15000 – MECHANICAL/PLUMBING

I. DESIGN

A. A/E Coordination

1. Mechanical equipment shall be located on the ground floor and provided with double doors. Paved access for maintenance vehicles shall be as close as possible. Rooms shall be of sufficient size for all required clearances and all proposed piping and duct layouts. Travel paths shall be clearly indicated which present no to minimal obstacles for equipment replacement and servicing. Where it is not practical to design equipment rooms on the ground floor level, the room design, and if necessary adjacent spaces, shall incorporate clearly defined provisions for equipment replacement and servicing. Mechanical rooms that serve as air plenums shall be designed according to prevailing code and be void of combustible materials. Where practical and as directed by the County Project Manager, the floor shall be painted or otherwise treated with an industrial grade, slip resistant, water proof type coating of a light gray color and curbs and equipment pads painted/trimmed out in yellow color slip resistant, industrial grade treatment. Rooms shall have proper drainage depending on the type of equipment housed. Where there is equipment to be cleaned, etc., there shall be a ¾” hose bibb with backflow protection. Noise attenuation measures shall be incorporated into the design of the mechanical room(s). Equipment rooms must be weatherproofed and have secured locking hardware.

2. Refer to the Mechanical Code for requirements to provide guardrails at the edge of roof areas adjacent to rooftop equipment that require maintenance access at the roof level. If guard rails are unavoidable, Architect is to indicate and specify railing that is compatible with the building’s structure and aesthetics.

3. All roof levels shall be accessible for maintenance. Roof walkways must be provided in all expected travel areas and around roof mounted equipment. Provide platforms around cooling towers and other HVAC units elevated above roof surface. Ladders must be provided to all roof levels and interior ladders are preferred where practical. Refer to section G.2.b for detailed access criteria.

4. In ceiling areas where HVAC equipment, such as VAV boxes, need to be located, A/E shall provide appropriate ceiling space such that equipment, dampers, valves, etc., can be easily accessed for maintenance. Ceiling access shall be accessed no greater than that required from 8’ step ladder. For inaccessible ceilings, the Architect shall indicate and specify compatible access panels of sufficient size that have been coordinated with the Engineering layout and requirements. It is permissible to specify cable operated volume dampers for individual air devices where access panels may be less desirable. Equipment shall be a minimum of three feet from a wall.
5. Where built-in systems (furniture and/or shelving) are planned and basic layout can be
determined, VAV boxes/AC equipment shall be located above the walkways and not
directly over furnishings that cannot be easily moved.

6. Buildings with tall, vaulted attic spaces require close coordination between Architect
and Engineer. Use of attic space as an air plenum is not permissible. Design and specify
ducted supply/return systems where ductwork must traverse through an attic space or
within vaulted elements. For “flat” ceiling applications, plenum returns are preferred
unless there are compelling reasons for ducting back to the air mover(s). Where ceiling
return air plenums are utilized, coordinate the design intent and use of return air light
fixtures and other architectural return air measures with the project manager. The A/E
shall coordinate all full height walls, obstructions, and prevailing code requirements
such that the return air plenum is viable.

B. Submission Requirements

1. The A/E shall send building load letters and plans to the electric and gas companies at
appropriate times during design.

2. A/E shall submit cut sheets for the major equipment components which form the basis
for design, at the Design Development phase. The cut sheets must identify equipment
dimensions. The drawings shall include detailed part plans and section views (1/4" = 1'
or larger scale) dimensioned to show the major equipment, duct work, and piping
located within the mechanical spaces. Detailed plans must reflect that adequate space
and clearances are provided for inspection, maintenance and replacement access, and
all major mechanical equipment. It is preferred that these clearances be indicated by
light dashed lines.

3. A/E shall use eQuest, Trane Trace, DOE-2 or other pre-approved equivalent building
simulation programs to conduct energy modeling to aid in preparing a life-cycle cost
analysis for mechanical system selection, optimized building orientation, architectural
shading methods, building envelope characteristics, and day lighting options during the
Schematic/Design Development phases. The Owner and A/E shall meet to determine
what options shall be evaluated and to review costs/benefits of various design
alternatives. The A/E shall provide the Owner an annual energy budget model based
upon the computer simulation. Report shall include the program outputs and list of
input assumptions.

4. The following parameters shall be used for evaluating life-cycle cost analysis.

   a. 5% discount factor for capital costs.

   b. Utility escalation rate should be discussed at the time of the study as they can vary
      widely and have a big impact on life cycle analysis. 3% escalation rate has been
      used recently.
c. Study period shall be for 30 years. When packaged roof top equipment is used, which has a 15 year life cycle, assume a 15 year replacement.

d. All life cycle costs shall be in “Present Worth” format.

5. The A/E shall confirm design conditions early in the project and submit all heating and cooling load calculations for review by the end of Design Development. Revised load calculations shall be resubmitted to the Owner as required to reflect revised loads based on Owner & HVAC Peer Reviewer comments.

6. Provide a points list and sequence of operations for each project.

7. Show North arrow on all Mechanical plan sheets for all submissions.

8. For building footprints too large to fit on a single plan sheet, provide a key plan on all plan sheets. Provide a key plan on any sheet where partial plans are utilized and indicate in a light hatch pattern for the area(s) of work. Where feasible, maintain same building orientation for all plans and include column lines even on key plans, as applicable.

9. Provide outside air calculations by no later than the 50% CD review.

10. Equipment schedules shall contain capacities required by load calculations and capacities of proposed equipment. This applies for heating and cooling BTUH’s and GPM. This will allow the county to more easily verify that equipment has not been oversized (requirement of IECC) and facilitate future equipment replacements based on actual required capacities instead of what was installed.

C. Plumbing

1. In addition to the code required locations, provide sanitary sewer clean-outs at each end of building at main sanitary sewer trunk lines.

2. Provide accessible sanitary sewer cleanouts in all locker rooms and rest rooms.

3. The following criteria is to be included in the Plumbing system specifications and indicated accordingly on the plans:

   a. No plumbing piping is to be installed over electrical panels or other distribution equipment, unless in compliance with NEC limitations.

   b. No plumbing piping is to be installed over server or data room equipment or books in libraries.
c. Freeze proof, lockable/keyed, ¾” hose spigots with backflow prevention shall be provided near outside and rooftop mechanical equipment, to include a shutoff valve with air vent placed upstream of hose spigots. For applications where a roof hydrant is the only option, specify and detail a support system and indicate robust roof sealing so as to prevent pooling and leaks at the roof’s penetration.

d. Make-up water supply for the cooling tower and any irrigation systems shall be submetered to reduce monthly sanitary sewer costs. Provide a manual bypass for the automatic fill.

e. Lavatories at all publicly accessible restrooms shall have hard wired infrared sensor controls and grid drains. Lavatories and pantry sinks in staff only areas may have manual controls and grid drains.

f. All piping that will gain or lose energy to/from the surrounding atmosphere, or may cause condensation problems, shall be properly insulated to minimize energy costs and condensation problems. All roof drain bodies and horizontal piping including the down turn elbow shall be insulated. All pipe insulation joints must be properly sealed.

g. Electric heat trace, tape system shall not be specified for domestic hot water systems. Avoid long runs of hot water piping, but where impractical provide hot water circulator pump and recirculation piping of at least ¾”. Unless determined otherwise, it is permissible to control the pump’s operation with an aqua stat.

h. Domestic tank type water heaters shall have glass lined tanks.

i. Floor or trench drains shall be installed for intentionally level floors and shall be shown on drawings.

j. Provide pressure gauges at high points of piping branches and/or points furthest away from building’s source. Provide an isolation valve up-stream of pressure gauge. Indicate locations on the riser diagrams as well as on plans.

k. In restrooms, coordinate the requirement for a centralized floor drain with the County’s project manager. Utilize a “water saver” type trap primer directly connected to a nearby lavatory tailpiece to avoid the maintenance associated with mechanical trap primers.

l. Fixture units shall be tabulated on drawings. Where fixtures have been demolished, demolished fixture units shall also be tabulated on drawings.

m. As a general rule, garbage disposers are not permitted in commercial applications. They will be considered and approved by the County’s Project Manager on a case by case basis for applications such as fire stations and other residential facilities where the end user will be solely responsible for their servicing.

Guidelines for Architects and Engineers

February 2015
n. Gas piping shall be painted bright yellow with a minimum of two coats of industrial grade enamel. Domestic piping shall be labeled with use and flow directional arrows on the exterior of the insulation. Drainage piping shall be labeled with use and flow directional arrows.

o. A programmable digital time clock (located next to the unit) may be utilized to minimize water heater “standby” losses during the building’s unoccupied schedule. Indicate time clock on electrical plans for coordination purposes.

D. Fire Protection

1. Sprinkler System to be designed, installed, and tested in accordance with all applicable codes and reviewed and approved by local authorities having jurisdiction. Contractor is responsible for all shop drawing review fees and permit fees charged by the Fire Marshal's office.

2. Sprinkler piping is not to be routed over top of electrical panels or equipment, except as specifically permitted by NEC.

3. The inspectors test valve shall be located in a readily accessible location. This is essential to minimize the impact to the user agencies during the cyclic testing. Provisions for discharging the water during the cyclic system test shall be made by piping the drain to the exterior of the building. The use of buckets for cyclic testing is not acceptable.

4. Sprinkler devices, valves, etc., shall be permanently tagged noting the device and its purpose. Valves or devices that are located above accessible ceilings shall be marked at the ceiling level indicating a device or valve above.

5. The use of McDonnell & Miller flow switches for the sprinkler system is unacceptable. These are not rated for use with fire alarm systems.

6. Do not specify any currently or previously recalled sprinkler heads for use on any Fairfax County project without prior, written approval from the Fairfax County Fire Marshall.

7. Specifications shall require contractor to provide appropriate quantities of spare sprinkler heads and spare sprinkler head wrenches (for each type installed) as required by code.

8. All sprinkler piping shall be Schedule 40. Schedule 10 is not acceptable as it tends to fail after a few years with pinhole leaks.

9. All riser fittings and inspectors test line shall be brass ball valves.
10. All 2” main drain lines shall be piped to the exterior of the building. This is necessary to facilitate the annual testing and maintenance of the lines. The floor drains will not handle the rate of flow required for the Fire Marshall’s annual test and recertification.

11. Dry sprinkler valves shall be installed so that a proper test, reset, and maintenance can be performed from one location. Pressure gauges, drains and valves shall be installed as required to accomplish this.

12. Use of dry sprinkler systems is discouraged and should only be used where required by code or operational requirements due to high maintenance and expensive repairs. If used:
   a. Specify self-restorable valves to be reset by County’s FMD staff.
   b. Specify oil-less type air compressor.

E. Main Fuel Tank, Day Tank & Piping for Diesel Generators
duplex fuel oil pump arrangement is preferred.

1. Primary tanks and day tanks shall not be located or mounted on the same frame as the emergency generator. The Day Tank shall be mounted on a slab on grade, independent of the emergency generator. Simplex Day Tanks are preferred; Tremont Day Tanks are not acceptable. For an exterior Day Tank, provide Day Tank heater and heat tape on fuel lines, as necessary. A secondary fuel pump shall be provided for the return line from the Day Tank to the Main Fuel Tank as an integral part of Day Tank, as required.

2. Packaged units with main fuel tanks, sub-base fuel tanks, belly tanks, on-board tanks or rail mounted tanks are not acceptable. All fuel piping and fuel tank designs should be approved by the system manufacturer of the generator set. Copper piping is not to be used for fuel supply or return. Fuel oil return piping must be provided from the generator to the Day Tank and from the Day Tank to the Main Fuel Tank.

3. The main fuel tank shall be a separate component, and shall either be a buried double wall tank or an approved above ground storage tank (AST) mounted on a slab independent of the generator in accordance with UL listing. The AST shall be securely bolted to the slab and properly grounded.

4. Fuel system piping shall be black pipe and painted with Corrosion-resistant black paint. Fuel return line piping must be properly sized as per manufacturer’s recommendations. The fuel piping and the electrical conduit between the generator and the Day Tank and fuel piping between the Day Tank and the Main Fuel Storage Tank shall be routed to allow easy access around these items without conflict. In the event the fuel piping has to be elevated, provide a set of check valves and a shut-off valve in each of the sections (from main tank to day tank and day tank to generator) in order to be able to maintain the prime at all times.
5. Where a buried fuel tank is used, a foot valve shall be installed at the tank’s lowest point, to prevent air from entering the system.

6. Where a diesel generator set is specified, provide a foot valve in the tank at the lowest point in the piping to prevent the possibility of air getting into the system.

7. The minimum size for the diesel fuel tank to support only the generator shall be 500 gallons or the fuel tank shall be sufficiently sized to fuel the generator for a period of 96 hours at full load capacity assuming the tank to be full at ¾ capacity at all times. The installer shall provide a min. of half tank of fuel at the time of generator startup.

8. The Day Tank shall be specified with a hand pump for emergency operation. The day tank piping shall be provided with unions so that the Day Tank may be isolated and replaced without redoing the piping. The return lines shall have no valves, as required by code.

9. Above ground Fuel Storage Tanks shall be located at or near grade and shall be easily accessible for ease of maintenance and repair. There should not be any obstacles to accessing the generator with dollies and 55 gallon drums.

10. Main fuel tank, Day tank and fuel lines shall be installed by a certified contractor in accordance with manufacturer’s installation requirements and the requirements of the NFPA, IBC, NEC. The main fuel tank and Day Tank may be painted with the same color as that of the generator.

F. Heating, Ventilation and Air Conditioning System Selection

1. The A/E shall coordinate with DPWES and FMD prior to selection of the mechanical system.

2. Where building size and use require complex multi-zone comfort systems, central plant configurations are preferred. In such cases, the basis of the heating and cooling system shall incorporate the following:

   a. Centrifugal chillers above 120 tons and scroll or screw type chillers below 120 tons supplying chilled water, with VAV air handling units are strongly preferred.

   b. A four-pipe system is preferred.

   c. Firetube hot water boilers supplying hot water to perimeter baseboard or VAV terminal mounted heaters and air handlers (use hot water coils for morning warm-up) should be used for the heating system. For VAV systems, the decision to use terminal unit electric reheat will be made on a case by case basis.
d. The use of condensing boilers is preferred for new installations. For retrofits, the use of condensing vs. non-condensing boilers will be made on a case by case basis. Multiple boilers should be incorporated for redundancy.

e. Temperature controls shall be Direct Digital Control (DDC).

f. Chillers should be located in an enclosed mechanical room. Provide refrigerant monitoring, detection, alarms, and ventilation as required to meet Mechanical Code requirements and ASHRAE standards. Smaller chillers that use scroll compressors can be packaged units located outdoors but must be designed to include glycol to prevent freeze-ups and/or the need to drain/fill the system seasonally. CFC and HCFC refrigerants are not to be used in mechanical equipment on County projects. The County goal is to achieve the LEED Enhanced Refrigerant Management Credit, and the use of HFC refrigerants is strongly encouraged.

g. AHUs located in mechanical rooms are the owner’s preference to achieve extended AHU life cycle.

h. The County has had difficulty with chilled water units located above the roofline, even with electric heat tracing. Avoid locating chilled water units above the roof line. Specify glycol and for piping to enter the unit directly below the unit, when no other acceptable options are available.

i. Avoid designs that require boiler operation in the summer. County boilers, typically, are not run during the summer months.

j. Avoid designs that require chiller operation during the winter. Any space that requires 24/7 cooling should use a DX system. County chillers typically, are not run during the winter months.

3. In small, less complex buildings, VAV or constant volume roof top units with natural gas heat (where available) and DX cooling are acceptable.

4. Where commercially available, DX units shall have multiple compressors or unloading capabilities to avoid excessive cycling of compressor(s). Hot gas bypass may be utilized where appropriate, such as with single compressor units.

5. VAV systems are preferred for indoor comfort control (humidity). Avoid VVT systems. Where commercially available, provide hot gas reheat for humidity control.

6. Where natural gas is not available, packaged air to air heat pump units with 100% electric back up are acceptable.

7. Where airflow monitoring stations are required, use “thermistor in tube” products and tie into the building’s energy management system for “real time” air flow and temperature monitoring. Otherwise, avoid designing systems that require airflow monitoring.
monitoring stations for fan speed or system control. Fairfax County has experienced installation, calibration and clogging problems with these systems. If a return fan is used, consider return air fan speed being based on supply fan speed, pressurization offset and actual fan curve characteristics, and the position of the outside air damper and calculation. Use gravity relief dampers where possible. Incorporate motor operated damper in series with barometric backdraft damper.

8. Supply air shall be directed away from thermostats. Thermostat locations must be shown on the drawings. Before locating thermostat, coordinate thermostat locations with loose and fixed furniture plans to avoid conflicts and poor sensing capabilities. For exterior zones, avoid locating thermostat too far from the exterior wall.

9. Interlock exhaust fans with associated AHU to assure they are included in controls package and don’t run continuously. This will also save control points.

10. For telecommunication rooms, provide HVAC systems capable of maintaining the temperature between 72 and 74 degrees F and 50% relative humidity. Independent split system units are acceptable where appropriate to the facility’s operations. The unit may be wall mounted, located above the door.

G. Heating, Ventilation and Air Conditioning Design Criteria

Optimal design will emphasize energy efficiency, accessibility, and maintainability.

1. Energy Efficiency

a. The HVAC system shall meet all building code requirements for heating and cooling loads. Building envelope components shall be designed for energy efficiency in compliance with ASHRAE, IMC, and other applicable building and energy codes. Special attention shall be paid to the International Energy Conservation Code requirements for equipment sizing criteria.

b. The HVAC designer shall pay close attention to actual building occupant load patterns and anticipated actual building loads to ensure that the system efficiently meets these requirements. Fairfax County has had problems with systems that meet the code requirements but do not effectively heat, cool or dehumidify the building in actual loading conditions. A/E shall:

i. Use all code approved methods to reduce occupant loads to match actual conditions and to reduce fresh air quantities to lowest possible levels. For libraries, remove square footage of permanent stacks prior to applying code required occupants per square foot. Use occupant averaging, room volume, transfer air techniques or other approved code methods to reduce fresh air requirements. This is mandatory for all meeting rooms, conference rooms, or other assembly areas. Use DPWES occupancy load program to calculate
outside air quantity reductions for variable and intermittent occupancies where possible. Coordinate with the County Project Manager, or contact Building Plan Review in County’s Land Development Services to obtain the most current copy.

ii. In buildings with fixed shelving and stacks, such shelving and stack floor areas, must be deducted from the net square foot calculations.

iii. Size cooling equipment to match actual building occupant load conditions.

iv. HVAC loads shall be based on actual lighting levels wherever possible. If actual lighting levels are not available at the time loads are calculated, lighting load shall be estimated by maximum lighting levels permitted by space type according to IECC. Do not use 2 W/SF as standard lighting level for all spaces.

v. Central plant equipment shall be sized for the building peak, not the sum of the zone peaks.

vi. If packaged DX equipment is used, they shall have multiple cooling and heating stages to meet part load conditions for proper humidity control. Design CFM range for DX equipment that serves occupied spaces shall be in the range of 340-360 CFM/Ton. Design CFM/ton for equipment that primarily serves equipment such as server rooms shall be at the equipment manufacturer’s rate to adhere to the cataloged cooling capacity.

vii. HVAC systems shall be designed to limit indoor humidity levels in the cooling mode to approximately 50%.

viii. Provide HVAC zones for different functional areas and to allow for night use in appropriate areas.

ix. Where design loads for a space may vary significantly from actual loads, the system shall be designed with capacity reduction capability.

x. CO₂ sensors shall be provided to control amount of fresh outside air intake.

c. Systems designed should maintain the following temperature settings:
<table>
<thead>
<tr>
<th>Building Area</th>
<th>OCCUPIED</th>
<th>UNOCCUPIED</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Office Space Heating</td>
<td>70°F</td>
<td>55°F</td>
</tr>
<tr>
<td>General Office Space Cooling</td>
<td>74°F</td>
<td>85°F</td>
</tr>
<tr>
<td>Warehouses/Garages/Apparatus</td>
<td>60°F</td>
<td>N/A</td>
</tr>
<tr>
<td>Data Center</td>
<td>74°F</td>
<td>78°F</td>
</tr>
<tr>
<td>Telecommunications Rooms</td>
<td>72°F</td>
<td>74°F</td>
</tr>
</tbody>
</table>

d. Outside Air Design Parameters (temperatures) for General Building Areas.

<table>
<thead>
<tr>
<th>Season</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>14°F</td>
</tr>
<tr>
<td>Summer</td>
<td>95/74°F</td>
</tr>
</tbody>
</table>

(Verify design temperatures with ASHRAE Standards.)

e. The building thermal envelope shall, as a minimum, be designed as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>U-Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window U-Factor</td>
<td>0.50 Max</td>
</tr>
<tr>
<td>Average Wall U-Factor</td>
<td>0.10 Max</td>
</tr>
<tr>
<td>Soffit/Floors U-Factor</td>
<td>0.10 Max</td>
</tr>
<tr>
<td>Roof U-Factor</td>
<td>0.05 Max</td>
</tr>
</tbody>
</table>

0.10 Max in storage/equip. rms.

Exterior envelope shall also have interior and exterior vapor barriers, and entire thermal envelope, including attic and plenum spaces, must be sealed to the exterior.

f. Warehouses, garages and Fire Station Apparatus Bays should be provided with infrared tube heating systems and should not be air-conditioned. All infrared heat systems which have more than five burners shall be “Co-Ray-Vac” Class I serpentine infrared system manufactured by Roberts Gordon, or approved equal. Infrared heat systems with less than five burners can be specified as a Class II, open to several manufacturers. Whenever possible, eliminate or reduce the use of make-up air heaters. Use single bulb temperature sensors (Accustat) set at 65 degrees in lieu of factory infrared controls. Bring in un-tempered air at the ceiling level, with the infrared systems sized for the additional load. If make-up air heaters are used, specify modulating burners with a 65 degree discharge air temperature introduced at the ceiling level. Exhaust systems shall be automatically controlled by exhaust gas sensors. For maintenance garages, provide ceiling mounted commercial grade propeller fans for summer ventilation. For all bay door’s provide interlock to shutdown conditioning system in bay area(s) when a bay door is open.

g. The use of air to air heat exchangers over energy recovery wheels is preferred. While the air to air exchanger does not offer latent heat recovery, it is more efficient in the long run, since it will continue to provide sensible heat recovery long after the heat wheel fails (which is typically less than 5 years).
2. Accessibility and Maintainability

a. Planning and coordination is required during design and construction to assure accessibility to new mechanical equipment. The long-term equipment maintenance requirements must be evaluated so that reliable, sustainable, maintainable and replaceable mechanical systems are installed. This will help the systems operate efficiently and safely throughout the life of the building.

b. Design shall provide for adequate access and work space to all HVAC equipment for maintenance, inspections, repairs, cleaning and replacement.

c. Mechanical rooms shall, to the degree possible, be located on the ground level, at an outside wall with maintenance vehicle parking spaces and loading zone immediately adjacent to the mechanical room door. All major HVAC equipment shall be located in the mechanical room(s).

d. Maintenance, repair, and replacement requirements must be carefully considered and evaluated, during the design phase, for all equipment mounted on the roof or located in the attic to assure reasonable and appropriate access.

e. All HVAC equipment located in the ceiling such as VAV boxes shall have unimpeded access from an 8’ step ladder.

f. All HVAC equipment shall have accessibility details noted on the mechanical and architectural plans and specifications, including, but not limited to: walk-ways, cat-walks, access doors, maintenance areas, electrical disconnects, electrical control panels, VAV box maintenance areas, equipment coil, filter and belt access locations.

g. The manufacturer’s minimum clearance requirements shall be provided. At least 42 inches of clearance is required for maintenance around all mechanical equipment, unless otherwise recommended by the manufacturer, and allowed by NEC.

h. Avoid locating ceiling mounted HVAC equipment over areas that would be adversely affected by daytime service, such as a kitchen.

i. Air conditioning condensate drain piping shall discharge to a storm drain or directly outdoors. Liquid combustion byproducts from fuel fired boilers and furnaces shall discharge to an approved location in accordance with the appliance manufacturer’s instructions. All condensate piping shall discharge to a location where it will not cause a nuisance. Piping shall be properly anchored. Condensate drains from rooftop equipment shall terminate directly at roof drain. Provide drainable P-traps for systems subject to freezing.
j. Non-curb mechanical equipment shall be supported by platforms with pipe columns with umbrella flashings where applicable. Height of column should be a minimum of 8" above roof membrane.

H. Heating, Ventilation and Air Conditioning Specifications

1. Boilers - The specifications shall include:
   a. **Outside Air Reset** - For non-condensing units, provide hot water reset based on outside air temperature by the use of a three-way mixing valve.
   b. **Combustion Efficiency Test** - Burner shall be tuned up for maximum performance, including correct nozzle size, flame shape, and air damper adjustment for minimum excess air. Performance shall be verified via written results of an instrumented combustion efficiency test, including test data net stack temperature, percentage CO₂ or O₂ oil smoke spot or percentage CO, and total combustion efficiency percentage.
   c. **Boiler Water Flow** - Consider boiler re-circulation pumps or injector pumps for boilers to maintain water flow. Re-circulation pumps shall maintain minimum flow in the boilers as recommended by boiler manufacturer. The water flow can be a problem where three way valves are used for outside air reset at warmer OA air temperature when most water is by-passed and the boilers have very low flow. Systems shall also be designed to avoid thermal shock to boilers at start-up.

2. Where removable printed circuit boards are provided, an extra set shall be furnished including description, manufacturer, and source of supply identified.

3. Provide spare relays for A/C units and identify manufacturer and source of supply (include in Operations and Maintenance Manual).

4. Provide one extra set of belts for each belt driven unit.

5. In designs where the number of similar sized VFD units exceeds 10 units, provide a spare VFD.

6. Use of lining for ductwork will be determined on a case by case basis. If possible, where required for acoustics, use perforated metal liner for inner wall or sound attenuator.

7. Provide two extra changes for each type filter. 2" pleated are preferred. Install new filters at Substantial Completion in addition to the two spare sets.

8. Provide proper set of any non-standard test tools/equipment and appropriate training for installed equipment. Avoid specifying non-standard test tools/equipment, as applicable.
9. The temperature control system and the energy management control system shall be provided by one manufacturer.

10. An instructional session shall be held after systems are functional to familiarize Fairfax County staff (FMD) mechanics with the design and construction of the system. Time shall be set up during the warranty period for "shake down" meetings as needed. Total instructional and "shake down" time provided by the design engineer and installing Contractor shall be coordinated with the Owner prior to bidding but shall not be less than six hours. Contractor shall video record all instructional sessions and provide the DVD to the Owner.

11. The specifications shall provide for a full one-year warranty period for all HVAC systems equipment and associated controls, in addition to more extensive standard warranties carried by the specified systems and equipment. Special or extended warranties must be evaluated and approved by the Owner during the design process.

12. If roof mounted A/C units are used, provide a power receptacle, an interior stepladder with hand rails, steps 12" apart and top step no more than 15" from opening up of roof hatch.

13. Provide wall mounted control diagrams in all boiler and mechanical rooms. The diagrams shall be framed and covered with Plexiglas, or laminated.

14. All valves shall be numbered with brass tags and referenced to operational instructions.

15. Provisions shall be made for metering of heating fuel oil consumption. Provide back flow preventers in fuel lines, as required. Exposed exterior fuel lines must be insulated/heated.

16. Coordinate with DPWES to notify FMD staff when system balancing is scheduled so FMD HVAC mechanics can observe the procedure.

17. Access panels or doors must be provided for any equipment located in all wall or ceiling spaces that may require maintenance, repairs, or modifications.

18. All equipment, smoke detectors, heat detectors, etc., which are located above a suspended ceiling must be clearly labeled at the appropriate location on the ceiling.

19. CFC and HCFC refrigerants are not to be used in mechanical equipment on County projects. The County goal is to achieve the LEED Enhanced Refrigerant Management Credit. Use of HFC refrigerants is strongly encouraged.

20. In DX units that have multiple compressors, cooling coils shall be intertwined.

21. All motors are to be NEMA Premium efficiency.
22. A minimum of three-foot clearance is required at electrical elements at VAV boxes, fan coil units, etc. per National Electric Code (NEC.)

23. All ductwork and piping that will gain or lose energy to/from the surrounding atmosphere, or may cause condensation, shall be properly insulated to minimize energy costs and condensation. All duct and pipe insulation joints must be properly sealed.

24. All hydronic piping shall be run in conditioned space to avoid freezing. Where it is unavoidable to run in spaces subject to freezing, thermostatically controlled electric heat tape shall be provided on piping. In cases where emergency generators are specified, the electronic heat tape shall be connected to the emergency generator.

25. Provide Aegis grounding rings for all motors controlled by a VFD.

26. Fire dampers shall be type B and are to be dynamic type.

I. Energy Management and Control Systems

1. In all buildings, a DDC energy management and control system (EMCS) shall be installed. For new control systems, the protocol shall be based on BacNet. System Database shall host on a server, and use Microsoft Internet Explorer or Netscape to remotely view system graphics, and monitor, control, and configure HVAC system and its properties. EMCS shall include Owner approved graphics including Floor-level graphics with links to equipment for each building system.

2. All EMCS building controllers shall have UPS backup for 24 hours and shall be connected to generator power where available.

3. The energy management and control system shall monitor and control HVAC operations and conditions, alarm abnormal conditions and index control modes and provide AHU optimized start/stop operations, and provide reporting and trend logs. The specific system requirements shall be reviewed with the County during design.

4. The plans and specifications for the EMCS and mechanical system must include a detailed points list showing all monitor and control points and identify all required software and hardware, and must also include a sequence of operations for major equipment and systems.

5. The EMCS must be capable of performing the following functions:

   a. Monitor and Alarm Selected Conditions: Temperature; Pressure; Flow; On/Off, Start/Stop Status; Safety Control Status (Fire, Freeze, Smoke).
b. **Initiate Selected Control Sequences**: AHU/Chiller/boiler/pump; Start/Stop; Occupied/unoccupied modes; Optimized Equipment Start/Stop operation, monitor total building electric usage and provide demand limiting routines as determined by Owner.

c. **Building Lighting controls**: Indoor and outdoor lighting to be controlled by BAS. Refer to Division 16000 for more information.

6. The EMCS shall not be directly involved in the local loop controls, and the local loops shall continue to operate if the EMCS fails.

7. All EMCS components shall have surge suppression devices. Building controllers shall provide a service communication port for connection to a portable Operator’s terminal (furnished by contractor). Each piece of equipment shall be controlled by a single controller to provide stand-alone control in the event of communication failure.

8. The EMCS must be capable of alarming to, and allowing interface and programming by any compatible personal computer via the County’s LAN. EMCS shall be expandable and be compatible with the electronic equipment controls. EMCS must have a security password/code for system entry and programming. A network RJ45 jack shall be provided for network communications over the County’s LAN.

9. Specifications shall require contractor to provide on-site operator display LCD panel for local interface and all required interface devices that may include laptop computer, and/or handheld devices. Provide submittal for interface device hardware and software to confirm system configuration and operating system for approval by Owner. Remote processing units shall be capable of communicating with the local terminal. Integrate the new site into the County’s existing EMCS workstation server. Provide licensed software for the EMCS. Provide CD copy of graphics package and programming software to Owner and install at Owner’s central EMCS control station.

10. All control dampers critical to emergency systems operation shall fail to the position required to allow this system to operate (fail safe operation).

J. Commissioning

1. Requirements for the HVAC system commissioning process shall be included in the construction contract. An independent Commissioning Authority may be hired by the Owner through the Architect’s contract. The ASHRAE standard or other industry recognized guidelines for commissioning shall serve as the basis for all HVAC commissioning and the guidelines will be tailored to the specific requirements of the project.

2. The Architect and Mechanical Engineer and Commissioning Authority will perform reviews of the HVAC system design from a commissioning perspective at all review
phases of the design process, and will cooperate fully with the Owner’s Commissioning Authority throughout the design review process as applicable.

3. The contract specifications must clearly spell out the responsibilities of the General Contractor and all appropriate subcontractors relative to commissioning, and shall also define the role of the Commissioning Authority.

4. The Architect and Mechanical Engineer shall coordinate and cooperate fully with the Owner’s Commissioning Agent and with DPWES representatives throughout the actual HVAC system commissioning process prior and subsequent to, system acceptance. The Architect and Mechanical Engineer shall provide all design and or system information that is requested by the commissioning team members and respond to all comments from the Commissioning Authority from design through system acceptance.

II. PRODUCTS

A. Mechanical Equipment Preferences

1. Below are listed preferred equipment brands for which supply of repair parts exist (specifications shall include at least three acceptable equipment options for competitive bidding, unless a limited source procurement is approved in advance by the owner):

   a. **Chillers:** Trane, Airstack or Carrier (coordinate with the Owner for the most recent updates) (No Equals or Substitutions)

   b. **Cooling Towers** Baltimore Aircoil, Evapco, or Approved Equal

   c. **Pumps:** Bell Gossett, or Approved Equal

   d. **Non Condensing Boilers:** Natural gas/#2 oil Fired Burnham 4F or Approved Equal

   e. **Condensing Boilers:** Aerco, Veisman; or Approved Equal (based on technical specs including turndown ratio)

   f. **Air Handlers:** Trane, Carrier, AEI, Liebert, Valant or McQuay

   g. **VAV Boxes:** Titus, Trane, Nailor, or Approved Equal (Electronically controlled)

   h. **EMCS:** 1. Trane
      2. Siemens
      3. Automated Logic
4. Delta
(No Equals or Substitutions)

i. **Rooftop Units:**
   Trane or Carrier

j. **Variable Frequency Drives:**
   Yaskawa, Danfoss ABB, or Square-D

k. **Baseboard Heaters:**
   Trane without Dampers, or Approved Equal

l. **Underground Storage Tanks:**
   Double wall, urethane coated steel. Act 100U, Type II, and approved by U.L.58 for underground storage of motor fuel. Double wall welded steel with a primary (internal) tank and a secondary (external) tank; as manufactured by (Highland, General Industries or Approved Equal). UST shall include quick release filler neck; 9 water tight raised access to filler neck; and shall support accessory equipment including drop tubes, two tank sumps, and submersible removable pumps. UST design shall allow for continuous monitoring of the interstitial spaces between the two walls and the two manways.

m. **Fuel Storage Monitoring and Leak Detection System:**
   Veeder Root Model TLS-350
(No Equals or Substitutions)

n. **Submersible Fuel Pump:**
   Redjacket (submerged turbine); or Approved Equal

o. **Fuel Dispensers:**
   Gas Boy (No Equals or Substitutions)

p. **UST Fill Caps and Overflow Devices:**
   Ohio Pipe Works (OPW) Model 2100 overfill containment basin (5 gallon); or Approved Equal

q. **Fire Station Diesel Exhaust Extraction System:**
   Plymovent (No Equals or Substitutions) A/E to specify appropriate temperature rating.

**B. Plumbing Equipment Preferences**

1. For plumbing systems, American Standard, Kohler, or Moen fixtures with Sloan or Zurn flush valves are preferred. Provide ball type shut off valves to isolate individual rest room areas and provide access to valves in janitor's closets adjacent to rest rooms.

2. All plumbing fixtures shall be specified and installed to be compliant with ADAAG requirements.
3. Provide service valves to enable segmented shutdown of building's water lines. Provide repair kit for any non-standard type plumbing fixtures and faucets.

   a. Water Closets: Water closets should be floor mounted. Kohler, Model #k-4262-ET; or Approved Equal

   b. Urinals: Low flow as approved by Fairfax County Project Manager and as needed for water savings.


   d. Flush Valves: Sloan or Approved Equal
   Dual flush or low flow valve as appropriate to meet water savings requirements in water closets and urinals. Waterless urinals NOT permitted.

   e. Frost Free Hydrants: Josam, Woodford, or Approved Equal

   f. Vitreous China Fixtures: American Standard, Kohler, Zurn, or Approved Equal
   Integral bowl w/ solid surface preferred.

   g. Garbage Disposers: Insinkerator (I.E.S.); or Approved Equal

   h. Valves: All valves 2” and smaller should be ball type valves

   i. Dry Sprinkler Valves: TYCO or Viking

   j. Domestic Water Heaters: AO Smith, State, PVI, or Lochinvar
   (No Equals or substitutions)

   k. Domestic Booster Pumps: Bell and Gosset, Tigerflow, or Ironheart
   (No Equals or substitutions)

4. Specifications shall identify at least three acceptable plumbing equipment manufacturers for competitive bidding; unless otherwise noted herein, or unless limited source procurement is approved in advance by the owner.
III. CONSTRUCTION

A. Coordination Drawings: On projects or substantial size and/or complexity, multiple-discipline shop drawings are to be provided by the Contractor and reviewed and approved by the design team. Drawings shall include all trades to be installed above, ceilings, in shafts, or exposed. Trades to be included but not limited to shall be Mechanical, Electrical, Plumbing, and Telecom.

B. Record Drawings: As-built drawings indicating the final field installation of the mechanical and plumbing systems shall be provided to the County in the latest AutoCAD and .pdf formats.