FOREST HILLS BOROUGH BUILDING

DESCRIPTION OF MEP SYSTEMS

November 4, 2015

Iams Consulting, LLC
ENGINEERING ENVIRONMENTS
333 East Carson Street, Suite 323
Pittsburgh, PA 15219
(412) 697-3590
(412) 697-3591

Forest Hills Borough Building

Description of MEP Systems

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this study is to describe the planned systems for a new borough building for the Forest Hills and provide options and recommendations for different levels of greening of the facility.

2.0 DESCRIPTION OF HVAC SYSTEMS

2.1 HVAC - General

The building shall be conditioned via a geothermal water source heat pump system. The following equipment shall be provided:

- Geothermal Water Source Heat Pump System
    - Extended Range Water Source heat pump units;
    - Reverse Return Condenser Water Loop;
    - Variable Speed Condenser Water Pumps;
    - Geothermal Well Field;
    - Variable Speed Geothermal Water Pumps;
- Make-Up Air/General Exhaust for Common Spaces;
- Electric Resistance Wall-mounted heaters at doors;
- Radiant Floor Heating;
- Digital Controls.

2.2 Water Source Heat Pump Units

Water source heat pump units will be provided throughout the building.

- Extended range horizontal water source heat pumps units shall be provided throughout the building to be located in the Attic. Each unit shall be provided as follows:
    - Throw away filters;
    - Compressor system;
    - Supply and Return piping;
    - Condensate piping;
        - The use of condensate drain pumps shall be minimized;
        - All condensate drains shall be routed to sanitary drains;
    - Isolation valves;
    - Balancing valves;
    - Solenoid shut-off valves;
    - Digital thermostat;
    - Low pressure internally lined ductwork as required.

- Aluminum supply and return air grilles;

2.3 Reverse Return Condenser Water Loop

Each of the water source heat pump units shall be connected to the main system via a reverse return condenser water loop. The supply and return loops shall be placed in the Attic of the building. The condenser water loop shall consist of copper and steel piping as described below:

- Condenser water piping 2-1/2" or smaller shall be Type 'L' copper;
- Condenser water piping 3" or larger shall be Schedule 40 steel;
- All condenser water piping shall be insulated with 1" fiberglass insulation;
- Shut-off valves shall be provided to isolate each heat pump unit from the loop;
- A set of lines shall be provided in the mechanical room, equipped with shut-off valves to allow for bench scale testing and repair of heat pump unit chases.

The primary condenser water loop shall also have the following equipment:

- Air Separator;
- Expansion tank;
- One-shot by-pass feeder;
- Automatic city make-up water.

2.4 Variable Volume Condenser Water Pumps

Variable volume condenser water pumps shall be located in the Mechanical Room on the First Floor. As discussed above each of the heat pump units shall be provided with a solenoid shut-off valve. When the heat pump unit's compressor is not running, the solenoid valve will close. A differential pressure sensor located in the condenser water loop shall control the variable speed drive at the condenser water pump to reduce or increase water flow as necessary. Two pumps will be provided, one shall be primary, the second shall be a backup. Each pump shall be equipped as follows:

- High efficiency inverter duty pump motor;
- High efficiency end-suction pump;
- Shut-off valve on the return;
- Strainer on the return;
- Suction diffuser;
- Triple duty valve (i.e. shut-off, check and balancing valve) on supply;
- Flexible pump connectors and isolation bushings for pumps and pump hangers;
- Manifolded pressure gauges;
- Pump drain.

2.5 Geothermal Well Field

The building's geothermal well field shall consist of the following:

- Approximately 14 geothermal wells consisting of 1-1/4" poly-ethylene U-bend pipes, grouted in an enhanced bentonite grout approximately 480 feet deep;
- The supply and return piping from each of the wells shall connect to a manifold inside the building;

2.6 Variable Volume Geothermal Field Pumps

Variable volume geothermal field pumps shall be located in a Mechanical Room on the First Floor. The pumps shall pump water from the building to geothermal field and back. The pumps shall operate to maintain the same delta T in the external geothermal loop as the internal building condenser water loop. Two pumps will be provided, one shall be primary, and the second shall be a backup. Each pump shall be equipped as follows:

- High efficiency inverter duty pump motor;
- High efficiency end-suction pump;
- Shut-off valve on the return;
- Strainer on the return;
- Suction diffuser;
- Triple duty valve (i.e. shut-off, check and balancing valve) on supply;
- Flexible pump connectors and isolation bushings for pumps and pump hangers;
- Manifolded pressure gauges;
- Pump drain.

2.7 Make-Up Air/Exhaust

Outside air for the spaces will be provided via a water-source heat pump unit with energy recovery wheel to be located in the attic of the building. These units will condition outside air to neutral temperatures and distribute the air to each space. The unit shall have the following characteristics:

- Variable volume supply air fan;
- Variable volume return air fan;
- Total energy recovery wheel;
- 2" pleated angle filters;
- CO_2 control of outside air;
- Building pressurization tracking of return/exhaust air fan;
- Hot gas reheat;
- Hot gas bypass.
- Low pressure supply air ductwork with 1" liner;

- Low pressure return air ductwork with 1" liner;
- Grilles, registers and diffusers;

2.8 Electric Resistance Heaters

Located at each exterior door and in the stairwells shall be electric resistance unit heaters to provide tempering of these spaces. They shall be provided with the following options:

- Integral disconnect;
- Semi-recessed or recessed mounting frames;
- Tamperproof thermostat;

2.9 Direct Digital Controls

Direct Digital controls shall be provided to control the central system only. Unitary DDC controllers shall be provided for each specific piece of equipment.

3.0 DESCRIPTION OF PLUMBING SYSTEMS

3.1 Plumbing - General

The building shall be equipped with the following plumbing systems:

- Domestic Hot and Cold Water Distribution;
- Sanitary, Waste and Vent Distribution;
- Domestic Hot Water Heater;
- Condensate Drainage for Mechanical Equipment
- Gas Piping for Kitchen and Mechanical Equipment

3.2 Domestic Hot and Cold Water Distribution

A new 2" domestic water service (sizing is preliminary) will be installed within the building. It shall consist of the following:

- Shut-off valves;
- Pressure regulating valve;
- Water meter;
- Backflow preventer;
- By-pass loop;

All hot and cold water, hot water and hot water reheat piping shall be:

Copper Tubing: ASTM B88, Type L, hard drawn.
Fittings: ASME B16.22, wrought copper.
Joints: ASTM B32, solder, Grade 95TA, lead free.

Pex Tubing and Manifolds.

All copper piping shall be insulated with 1" fiberglass insulation. All pex piping shall be uninsulated.

3.3 Sanitary, Waste and Vent Distribution

Sanitary, waste and vent piping shall be:

No-Hub Cast Iron Pipe where required by code.
Fittings: No-Hub Cast Iron.
Joints: Neoprene gasket with stainless steel clamps.

PVC Pipe: NSF-DWV, Schedule 40 where permitted by code.
Fittings: PVC.
Joints: Solvent welded.

3.4 Domestic Hot Water Heating

Domestic hot water heating shall be completed by an A.O. Smith or approved equal, electric hot water heater to be located in the Mechanical Room. The system shall consist of the following:

- An electric hot water tank;
- Overflow pan;
- 1" Overflow pan drain;
- Pressure relief valve;
- ¾" Piping from pressure relief valve to overflow pan;
- Anti-scald tempering valve;
- Isolation valves;
- A recirculation pump.

3.5 Plumbing Fixtures

Water closets shall be manufactured by American Standard, Kohler, or Eljer. Water closets shall be wall-mounted, elongated type fixtures with automatic Sloan Royal Flush valves, appropriate wall carriers, and elongated seats. Fixtures noted to be accessible shall be installed per the requirements of ADA.

Urinals shall be manufactured by American Standard, Kohler, or Eljer. Urinals shall be wall-mounted type fixtures with automatic Sloan Royal Flush valves, and appropriate wall carriers. Fixtures noted to be accessible shall be installed per the requirements of ADA.

Lavatories shall be integral with counter tops. The general contractor shall provide all integral lavatories/countertop assemblies. All lavatories shall have ADA compliant faucets; 1-1/4", 17-gauge semi-cast P-traps with clean-outs; and angle shut-off valves with brass stems. All ADA compliant lavatories shall have piping insulation. Wall mounted ADA compliant lavatories shall be manufactured by American Standard, Kohler, or Eljer and shall be provided with an appropriate wall carrier. All faucets shall be automatic.

Floor drains shall be manufactured by Zurn or Josam. Floor drains shall be 7" in diameter with brass tops in all finished spaces. Floor drains in the mechanical rooms shall be heavy duty 7" cast iron drains.

Standard hose bibs shall be provided in the mechanical room spaces. Lockable, non-freeze type hose bibs shall be provided at two locations on the exterior of the building.

Janitor's sink shall be manufactured by Zurn or Josam. Janitor sink shall be a 36" x 24" floor mounted unit with standard accessories, including faucet, mop hangers, etc.

Water coolers shall be ADA compliant and shall be lead free as manufactured by Eljer or approved equal.

Kitchen sinks shall be a stainless steel drop-in type sink with ADA compliant faucets; 1-1/4", 17-gauge semi-cast P-trap with clean out and angle shut-off valves with brass stems.

3.6 Condensate Drainage for Mechanical Equipment

Condensate drains shall be provided for all mechanical equipment.

4.0 DESCRIPTION OF FIRE PROTECTION SYSTEM

A new 4" fire service will be required (sizing is preliminary). The sprinkler system shall meet the following requirements:

- The sprinkler system shall be a wet pipe system installed in accordance with NFPA-13 for light hazard occupancies. Storage Closets, Kitchens and the Mechanical spaces shall be designed for Ordinary Hazard, Group I;
- The fire water service shall be equipped as follows:
  - Fire department connection;
  - Shut-off valves;
  - Double check backflow preventer;
  - Tamper switches;
  - Flow switches;
- All sprinkler heads shall be concealed in finished spaces;
- All sprinkler heads shall be upright in non finished spaces;
- The system shall be hydraulically designed with a minimum residual pressure of 15 psi;
- The piping shall be Schedule 10 black steel with Victaulic fittings;
- The sprinkler heads shall be rated 212°F where required by NFPA.

5.0 DESCRIPTION OF THE ELECTRICAL SYSTEM

5.1 Electrical - General

The building shall be served by a 1000-amp, 120/208-volt, 3-phase, 4 wire service. The following electrical systems are planned:

- Power Distribution
- Lighting
- Life Safety
- Security
- Communications

5.2 Power Distribution

Power distribution shall consist of the following:

- A 120/208-volt, 3-phase transformer with integral meter by the power company;
- Feeders from the transformer to the building;
- A 120/208-volt MDP with TVSS;
- 120/208-volt distribution panels;
- 120-volt branch circuits for lighting;
- New 120/208 volt three phase power distribution for HVAC equipment.

Panelboards and MDP shall be manufactured by Cutler Hammer, General Electric or Siemens. Panelboards shall consist of door-in-door construction, copper busses, main breakers, 42-circuit, bolt-on branch breakers, with a minimum AIC rating of 22,000 amperes.

All of the spaces will require general 120-volt, single phase power for receptacles. At a minimum, every wall shall have a receptacle.

Wiring methods shall be as follows:

- Concealed Dry Interior Locations above lay-in ceilings or non-block partition walls: Use THHN/THWN insulation, in raceway for home runs. MC cable may be used for branch circuit wiring other than homeruns;
- Exposed Dry Interior Locations: Use building wire THHN/THWN insulation in rigid galvanized steel raceway;
- Above Accessible Ceilings: Use building wire THHN/THWN insulation in raceway for homeruns. Use metal clad cable for branch circuit wiring other than home runs;
- Wet or Damp Interior Locations: Use only building wire Type THHN/THWN insulation in rigid galvanized steel raceway;
- Exterior Locations: Use building wire THHN/THWN insulation in rigid galvanized steel raceway.

Wiring devices:

- Wall Switches
  - Single Pole Switch:
    - Hubbell Model HBL1221-X (X= color per Architect).
    - Equal by Bryant.
    - Equal by Pass & Seymour.
  - Three-way Switch:
    - Hubbell Model HBL1223-X (X= color per Architect).
    - Equal by Bryant.
    - Equal by Pass & Seymour.
  - Four-way Switch:
    - Hubbell Model HBL1224-X (X= color per Architect).
    - Equal by Bryant.
    - Equal by Pass & Seymour.
  - Ratings:
    - Voltage: 120-277 volts, AC, except pilot lit and indicator switches shall have a voltage matching the load served.
    - Current: 20 amperes.
    - Match branch circuit and load characteristics.
- Receptacles
  - Single Convenience Receptacle:
    - Hubbell Model 5361-X (X = color by Architect).
    - Equal by Bryant.
    - Equal by Pass & Seymour.
  - Duplex Convenience Receptacle:
    - Hubbell Model 5362-X (X= color per Architect).
    - Equal by Bryant.
    - Equal by Pass & Seymour.
  - GFCI Receptacle:
    - Hubbell Model GF-5362-X (X= color per Architect).
    - Equal by Bryant.

        - Equal by Pass & Seymour.
    - Special Purpose Receptacle:
        - Hubbell Model to match load and phase requirements.
        - Equal by Bryant.
        - Equal by Pass & Seymour.
- Wall Plates
    - Decorative Cover Plate: Provide stainless steel cover plates in unfinished areas and on block walls unless instructed otherwise by the project architect. In finished areas provide nylon plates with color to match associated devices.
        - Bryant.
        - Hubbell.
        - Mulberry.

5.3 Emergency Power

A 30 kW exterior diesel power emergency generator shall be provided for the building. It shall be provided with the following:

- Circuit breakers, one for life safety the other for standby power loads;
- Diesel fuel tank;
    - Vent piping;
    - Fill/spill container;
- Critical silencer;
- Exhaust piping;
- Battery charger;
- Crankcase heater;
- Soundproof enclosure;
- (2) transfer switches;
- Remote annunciator panel.

5.4 Lighting

Lighting shall consist of the following:

- New energy efficient 120-volt lighting throughout the building;
- New exit signage and emergency egress lighting;
- New exterior building lighting.

All lighting shall be manufactured by Lithonia, Lightolier, or approved equal and shall be 120-volt. All fixtures shall have high efficiency fluorescent ballasts and/or LED.

5.5 Life Safety

Life Safety shall consist of the following:

- An automatic fire alarm system designed in accordance with NFPA-72

The fire alarm system will be manufactured by Pyrotronics or approved equal and shall be an addressable type system. The main fire alarm panel will be installed in the Main Lobby of the building. Fire alarm devices shall include the following:

- Pull stations;
- Horn/Strobes;
- Strobes;
- Smoke and Heat detectors;
- Duct detectors;
- Tamper switches;
- Flow switches;
- Conventional Zone Interfaces;

5.6 Communications

Communications shall consist of the following:

- EC to provide complete communications rough-in including backboards, power, raceway, boxes and plaster rings. Phone, data wiring and devices will be by the owner's data/com contractor;
- All of the spaces shall be provided with communication rough-ins; except for the following:
  - Corridors;
  - Restrooms;
  - Mechanical Rooms;
  - Storage Closets.
- For each communication rough-in, the contractor shall provide the following:
  - a 4x4 junction box;
  - a single gang plaster ring;
  - a 1" conduit from the box to 6" above the accessible ceiling.
- A communication rough-in shall be capable of providing up to four data/phone drops.

6.0 SUSTAINABILITY - OPTIONS

Below is a menu of strategies for greening the facility.

6.1 Photovoltaic Panels

Photo-voltaic panels provide a great source of on-site renewable energy. If 25% of the roof is utilized for a PV array, the roof could support a 60 kW array. This has the potential of generating nearly 15-20% of the buildings power usage.

6.2 Ultra Low Flow Plumbing Fixtures

Ultra Low flow and water conserving plumbing fixtures are a great way to reduce the amount of water that is required to be treated and the amount of sanitary waste that has to be handled. In addition, ultra low flow plumbing fixtures allow us to reduce the amount of energy that is utilized to create hot water as the quantity of water needed is less. From a greening perspective, the following is recommended:

- 0.5 gpm lavatory faucets;
- 1.1 gpf water closets;
- 0.75 gpf urinals; or the use of waterless urinals;
- 1.1 gpm shower heads;

Typically, implementation of the above will generally reduce water consumption by 25-30%.

6.3 Plumbing Fixture Automatic Controls

Typically speaking, the use of automatic flushing devices on water-closets, urinals and lavatory faucets can reduce water consumption be nearly 5-10%. An added benefit is that these devices also provide for a more sanitary condition as they are hands free.

6.4 Solar Domestic Hot Water Heating

Solar domestic hot water heating utilizes the sun for creation and storage of domestic hot water heating. These systems consist of a domestic hot water storage tank, PV powered solar domestic hot water pump and solar domestic hot water panels which are sized for the potable hot water load for the building. It is estimated that a roof space of approximately 500 square feet could provide adequate space to provide a majority of the hot water heating from the sun. These systems typically reduce the energy needed for domestic hot water heating load by 50% or more.

6.5 High Efficiency Lighting with Lighting Controls

The use of LED fixtures throughout the facility can save up to 30% of the lighting energy power. The addition of occupancy sensors, day-lighting and time of day controls can provide up to 15% energy savings in the amount of energy used for facility lighting.

6.7 Grey Water System

From a water conservation viewpoint, a grey water system could be installed that would collect rain water and condition it for use in urinals and water-closets. The system would consist of the following:

- A rainwater cistern to collect rainwater;
- A submersible pump to pump rainwater to building;
- A compression tank to provide a cushion between pump cycles;
- A filter to collect sediment from the storm water;
- A UV device to kill off microbial organisms;
- And a die kit to die the water so that is it not confused with potable water;

These systems are an excellent way to reduce potable water consumption.

7.0 ESTIMATION OF PROBABLE COST

Below is an estimation of probable cost based on the above recommendations and greening options:

HVAC:	$420,000.00
Plumbing:	$150,000.00
Fire Protection:	$40,000.00
Electrical:	$320,000.00
Total for MEP Work:	**$930,000.00**

Greening Strategies Options:

60 KW Photo-voltaic Array:	$250,000.00
Ultra Low Flow Plumbing Fixtures: (this number adds to the Plumbing number above)	$7,000.00
Automatic Flushing Devices:	$8,400.00
Solar Domestic Hot Water Heating:	$23,000.00
High Efficiency Lighting with Lighting Controls:	$65,000.00
Grey Water System	$28,000.00