Beth Israel Deaconess Medical Center

Beth Israel Deaconess Medical Center HVAC Design Guidelines

These guidelines are required as part of a basis of design for all HVAC systems designed for Beth Israel Deaconess Medical Center. The guidelines shall not directly replace MEP Engineering consultant specifications but are intended to convey a set of standards for all projects at the facility. Where applicable codes conflict with these guidelines the code shall supersede these requirements and consultant shall notify the BIDMC Facilities Engineering Department of such conflicts and guidelines shall be updated accordingly. Any deviation from these requirements shall be brought to the attention of the BIDMC Facilities Engineering Department during review with an explanation why it is required or how it may improve the system or systems affected.

HVAC Guidelines Table of Contents

I. Products and Equipment

1. Supply Terminal Boxes

1. Units shall be constructed of galvanized steel not less than 22 Ga. Terminal casing shall be double wall construction with minimum 22 Ga galvanized liner covering fiberglass insulation. Units shall be pressure independent and furnished with integral 3' sound attenuator, tool free insulated bottom access panel, integral multi-point airflow sensor and hanger brackets.
    a. Hot water reheat Coil – Provide with integral 2 row hot water heating coil (pressure drop not to exceed 2(two) PSI).
    b. Electric reheat coil - Provide with integral airflow proving switch, high temperature limit sensor, modulating SCR control, integral transformer, single point power, hinged access panel, integral disconnect and meet all UL and NEC requirements.
2. Acceptable Manufacturers: Enviro-Tec, Nailor, Price, Titus

2. Return/Exhaust Terminal Boxes

1. Units shall be constructed of galvanized steel not less than 22 Ga. Terminal casing shall be double wall construction with minimum 22 Ga galvanized liner covering fiberglass insulation. Units shall be pressure independent and furnished integral multi-point airflow sensor and hanger brackets.
    a. Design note: Provide minimum 16"x16" Merv-8 filter at return grilles of all medium pressure return/exhaust systems serving areas with possible high dust and lint accumulation (patient rooms, laundry area, etc.) to prevent particulate build up at integral airflow sensor at terminal box. Coordinate requirement for filter grille with BIDMC Engineering.
2. Acceptable Manufacturers: Enviro-Tec, Nailor, Price, Titus

3. Room Pressure Monitor

1. Device shall be bidirectional pressure sensing unit. Unit shall be capable of detecting pressure changes within 0.1 seconds using a thermal room pressure sensor and capable of reading as low as 0.00001" wc.
2. At East Campus monitor shall be TSI 8360 with 8694 key switch. On West Campus monitor shall be Siemens series 547-005 for negative pressure applications and 547-006 for positive pressure applications.
3. Coordinate any installation of room pressure monitor with BIDMC Project Manager and BIDMC Maintenance Department to update on-going list.

4. Supply Air/Exhaust Air Valve

1. Valves shall be pressure independent with valve body constructed of minimum 16 Ga aluminum with continuous welded seam (corrosion resistant coatings furnished per project requirements), Teflon coated 316 stainless steel shaft with Teflon coated bearings, operational from 32-120F.
2. Valves shall be provided with variable volume capability unless otherwise coordinated with BIDMC Engineering.
3. Acceptable Manufacturers: Phoenix Controls, Price, TSI

5. Fan Coil units

1. Provide unit with single point power, integral disconnect switch, solid metal liner, 20 Ga 304 stainless steel sloped drain pan, spring isolator hanger brackets, manual air vents at all coils, condensate level switch at drain pan, duct collar on plenum units at supply and return connections, tool free bottom access panel.
2. Unit shall have separate heating and cooling coils unless coordinated with BIDMC Facilities Engineering.
    a. Design note: Condensate high level switch shall initiate alarm at BAS. Depending on FCU location associated cooling coil control valve shall be closed until level alarm has been cleared.
    b. Design note: Provide minimum 16”x16” Merv-8 filter at all associated return grilles of ceiling concealed FCU. Filter shall not be located at FCU return inlet unless specifically coordinated with BIDMC Facilities Engineering.
3. Provide EC Motor at all applications in lieu of PSC motor where possible. Provide with manual and controlled speed adjustment capability.
4. Chilled water coils:
    a. Maximum air velocity at chilled water coil shall 500 FPM.
    b. Water pressure drop shall not exceed 5 (five) PSI at chilled water coil.
    c. Chilled water entering water temperature (EWT) shall be 44°F with a 16°F rise. Coordinate with BIDMC Facilities Engineering for most up to date operating conditions.
5. Hot water coils:
    a. Maximum air velocity at hot water coil shall be 750 FPM.
    b. Water pressure drop shall not exceed 5 (five) PSI at hot water coil.
    c. Hot water entering water temperature (EWT) shall be 180°F unless otherwise noted. Coordinate with BIDMC Facilities Engineering for most up to date operation conditions.
6. Acceptable Manufacturers: Enviro-Tec, Price, Trane, Williams

6. Registers, Grilles and Diffusers

1. RGD's shall be constructed of aluminum, steel or stainless steel as noted in contract documents. Finish color shall be white unless otherwise coordinated with BIDMC end user and architect. Surfaced mounted RGDs shall have countersunk screws for mounting to ceiling.
2. Maximum sound power level shall be NC30 unless otherwise noted as acceptable by BIDMC Facilities Engineering.
3. Supply linear diffusers shall be furnished with integral plenum with round inlet and all mounting accessories and trim to coordinate with ceiling. All non-active sections of linear diffusers shall be provided with blank off access plate and painted flat black.
4. Opposed blade dampers shall not be installed in neck of RGD unless dictated by lack of space at branch ductwork where volume damper is not feasible.
5. Return grilles with integral filter shall be capable of accommodating 1" or 2" filter and shall have room side access via quarter turn fastener with opposite side hinge. Hinge shall be parallel to long or short side based on field conditions.
6. Provide stainless steel devices at shower rooms or in environments with high moisture content. First 10'-0" of ductwork connected to device shall be stainless steel and shall be pitched back to device to avoid condensation build up at ductwork.
7. Inside of ductwork visible through RGD shall be painted flat black.
8. Acceptable Manufacturers: Price, Nailor, Titus, Tuttle and Bailey

7. Radiant Heating Panel

1. Panel shall be of extruded aluminum construction with integrated heat sinks at top of unit with copper tubing of size and quantity per contract documents. Furnish with ¾"PCF unfaced fiberglass batt insulation on top of panel at ceiling cavity.
2. Finish color shall be white unless otherwise noted by BIDMC end user or architect.
3. Acceptable Manufacturers: Steel Ceilings Inc., Sterling

8. Fans

1. All motors shall be premium efficiency.
2. Provide direct drive motors at all instances possible unless otherwise coordinated with BIDMC Facilities Engineering.
3. AC Motors above ½ HP shall be 480V/3PH unless approved by BIDMC Facilities Engineering.
4. EC (Electronically Commutated) Motors shall be provided at all instances possible. EC motors shall be provided with means of speed modulation and control (Control panel, potentiometer, etc.).

5. Fan shall be suited for specific use (indoor, outdoor, high moisture environment, high temperature, grease, spark proof, etc.)
6. Where belt drive fan must be used and use is approved by BIDMC Facilities Engineering provide fan with spare belt, belt guard, extended lube lines, minimum 80k hour bearings.
7. Acceptable Manufacturers: Greenheck, Loren Cook, Twin City

9. Variable Frequency Drives (VFDs)

1. Unless otherwise noted or coordinated with BIDMC Facilities Engineering all VFDs shall be by Yaskawa. Preferred model Yaskawa Z-1000.
2. Provide CoolBLUE inductive absorber between all VFDs and Motors to minimize motor bearing failures. Quantity and size of cores shall be determined based on motor size (HP).
3. Provide motor with ceramic bearings specifically designed for use with VFDs.
4. VFDs shall be capable of direct interface with DDC control system.
5. When installing new VFDs, contractor shall apply for energy rebates on behalf of BIDMC and coordinate rebate process with BIDMC Facilities Engineering and Energy Management team.

10. Motors and Starters

1. Unless otherwise noted and coordinated with BIDMC Facilities Engineering all motors shall be by Baldor.
2. Unless otherwise noted and coordinated with BIDMC Facilities Engineering all starters shall be by Eaton or Square D.
3. Provide Hand/Off/Auto (HOA) switches at starter for all mechanical equipment with automatic control signals.
    a. Design Note: No Start/Stop on HOA switches on fan starters designated only for smoke control.

11. Insulation

1. Piping insulation:
    a. All hydronic piping insulation shall be fiberglass with all service jacket with installed minimum R-value per latest applicable energy code values. Elbows and transitions shall have PVC fitting covers.
    b. Manufacturers: Knauf, Manville, Certainteed or approved equal.
    c. Flexible elastomeric insulation shall be allowed on all refrigerant piping. Insulation shall be equal to Armaflex, Aeroflex or approved equal.
    d. Where hydronic piping is located directly above, provide PVC insulation cover at lower piping to prevent possible water damage to fiberglass insulation.

2. Ductwork insulation:
    a. Ductwork insulation installed at ceilings and plenums shall be externally wrapped and shall be fiberglass with FSK aluminum foil reinforced vapor barrier jacket. Thickness and installed R-value shall per latest applicable energy code values.
    b. Outdoor ductwork insulation shall have top side tapered with 2" thick foam to avoid pooling at top of ductwork. All outdoor insulation shall be covered with waterproofing membrane. Insulation shall be fastened to ductwork with stainless steel fasteners.
    c. Plenums at mechanical rooms shall be insulated with rigid fiberglass insulation with FSK vapor barrier facing. Insulation shall be attached to plenum ductwork at intervals to avoid peeling.
    d. Acceptable Manufacturers: Certainteed, Knauf, Owens Corning or approved equal.

12. Custom Air Handling Unit

1. Preferred custom Air Handling Unit (AHU) vendor shall be Custom Air Solutions by Cambridgeport. Unit design shall be fully coordinated with BIDMC Facilities Engineering during schematic design and again prior to final construction documents being issued.

2. General Unit Construction:
    a. Unit shall be constructed of aluminum wherever possible (Panels, bases, supports, etc.) and shall be double wall construction filled with minimum 2" thick (3 lbs./C.F.) high density urethane foam at all panels (Walls, floor, roof) fully filled so that no void exists at interior panel.
    b. Panels and doors shall have true thermal break. Gaskets at panels and doors shall not be acceptable.
    c. Unit shall be factory tested at 100% of design airflow value and 150% (1.5 times) of the design static pressure both positive and negative.
    d. Unit shall be single point power where possible.
    e. Provide weatherproof LED lighting at vestibule and all sections of AHU.
    f. All electrical, fire alarm and piping penetrations at unit shall be done by unit manufacturer at factory prior to shipping and shall be sealed air and water tight. Any penetrations made in the field shall be coordinated with the manufacturer and shall be documented in record drawings.
    g. Steam traps, isolation valves, drains, etc serving AHU shall be mounted at vestibule of unit or safe enclosed location.

h. All access doors shall have swings that act against section pressurization.
i. Fresh air dampers shall be Tamco type SW.
j. Typically OA and Supply air dampers shall fail closed; return air damper shall fail open. Coordinate per specific project.
k. Air blenders shall be of stainless steel or aluminum construction only.
l. All accessories located within airstream of unit shall be of water tight construction and rated as such.

3. Fans:
   a. All supply, return and exhaust fans shall be direct drive.
   b. Where EC Motors are utilized, EC Motor Control Center shall be provided at the AHU service vestibule or in an acceptable location in a mechanical room. Final location of panel not located in vestibule shall be coordinated with BIDMC Facilities Engineering.
   c. Where motors with VFDs are utilized VFD shall be located at AHU service vestibule or in an acceptable location in a mechanical room. Final location of drives not located in vestibule shall be coordinated with BIDMC Facilities Engineering.
   d. Fan sections with multiple fan array shall have N+1 capacity based on total design airflow and static pressure. Each fan shall have individual isolation damper that shall close on fan failure to prevent unit back feeding. Isolation dampers shall be by Tamco and shall be back draft damper (BDD) type unless otherwise coordinated with BIDMC Facilities Engineering.
   e. Where multiple fan arrays are present provide redundant means for control (VFD or EC Motor Control Panel) to provide full fan capacity on loss of a controller.
   f. Acceptable Fan Manufacturers: Mechanovent or EBM Papst.

4. Chilled Water Coils:
   a. Coil shall be certified in accordance with ARI standard 410.
   b. Coil shall have maximum face velocity of 450 FPM.
   c. Coil shall have 3/8" O.D., 0.025" thick copper tubes with 0.0075 thick aluminum fins. Fin spacing shall be based on final capacity selection.
   d. Coil shall have minimum 18 gauge stainless steel double sloped condensate drain panel under entire length of coil. For multiple height coils each coil shall have individual drain pan of similar construction. Drains shall not be combined or cascaded.
   e. Coil shall have removable panel at side for possible removal. Coordinate clearances of coil pull with field conditions.

i. Design Note: Coil shall be sized for 91°F DB, 73°F WB 100% OA EAT with 50-55°F DB LAT. Coordinate LAT requirements with areas being serviced by AHU.
ii. Provide CHW bypass valve around control valve.

f. Provide flow meter at CHW Return piping. Meter shall be connected to DDC for monitoring.
g. Provide wye strainers at control valves or inlet to AHU greater than 5 tons (60,000 BTU).

5. Heating Coils (Steam):
    a. Coil shall be certified in accordance with ARI standard 410.
    b. Coil shall have maximum face velocity of 750 FPM.
    c. Coil shall be 1.0" tubes of 0.049" tube wall thickness seamless copper with 0.0075 thick aluminum fins.
    d. Coordinate height of steam heating coil mounting to provide proper pitch at associated steam trap. Bottom of steam outlet (condensate) shall be a minimum of 14" above unit floor.
    e. Provide 1/3, 2/3 control valve set up.
    f. Coil shall have removable panel at side for possible removal. Coordinate clearances of coil pull with field conditions.
    g. Design Note: Steam pre-heat coil shall be sized for 100% OA with 5 PSIG LPS, 0°F EAT, 55°F LAT.

6. Filter Section:
    a. All filter rack framing shall be minimum 16 Ga stainless steel, permanently gasketed and of rugged construction to properly support all filters and subsequent replacements. Final filter rack shall be HEPA frame bolt housing unit and shall be capable of housing 95% or 98% filter media.
    b. Provide filter media as listed on construction documents. AHU Manufacturer shall provide two (2) sets of filters (1 set for use during start-up and balancing and 1 set for initial space usage) unless otherwise noted.
    c. Units where all filters are not able to be replaced from single side unit shall have access doors at each side of filter section.
    d. Provide magnehelic differential pressure gauge at all filter racks. Where located outdoors provide suitable weather resistant enclosure.
    e. Maximum face velocity and pressure drops shall be as noted in table below. Additional 0.2-0.75" of pressure drop shall be added into the design for dirty filter calculations.

Filter Velocity and Pressure Drop		
Filter Type	Max Face Velocity	Pressure Drop Range
2" Filter Media	250-500 FPM	0.1-0.4"
4" Filter Media	300-600 FPM	0.1-0.4"
HEPA (Standard)	200-300 FPM	0.3-0.9"
HEPA (High Capacity)	300-500 FPM	0.8-1.3"

7. UV Lighting:
    a. UV light shall be high output, HVAC-type, germicidal UVC light source, factory tested and assembled. Unit shall include housing (304 Stainless Steel), reflector (Aluminum alloy minimum 85% reflectance), high efficiency electronic power source, emitter sockets and emitter tube.
    b. Electrical connection shall be part of single point power connection and shall be wired by the AHU manufacturer prior to shipping to site.
    c. UV Light and associated conduits shall be weather tight.
    d. UV Light shall be located downstream of cooling coil.
    e. UV light shall be provided by Sanuvox or approved equal and shall be integral to unit. Safety switch shall be installed at associated door with caution/warning label.

13. Labeling and Identification

1. All ductwork, piping and equipment installed shall be clearly labeled for identification. All labels shall be in accessible and visible locations.
    a. Piping - Provide pre-fabricated semi-rigid plastic labels mechanically fastened directly to insulation color coded as noted in table below. Labeling shall occur at a minimum of every 20 linear feet of straight run and at every section of piping less than 20' in length and at both sides of all penetrations through floors or walls. Label shall have 2" high lettering on piping 4" and larger and ¾" high lettering on piping 3" and smaller. Provide similar sized flow arrow labeling stating direction of flow at same occurrences. Paint/stencil at similar distances shall be an acceptable means of identification. Vinyl stickers shall not be allowed.

HVAC Piping Identification Labeling	
System	**Label**
Heating Hot Water Supply/Return	HHWS/R
Chilled Water Supply/Return	CHWS/R
Steam/Condensate	LPS/MPS/LPC/MPC
Fuel Oil Supply/Return	FOS/R

b. Ductwork - Provide ductwork labeling minimum of every 20' of straight run and at every section less than 20' in length and at both sides of all penetrations through floors or walls. Labeling shall include system name (Supply/Return/Exhaust, abbreviations acceptable), ductwork source (AHU-1, ERU-1, EF-1, etc) and direction of flow. All lettering shall be a minimum of 2" in height.
    i. All fire dampers, smoke dampers and combination fire/smoke dampers shall be labeled as such with permanently mounted labels minimum of 1" high lettering. Associated access panels shall be labeled in a similar fashion.

2. Equipment Nameplate – Provide metal with data engraved or stamped nameplate mechanically fastened to equipment.
    a. Data listed shall include, but not be limited to: Manufacturer, product name, model and serial number, capacity, operating and power characteristics and all tested compliances.
    b. Equipment Marker – Provide engraved laminated plastic label mechanically fastened labels on all equipment. Labeling shall be consistent with construction documents and coordinated with BIDMC Facilities Engineering for any revised equipment naming standards. At mechanical rooms with ceilings above 10'-0" provide sufficient sized labeling legible from floor level.
    c. Information on label shall include, but not be limited to: Equipment name (abbreviation), associated plan number, area served by equipment, and design capacity.

14. Hydronic Piping

1. Mechanical press to fit piping (such as Pro-Press) shall not be used unless coordinated and approved by BIDMC Facilities Engineering.
2. Piping 2" and smaller shall be copper.
3. Piping 2 ½" and larger shall be black steel schedule 80.
4. Piping shall be designed for a pressure drop between 1' to 4' per 100'.
5. Hydronic piping located in ceilings above occupied spaces shall have velocity no greater than 4 FPS. Hydronic piping located in larger mains, mechanical rooms and shafts shall have velocity no greater than 10 FPS.
6. Provide automatic air vents and parallel manual vents and pressure gauge at all high points in hydronic systems. Provide air separator in closed systems that are isolated from MATEP system.
7. Solid brass caps shall be furnished at all drain and blow off valves
8. Provide isolation valves (refer to HVAC specification for types and size) at each floor and at all equipment to allow for servicing of components.
9. Provide submittal listing all isolation and services valves, as well as associated valve tag information, for each project. Submittal should

include master sheet which shall be mounted in associated mechanical room.

15. Steam and Condensate Piping

1. Steam pressure classes shall be defined as follows:
    a. Low pressure: 0-15 PSIG
    b. Medium Pressure: 16-100 PSIG
    c. High Pressure: 100 PSIG and above
2. Steam condensate piping shall be schedule 80.

16. Ductwork

1. Ductwork shall meet the latest SMACNA standards for all construction and pressure testing requirements.
2. All ductwork elbows and transitions shall be smooth full radius where space permits to minimize static pressure drops. Hard (mitered) elbows with turning vanes shall be used only where there is not sufficient space for full radius elbows.
3. Typical low pressure and medium pressure ductwork shall be constructed of minimum 22 Ga G-90 galvanized steel.
4. Flexible ductwork shall be limited to final RGD connection and shall not exceed 3'-0" or greater than a 90° angle to minimize additional pressure drops. Provide duct support at elbow of flexible ductwork to prevent sagging at ceiling.
5. Ductwork lining (acoustical or insulation) shall not be used unless coordinated and approved by BIDMC Facilities Engineering.
6. Refer to table below for recommended airflow velocities and pressure drops.

Low Pressure Ductwork (2" WC and below)		
Duct Location	Max Velocity (FPM)	Max PD ("/100')
Above unocc areas/shafts	1500	0.07-0.10
Above occupied areas	1200	0.07-0.10
Diffuser runout	700	0.08
Medium Pressure Ductwork (Above 2" WC, less than 6" WC)		
Above unocc areas/shafts	2500	0.20
Above occupied areas	2000	0.20
Runout to Terminal Box	2000	0.20

7. Shower exhaust ductwork (and other ductwork of similar moisture exposure) shall be stainless steel for a minimum of 10' from grille. Ductwork shall be pitched back to grille to avoid any moisture accumulation in ductwork.

8. Kitchen exhaust ductwork shall be continuously welded with completely sealed penetrations (liquid and airtight).

II. Design Criteria:

1. Heating Systems

1. BIDMC campus steam shall be used as a heat source, either directly or through conversion to hot water. Steam to hot water heat exchangers and pumps shall be provided if existing hot water system does not have sufficient capacity or are otherwise unsuitable.
2. Steam to HW convertor systems shall include redundant control valves, heat exchangers and pumps. Heating systems shall be designed with a minimum 15% allowance for system warm-up. Valves, unions and fittings shall be configured to allow for service and removal of components.
3. Electric heating systems shall be allowed only where other systems are not feasible and shall be coordinated and approved by BIDMC Facilities Engineering prior to design.
4. Steam Heating Systems:
    a. Review the need for steam metering with BIDMC Facilities and Engineering during schematic design.
    b. Steam traps shall be located in a heated space, outside of airstream.
    c. Large steam coils (those above 1000 lb./hr.) shall include provisions for 1/3 – 2/3 valve control.
    d. Steam control valves shall be sized for approximately 50% of the system operating pressure. Coordinate actual steam operating conditions (pressures) with BIDMC Facilities Engineering prior to final design.
    e. Steam branch piping shall connect to mains at top of piping to avoid carry of any moisture.
5. Hot Water Heating Systems:
    a. Provide 2-way modulating DDC control valves where applicable. Where existing HW system is constant volume with 3-way valves, renovated area shall be designed to match existing. Coordinate with BIDMC Facilities Engineering prior to final design.
    b. Hot water system shall be designed for a maximum hot water supply temp of 180°F. Water delta T shall be minimum 20°F. Coordinate with BIDMC Facilities Engineering for supply water reset temp and schedule of existing HW systems.

2. Cooling Systems:

1. All cooling on the main campus (East and West) shall be served from the central chilled water system (MATEP) where feasible. The addition of an air or water cooled chiller shall be coordinated with BIDMC Facilities Engineering and Energy Management Team prior to design.
2. Review the need for chilled water metering with BIDMC Facilities Engineering during schematic design.
3. Chilled water cooling coils shall be sized for 44°F entering water temperature with a minimum 16°F temperature rise. Coil pressure drop shall be minimized and should not exceed 7 PSI.
4. Provide 2-way modulating DDC control valves where applicable. Where existing CHW system is constant volume with 3-way valves, renovated area shall be designed to match existing. Coordinate with BIDMC Facilities Engineering prior to final design.
5. Provide wye strainers at control valves or inlet to equipment greater than 5 tons (60,000 BTU).
6. Provide main line chilled water wye strainers at take-offs serving floors or areas where fan coils or chilled water equipment below 5 tons is used.
7. Where equipment water has purity requirements (such as MRI) provide process water loop via plate and frame heat exchanger with redundant circulating pumps and redundant inline replaceable filters.
8. DX systems are allowed only where chilled water systems are not feasible or for specific applications (low temperature requirements beyond chilled water capability, backup for highly sensitive equipment, etc).
9. Once-through water cooled systems are not allowed except as emergency backup to critical systems per applicable code. Notify BIDMC Facilities Engineering of proposed design and required permits during conceptual design phase.

3. Equipment Accessibility

1. Design layout shall allow for maintenance and replacement access to all new equipment and shall not impede current access to existing equipment.
2. Follow all required clearances per manufacturers recommendations at all instances to allow for proper equipment operation and maintenance.
3. All equipment shall be installed with clear area for the full swing of associated access doors.
4. For equipment installed above a drop (ACT) ceiling, provide a clear 2'x2' work area in front of any equipment access panel for maintenance.
5. For equipment installed above a hard ceiling (gypsum board) provide a minimum 16"x16" access panel at the ceiling with access to the 2'x'2 clear area for equipment.

6. Provide minimum 12”x12” access door at ductwork for all fire dampers and all combination smoke fire dampers with access to fusible link.

4. Air and Water Balancing

1. Preferred balancing contractors for BIDMC are:
    a. Kevin S. Cox Associates, Inc. – (617) 268-8333
    b. J.F. Coffey Associates, Inc. – (781) 934-5200

2. Pre-Construction Balancing:
    a. Prior to the start of demolition pre-construction airflow and static pressure readings shall be taken by the balancing contractor at all key locations as noted by the mechanical engineer on associated HVAC drawings.
    b. Pre-construction readings shall be taken with the system over-ridden in the cooling mode to simulate maximum system operating conditions. Any deficiencies obtained from review of the pre-construction balancing report shall be immediately addressed.
    c. Profiles of existing equipment (Fan, AHU, terminal box, etc) directly serving the HVAC system being modified in the current project shall be provided.
3. Final Balancing:
    a. Once construction of the HVAC system is complete final balancing shall be done by the balancing contractor as per the HVAC drawings. For spaces requiring certain pressurization relationships final balancing shall not be completed until construction of the associated spaces are complete (including all sealing of walls, windows, ceilings, doors, etc) to ensure accurate pressure relationships.
    b. Affected spaces:
        i. During final balancing all systems not in scope affected by work done in the current project shall be rebalanced to the original values obtained during pre-construction readings.
        ii. Low pressure exhaust systems serving multiple floors shall include a full profile of the associated fan including operating CFM, operating static pressure, amperage, fan speed and any original design information listed.
4. Formatting:
    a. All balancing reports shall be formatted using standard BIDMC Template as noted in Portal. Copy available here.

5. Energy Efficiency

1. Energy efficient features should be included in all BIDMC projects where possible and all projects shall meet the latest applicable energy code and

ASHRAE Standards. Coordinate all energy savings strategies and possibilities with BIDMC Facilities Engineering and Energy Management Team. HVAC energy saving measures shall include, but not be limited, to the following:

a. Heat Recovery at all AHUs (DX Heat pipe, plate and frame heat exchanger, desiccant heat wheel, etc).
b. Use of VFDs and EC motors at all applications (Fans, pumps, etc).
c. Control Strategies (Unoccupied mode turndown, DAT Reset, Enthalpy economizer.)

2. All energy saving measures eligible for rebates through Mass Save shall be filled out and submitted by the contractor and credited to BIDMC. Refer to Mass Save website for more information. Coordinate rebate filing with BIDMC Energy Management Team.

III. Building Automation System (BAS)

1. Acceptable Manufacturers:

1. Siemens (East and West Campus)
2. Honeywell (West Campus)
3. Johnson Controls (East Campus)
4. Where there is an existing DDC manufacturer other than those listed above present at an area of renovation further use of said manufacturer shall be coordinated with BIDMC Facilities Engineering prior to specifying on contract documents.

2. General BAS Requirements:

1. All projects shall utilize electronic Direct Digital Controls (DDC). The use of pneumatic controls shall be reserved for specific renovations only where pneumatics currently exist and are not in the scope of the project to be replaced. Coordinate with BIDMC Facilities Engineering and BIDMC Building Automation Engineer.
2. All line voltage power (120V, 277V, etc) supplied to any BAS equipment shall be provided and installed by the electrical contractor.
3. All low voltage wiring (24 VDC, 0-10mA, etc) shall be provided and installed by the ATC contractor.
4. ATC contractor shall coordinate all power requirements for valves, actuators and all other control devices requiring power with electrical contractor.
5. ATC contractor shall coordinate all devices requiring mechanical interfacing (duct mounted sensors, hydronic well sensors, etc) with mechanical contractor.
6. All ATC equipment shall be on generator backed (emergency) power. Coordinate with electrical contractor and BIDMC Facilities Engineering.

7. All new DDC Field Panels installed on the East Campus must reside on the East Campus BAS Fiber Optic Network, NOT the hospital network. Notify BIDMC Building Automation Engineer prior to start of work. Fiber optic network switch ports will be assigned by the Building Automation Engineer to the BIDMC Project Manager.
8. ATC contractor shall provide a 1 year warranty on all BAS labor and materials. Warranty shall be good for 1 year from date of acceptance of product with all labor and materials provided, or adjusted, to remedy the issue at the cost of the ATC contractor.
9. Any new IP address on the West Campus shall be requested by the Building Automation Engineer.
10. All fiber optic terminations will be labeled inside of the fiber optic enclosure. Standard fiber optic switch is:
    a. Contemporary controls, model EIS6-100T/FC, Model EIS8-100T
11. Smoke dampers located on the east campus utilize a MODBUS communications protocol between the fire alarm system and the building automation system. Any smoke dampers added or removed must be reflected in both system data bases.

3. Extension of existing BAS

1. Any new BAS work shall become an extension of the existing BIDMC automation system. All new work shall integrate seamlessly with existing front end/user interface.
2. All new work shall be able to be viewed and controlled from existing front end/user interface.
3. ATC contractor shall become familiar with all existing BAS sequences and shall coordinate all new sequences with existing prior to final programming.
4. Existing Local Area Network (LAN) shall be extended to new area of scope as necessary.
5. All projects with an added scope of controls above what is existing may require a new local point of termination such as a DDC Field Panel (DDCFP) which shall connect back to the main hospital BAS via LAN connection. Coordinate unique IP address with BIDMC IT Department and Facilities Engineering.
6. Coordinate location of new DDCFP with Building Automation Engineer and BIDMC Facilities Engineering during design, prior to installation.

4. Graphics

1. All BAS Front end graphics shall be reviewed and accepted by the Building Automation Engineer and BIDMC Facilities Engineering prior to completion of project.
2. Provide interactive graphics that match existing BAS and accurately represent all new equipment installed. All control points installed shall have proper graphical representation.

3. Provide a link on graphics that will display the applicable control sequence.
4. On larger equipment (AHU, riser diagrams, etc) provide graphics that accurately describe the orientation of the equipment.
5. Existing graphical floor plans shall be updated within BAS with most recent from current project. If floor plans do not exist new ones shall be added to the BAS. Floor plans be fully interactive and shall include room layout and numbering, unit locations and thermostat locations. Coordinate all graphic requirements with BIDMC Building Automation Engineer prior to start of work.

5. Direct Digital Control Field Panel (DDCFP)

1. DDCFP shall be provided by the ATC contractor and shall be on generator backed power protected by UPS. Panel shall be located in a conditioned space local to area served. Final location shall be coordinated with BIDMC Facilities and Engineering.
2. Panel shall be given a specific IP address, Subnet Number and Gateway number from BIDMC Information and Technologies Dept and coordinated with BIDMC Facilities Engineering.
3. All DDCP shall be labeled with panel number at front of the enclosure.

6. Submittals and Documentation

1. ATC contractor shall provide a full set of submittals within 30 days of contract award unless otherwise coordinated with project team. Submittal package shall include, but not be limited to:
    a. System Architecture – Provide riser diagram of new DDCFP locations and tie in points to existing BAS including unique IP Addresses.
    b. Job Specific Sequences – Provide control sequences customized to the specific project including all sequences on contract documents and any necessary revisions to any existing house systems (AHUs, pumps, etc.).
    c. Control Valve Schedule – Provide schedules for all heating, cooling and humidification control valves.
    d. Master Bill of Materials – Provide a list of all equipment with quantities and model numbers.
    e. Brochure/Catalog Information – Provide cut sheets on all equipment being installed. Pertinent information shall be highlighted for easier reference.
2. During close out process provide a complete set of ATC As-Built diagrams with operating sequences in both electronic and hard copy format. As-builts shall be revised during construction and final set shall reflect actual installations.
3. Provide a separate hard copy of As-Built control diagrams to be located in associated DDCFP.

7. Controls Design Standards

1. No more than 3 rooms that share a common use and load profile shall be controlled by a single wall thermostat.
2. Patient rooms shall have individual thermostats per room.
3. All zones serving non-patient areas shall have night-time/unoccupied setback controls. Coordinate schedules and sequencing with BIDMC Energy Group.
4. Where perimeter radiant heat (fin tube radiator, radiant heating panel, etc) and airside/house air are both present in the same room they shall be controlled by the same DDC thermostat to prevent simultaneous heating and cooling. Radiant heating shall be the first stage of heating with associated heating control valve modulating open on a drop in space temperature and the airside/house heating control valve modulating open on a continued drop in space temperature.
5. Air Handlers that are not constant volume with specific temperature and humidity requirements shall have setback and morning warm-up control sequences. All setback and warm-up sequences shall be coordinated with BIDMC Facilities Engineering.
6. At custom AHU, mixed air temperature shall control the OA and return dampers; heating coil leaving air temperature shall control heating control valve; discharge air temperature sensor shall control cooling coil control valve.
7. Control valves shall match existing DDC control valves currently within the building and be installed in an accessible location with isolation valves and unions for removal.
8. Steam DDC control valves shall be installed at 60° angle or less to prevent heat from damaging actuator.

END OF GUIDELINE