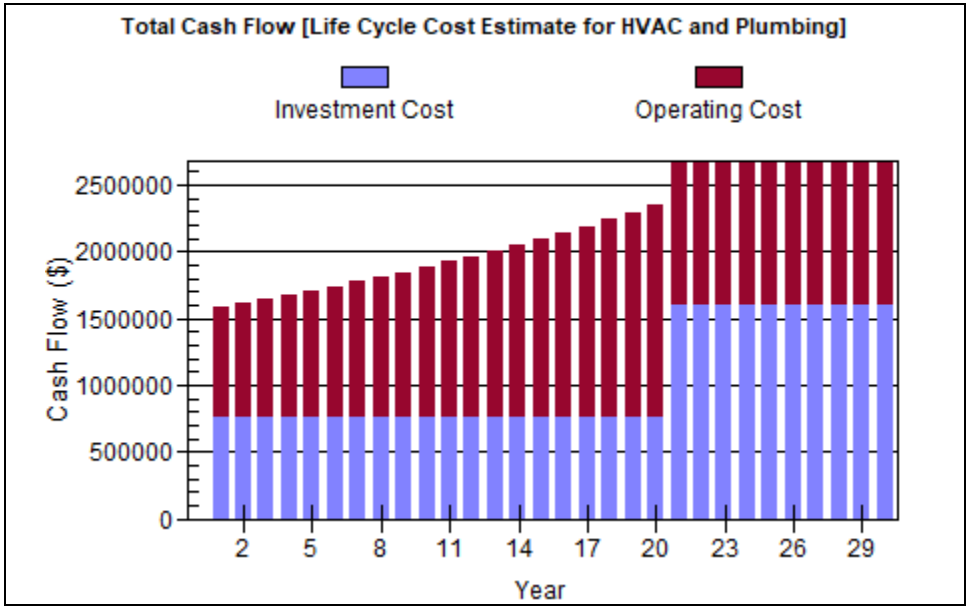
Project: Northeast Metropolitan Vocational High School
Prepared By: Bala

6/17/2021

NE Metro High School- LCCE for HVAC and Plumbing

30 year life-cycle cost estimate for HVAC system finance and operating costs.

Type of Analysis	Public Sector Lifecycle Analysis	
Type of Design Alternatives	Independent	
Length of Analysis	30	yrs
Discount Rate	0.25	%



1A. Component Cash Flows [Life Cycle Cost Estimate for HVAC and Plumbing], Actual Value

Year	Date	Cash Investment ($)	Loan Principal ($)	Loan Interest ($)	Total Investment Cost ($)	Annual Operating Cost ($)	Non-Annual Operating Cost ($)	Total Operating Cost ($)	Total Cash Flow ($)
0	Initial	0	0	0	0	0	0	0	0
1	2022	0	434,468	341,019	775,488	834,876	0	834,876	1,610,364
2	2023	0	442,940	332,547	775,488	863,792	0	863,792	1,639,280
3	2024	0	451,578	323,910	775,488	893,710	0	893,710	1,669,198
4	2025	0	460,383	315,104	775,488	924,665	0	924,665	1,700,153
5	2026	0	469,361	306,127	775,488	956,693	0	956,693	1,732,181
6	2027	0	478,513	296,974	775,488	989,831	0	989,831	1,765,318

Cash Flow Details

Year	Date	Cash Investment ($)	Loan Principal ($)	Loan Interest ($)	Total Investment Cost ($)	Annual Operating Cost ($)	Non-Annual Operating Cost ($)	Total Operating Cost ($)	Total Cash Flow ($)
7	2028	0	487,844	287,643	775,488	1,024,117	0	1,024,117	1,799,605
8	2029	0	497,357	278,130	775,488	1,059,592	0	1,059,592	1,835,080
9	2030	0	507,056	268,432	775,488	1,096,296	0	1,096,296	1,871,784
10	2031	0	516,943	258,544	775,488	1,134,273	0	1,134,273	1,909,761
11	2032	0	527,024	248,464	775,488	1,173,566	0	1,173,566	1,949,054
12	2033	0	537,301	238,187	775,488	1,214,221	0	1,214,221	1,989,709
13	2034	0	547,778	227,709	775,488	1,256,286	0	1,256,286	2,031,773
14	2035	0	558,460	217,028	775,488	1,299,808	0	1,299,808	2,075,296
15	2036	0	569,350	206,138	775,488	1,344,839	0	1,344,839	2,120,327
16	2037	0	580,452	195,035	775,488	1,391,432	0	1,391,432	2,166,920
17	2038	0	591,771	183,717	775,488	1,439,640	0	1,439,640	2,215,127
18	2039	0	603,311	172,177	775,488	1,489,518	0	1,489,518	2,265,006
19	2040	0	615,075	160,413	775,488	1,541,127	0	1,541,127	2,316,614
20	2041	0	627,069	148,419	775,488	1,594,524	0	1,594,524	2,370,012
21	2042	0	1,235,583	381,025	1,616,609	1,649,773	0	1,649,773	3,266,381
22	2043	0	1,268,920	347,689	1,616,609	1,706,937	0	1,706,937	3,323,545
23	2044	0	1,303,230	313,379	1,616,609	1,766,083	0	1,766,083	3,382,692
24	2045	0	1,338,543	278,065	1,616,609	1,827,280	0	1,827,280	3,443,888
25	2046	0	1,374,892	241,717	1,616,609	1,890,598	0	1,890,598	3,507,207
26	2047	0	1,412,308	204,300	1,616,609	1,956,113	0	1,956,113	3,572,721
27	2048	0	1,450,826	165,783	1,616,609	2,023,899	0	2,023,899	3,640,507
28	2049	0	1,490,478	126,131	1,616,609	2,094,035	0	2,094,035	3,710,644
29	2050	0	1,531,301	85,307	1,616,609	2,166,603	0	2,166,603	3,783,212
30	2051	0	1,573,332	43,276	1,616,609	2,241,688	0	2,241,688	3,858,297
Totals		0	24,483,447	7,192,389	31,675,850	42,845,815	0	42,845,815	74,521,656

1B. Present Worth Cash Flows [Life Cycle Cost Estimate for HVAC and Plumbing]

Year	Date	Total Investment Cost ($)	Total Operating Cost ($)	Total Present Worth ($)
0	Initial	0	0	0
1	2022	773,554	832,794	1,606,348
2	2023	771,625	859,489	1,631,114
3	2024	769,700	887,041	1,656,741
4	2025	767,781	915,476	1,683,257
5	2026	765,866	944,823	1,710,690
6	2027	763,956	975,112	1,739,069
7	2028	762,051	1,006,373	1,768,424

Cash Flow Details

Project: Northeast Metropolitan Vocational High School
Prepared By: Bala

6/17/2021

Year	Date	Total Investment Cost ($)	Total Operating Cost ($)	Total Present Worth ($)
8	2029	760,151	1,038,636	1,798,787
9	2030	758,255	1,071,935	1,830,190
10	2031	756,364	1,106,302	1,862,667
11	2032	754,478	1,141,772	1,896,250
12	2033	752,597	1,178,380	1,930,976
13	2034	750,720	1,216,162	1,966,882
14	2035	748,848	1,255,157	2,004,004
15	2036	746,980	1,295,403	2,042,383
16	2037	745,118	1,336,940	2,082,057
17	2038	743,259	1,379,810	2,123,069
18	2039	741,406	1,424,056	2,165,462
19	2040	739,557	1,469,722	2,209,279
20	2041	737,713	1,516,853	2,254,565
21	2042	1,534,027	1,565,496	3,099,523
22	2043	1,530,201	1,615,701	3,145,902
23	2044	1,526,385	1,667,517	3,193,902
24	2045	1,522,579	1,720,996	3,243,575
25	2046	1,518,782	1,776,191	3,294,973
26	2047	1,514,994	1,833,158	3,348,152
27	2048	1,511,216	1,891,953	3,403,170
28	2049	1,507,448	1,952,636	3,460,083
29	2050	1,503,688	2,015,266	3,518,954
30	2051	1,499,939	2,079,906	3,579,845
Totals		30,279,238	40,971,056	71,250,293

Design Case Inputs

Project: Northeast Metropolitan Vocational High School 6/17/2021
Prepared By: Bala

Type of Analysis ..... Public Sector Lifecycle Analysis
Length of Analysis ..... 30 yrs
Income Taxes ..... Not Considered

General Information :

Design Case Name ..... Life Cycle Cost Estimate for HVAC and Plumbing
Description :
30 year life-cycle cost estimate for HVAC system finance and operating costs.

Investment Costs :

Cost Item	Cost ($)	Year Incurred	Esc Rate (%/yr)	Salvage Value ($)	Useful Life (yrs)
Proposed Mech System Initial Cost	$ 9,000,000	0	0.00	$ 0	30
Proposed Mech System Initial Cost	$ 8,488,178	0	0.00	$ 0	30
Mech System Replacement Cost	$ 6,995,271	20	0.00	$ 0	10

Loans :

Loan Item	Start Year	Investment In Start Year ($)	Percent Financed	Term Of Loan (Years)	Interest Rate (%/yr)	Payment Method
Municipal Bond Financing for HVAC	0	$ 24,483,449	100	30	1.95	Equal Payments
Replacement Cost Financing	20	$ 24,483,449	100	10	3.50	Equal Payments

Annual Operating Costs :

Cost Item	Cost ($)	Start Year	Number Of Years	Esc Rate (%/yr)
Annual Energy Costs	$ 688,842	1	30	3.50
Annual Maintenance Costs	$ 118,087	1	30	3.25

There are no non-annual operating cost inputs

Study Inputs

Study Title	NE Metro High School- LCCE for HVAC and Plumbing	
Study Description :		
	30 year life-cycle cost estimate for HVAC system finance and operating costs.	
Type of Analysis	Public Sector Lifecycle Analysis	
Type of Design Alternatives	Independent	
Base Year	2022	
Currency Symbol	$	
Length of Analysis	30	yrs
Discount Rate	0.25	%