233200 HVAC EQUIPMENT

Part 1 – GENERAL

1.1 Description

A. This section details the guidelines and expectations for the design and installation of various associated HVAC equipment on Johns Hopkins University Homewood Campus. Project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification and approval from the JHFRE Engineering and Energy Department, it is expected that these guidelines will govern the design and specifications.

1.2 Submittals

A. The designer shall prepare a Life Cycle Cost Analysis to determine the heating and cooling systems, fuel sources and major system components. The analysis must conform to the life cycle cost and energy criteria specified in Chapter 6 of ASHRAE 90.1.

B. Contractor shall provide Certified Ratings conforming to the latest edition of the Air Movement and Control Association (AMCA) 210, 301-06, 310, 500-D, 500-L and AHRI 410 and 430. All electrical components and assemblies shall comply with National Electrical Manufacturer's Association (NEMA) Standards. AHU internal insulation shall have a flame spread rating not over 25 and a smoke developed no higher than 50 complying with NFPA 90A. AHUs shall comply with NFPA 70 and the National Electrical Code as applicable for installations and electrical connections of ancillary electrical components. AHUs shall be UL Listed.

1.3 Quality Assurance

A. For perimeter occupied spaces, such as offices, laboratories, operation spaces and public spaces, if the heating load calculations indicate a perimeter heat loss greater than or equal to 200 BTUs per linear foot or where there are windows, these areas shall be served by terminal units with hot water heating coils. Heating shall be served by a heating water system, a heating water system from a steam to hot water heat exchanger utilizing campus steam or low-pressure steam depending on systems already in use in the building. Control valves shall be 2-way modulating for all units. Thermostat shall be located within 10 ft of the exterior wall. Provide radiant heating panels where the heating load cannot be met by terminal unit reheat coils or where existing radiant heating panel systems are present.

B. All interior occupied spaces shall have heat provided, if they do not otherwise have warm-up capacity when conditioning rooms under roofs or above exposed floors. Supply valves shall be controlled by a local thermostat.

C. At a minimum, if any utility or other non-occupied space could be subjected to freezing conditions, provide heating terminals which are utility in nature such as suspended unit heaters or fan coils. Room Thermostat(s) shall be located within 10-feet of the exterior wall or at an appropriate location depending on the most critical point of freezing potential such as near ventilation opening(s).

1.4 Delivery and storage

A. Material deliveries and storage areas to be approved by Owner.

B. Material storage to comply with manufacturer's recommendations.

C. Modular AHUs shall be completely factory assembled and tested prior to shipping. Whenever possible, AHUs shall be shipped as a single factory assembled piece. However, due to space and/or accessibility restraints or shipping size limitations, it may be required to disassemble the AHU at the factory and reassemble the modular AHU sections in the field. Include within the specifications that reassembly of modular units, installation training, and field inspection shall be conducted by the AHU manufacturer with a report submitted for JHFRE approval. Reassembled AHU shall maintain factory leakage and performance integrity.

1. AHUs shall be specified to be furnished with sufficient gaskets and bolts for reassembly in the field by the contractor. Specifications shall require that a factory-trained service representative, who is knowledgeable in the manufacturing, servicing and maintenance of the equipment shall be contracted to supervise the lifting, rigging and field assembly process to ensure a quality installation.

Part 2 – PRODUCTS

2.1 General HVAC Equipment

A. Preferred manufacturers:

1. Lennox
2. Daikin
3. Carrier
4. Trane
5. York

B. Maintenance Material Requirement:

1. Filters: One (1) spare set of filters for each filter location.
2. Gaskets: One set for each access door.
3. Fan and motor assemblies: One complete fan and motor assembly for each fan array (supply and return/exhaust).
4. Array Controller: Spare controller for each size and type.
5. Disconnects: One set of fuses for each disconnect.

6. Energy recovery wheel: One motor, one fuse and one drive belt for each energy recovery wheel.

7. Breaker: One spare (new in box) breaker for each circuit associated with the unit.

C. Exterior panels shall be fabricated from 16 gauge galvanized steel. The casing shall be of the no-through-metal design. The casing structure shall incorporate insulating thermal breaks as required so that, when fully assembled, there is no path of continuous, unbroken, metal-to-metal conduction from inner-to-outer surfaces. Provide necessary support to limit casing deflection to 1/200 of the narrowest panel dimension. All panel seams shall be caulked and sealed for an airtight unit. Leakage rates shall be less than 1% at design static pressure or 8" whichever is greater. Exterior units shall have rain gutters for access doors and factory applied epoxy coating suitable for expected exposures.

D. Flexible connections shall have stainless steel double braided exterior with stainless steel corrugated interior. Stainless steel shall be a minimum grade of 304SS or higher. Flexible connectors shall have restraining guide bolts to prevent excessive movement or loss of alignment. Provide flexible connectors at connections to all chillers, pumps, cooling towers, and other equipment that moves or vibrates.

E. Factory-supplied (enclosed and gasketed), vapor tight, light fixtures shall be provided for all access, mixing box and fan sections. There shall be a minimum of two fixtures per section, evenly spaced for each module. Fixtures shall be complete with junction box, globe, aluminum globe guard, bulb, conduit and switch (on exterior wall of unit), with one switch per unit module. Light switch shall be located on access door side of unit. Lights shall be field wired and will require a 115/1/60 power source separate from the main power to the unit, permitting operation during periods of unit shutdown. Provide a pilot light at the switch to signify from the outside of the unit whether the interior lights are on or off.

F. All HVAC equipment shall be provided with auto-restart capability, unless directed otherwise by JHFRE.

2.2 HVAC Fans

A. Fans shall typically have an electronically commutated motor or be provided with variable frequency drives.

B. Direct drive fans are generally preferred. For belt driven fans, include within the specifications, the Contractor shall, after Testing and Balancing has been completed and accepted by the University, replace the factory-supplied variable pitch sheaves with fixed pitch sheaves.

C. Fans shall be at a minimum coated with a baked on phenolic coating. More resistant finishes may be required depending on function. Fan sections shall be equipped with access doors on both sides of the section.

D. Provide heavy duty, grease lubricated, precision anti-friction, self-aligning, ball, roller, or tapered double spherical roller, pillow block type bearings. Bearing shall be selected for a minimum life

of 200,000 hrs. Grease fittings shall be located to provide accessibility if applicable. Bearings requiring extended grease lines shall have lines run to the fan support bracket on the drive side.

E. For multiple fans on a common header provide each fan with an isolation damper on the inlet or outlet (depending on application and arrangement) to prevent it from turning the opposite rotation when the fan is off.

F. Motors on all HVAC shall be inverter duty allowing for the installation of a VFD.

G. Provide return fans where pressure loss exceeds 0.5 inches water column (w.g.) in return duct runs. House systems' Return Air shall use the ceiling plenum concept unless special conditions are required. Spaces requiring acoustical isolation may require ducted return and/or Z transfer ducts and shall be considered in the design. Ducted return may also be required to attenuate excessive fan noises if the mechanical room is located adjacent to the spaces.

2.3 Air Terminal Units

A. Supply air terminal units shall be pressure independent type. Controls shall be direct digital type as manufactured by the BAS vendor with 24-volt actuation. Unit shall be double wall construction with factory installed insulation. Provide access doors in unit casing.

B. All terminal units shall be located so easy accessibility for maintenance is provided.

C. Exhaust air terminals shall be provided for all laboratory exhaust. General exhaust terminals shall be similar to retrofit terminal units. Exhaust terminals serving fume hoods, biosafety cabinets and animal vivarium shall be fast acting type.

2.4 Central Heating Equipment

A. Design and selection of central heating equipment shall include consultation with the JHFRE Engineering and Energy group and comply with SECTION 235200.

B. Controls for central heating equipment such as boilers shall have BACNET capability.

2.5 Central Cooling Equipment

A. Design and selection of central cooling equipment (Chillers and Cooling towers, etc.) shall include consultation with the JHFRE Engineering and Energy group and comply with SECTION 236416.

B. Controls for central cooling equipment such as chillers and cooling towers shall have BACNET capability.

2.6 Central HVAC Equipment

A. Air Handling Units

1. Type, configuration and manufacturer selection shall be coordinated with the JHFRE Engineering and Energy group depending on the application. Consult with the JHFRE to determine if full N+1 redundancy is required.

2. Heat reclaim methods shall be utilized wherever possible.

3. Air handling units shall be double wall, corrosion resistant, sheet metal panel construction with thermal breaks at connections. Units shall be modular construction. Sections shall be complete with self-supporting framing. All units shall be specified to be 100% bolted construction.

4. Units shall typically be provided with a preheat coil, cooling coil, pre and final filters and a fan section. Units shall be provided with variable frequency drives.

5. Ease of maintenance shall be a strong consideration in the AHU configuration design. On drawings, the manufacturer's coil pull area as well as the perimeter and headroom required to perform maintenance on the equipment including filter changes, belt changes, motor replacements, controls repairs, coil cleanings, etc. must be identified. Unit shall be provided with at least 24” access space upstream and between sections that will require sensor installations, inspection and cleaning. Provide service windows and service lighting at each accessible section. Strategically placed flanges/unions for ease of maintenance and for damaged coil removal without affecting water flow through the remaining active coils, cutting pipes or moving headers.

6. AHU filter sections shall be angled to improve system efficiency. Coordinate with JHFRE if space constraints limit the use of angled filter sections to select an alternate approach, such as flat sections. Rigid Filter Media shall be 4 inches deep and shall have a minimum efficiency rating of MERV 13 (greater than 80% per dust spot test) as determined by ASHRAE Standard 52.2. Filters shall be of the mechanical type. The use of electro-mechanical (electrostatic) filters is prohibited. Factory fabricated filter sections shall be of the same construction and finish as the unit. Face loaded pre and final filters shall have type 8 frames as manufactured by AAF, FARR or equal. Side service filter sections shall include hinged access doors on both sides of the unit. Internal blank-offs shall be provided by the air handling unit manufacturer as required to prevent air bypass around the filters. A Magnahelic, differential pressure gauge shall be factory installed and flush mounted on the drive side of the filters to measure the pressure drop across the filters. The gauge shall be permanently marked for proper operating range. The contractor shall indicate the clean filter marking on the gauge or AHU to facilitate maintenance, timing filter changes and performing general evaluations.

a. Any 100% Outside Air Make-up filter section shall include a minimum efficiency reporting value MERV 8 with greater than 30% per dust spot test pre-filters in addition to the MERV 13 final filters. Consult JHFRE High Performance Healthy Building Standards for further details and recommendations on filter preferences.

7. Mixing sections/Air Blenders shall be considered in systems mixing recalculated air with outside air. Provide dampers to modulate the volume of outdoor and return air that are rated for a maximum leakage rate of less than 0.10% of airflow at 1.0” static pressure. The mixing box section shall have an access door. The mixing box arrangement shall allow for adequate mixing of outdoor and return air to prevent stratification and nuisance tripping of the freeze-stats.

8. Cooling coil selections shall be selected for a 16° F rise at peak conditions. Entering water shall be 45°F and leaving water shall be 61° F. Cooling coil framing and drain pans shall be constructed with non-corrosive material. Freeze protection shall be provided on all applications where

coils are subject to freezing. All coils shall have a maximum face velocity of 500 fpm. Coils shall be provided with maintenance bypass sized for the full coil capacity. The maximum pressure drop through the coils at full flow shall not exceed 20 feet of water.

a. For 100% Outside Air (OA) Units only, provide an integral face-and-bypass coil for the outside air preheat process. This will prevent coil freeze-up, stratification and control problems since there is constant flow through the coil.

9. Coils shall be constructed of seamless copper tubing mechanically expanded into fin collars and mounted on a stainless-steel support rack to permit coils to slide out individually from the unit. All fins shall be continuous within the coil casing to eliminate carryover inherent with a split fin design. If coil height exceeds 42”, or coil length exceeds 10’, or weight exceeds 600 pounds, then coils shall be selected of equal size sections to be smaller or lighter than these size/weight limitations to allow for ease of removal/replacement. Coil isolation valves shall be located on the branch lines of each coil supply and return header on the header side of the union/flange so as to allow for isolation and removal of the damaged coil while leaving undamaged coils in operation throughout the removal and installation processes.

10. Standard steam coils shall be constructed of seamless copper tubing mechanically expanded into fin collars. Fins shall be die-formed plate type. Headers shall be seamless copper with die-formed tube holes. Connections shall be male pipe thread (MPT) Schedule 40 Red Brass. Steam pressures above 50psig will have opposite end connections. A maximum fin length of 120” shall have same end connections. Intermediate tube supports shall be supplied on coils over 44” in length, with an additional support every 42” thereafter. Standard coils construction shall be suitable for 25psig steam pressure.

11. Dampers shall be high performance, low leakage airfoil type with DDC actuation. Shaft bearing holes shall be machine punched and fitted with 1” O.D. heavy duty nylon bearings to eliminate friction and any metal-to-metal contact.

12. All sections of the AHU shall each have a full-width, sloped, drain pan that extends downstream enough to provide sufficient space to contain moisture carryover or condensation. With drain pans installed in all sections, there is easy access for maintenance and cleaning (sweeping and washing) of coils, filter sections and fan sections in order to maintain equipment efficiency and performance. Drain pans shall be IAQ type (double sloped) to assure positive condensate drainage. The pan shall have a double wall construction with a stainless-steel liner and shall have a minimum of 2” of insulation (uncompressed). The pans shall have a minimum depth (free-board) of 4”. Drain pans shall be furnished with a drain connection on one side of the AHU. If clearance issues arise during the design process and adequate housekeeping pad dimensions cannot be achieved, it may be necessary to consider core drilling through the mechanical floor to install the traps in the room.

a. Minimum drain connection size for all sections shall match air handler manufacturer provided connection. Condensate traps shall be provided for the cooling coil and humidifier (if applicable) sections only. Heating coil, access, filter, fan and mixing box sections shall be

equipped with drain connections to assist in manual cleaning of interior of unit. Provide ball valve with hose end connection, cap and chain for these drain connections.

13. To the greatest extent possible, mechanical equipment shall be located indoors to maximize useful service life and ease of maintenance. Maintain recommended service clearances for coils, filters and fan.

14. AHUs shall be supplied with one complete set of spare fan belts and filters.

2.7 Fan Coil Units

A. Fan coil units shall be factory assembled complete with, at a minimum, coils, fans, filters, access panels, and stainless-steel double-sloped drain pans for units with a cooling coil. Units are preferred to be provided with hot water heating coils. Fan coil units shall be provided with insulated cabinets, fans with variable speed ECM motors, coils, drain pans and a filter.

B. All fans shall be internally isolated. Provide large access panels for ease of maintenance. To the maximum extent practical, units shall have the option of being shipped with or without pre-piped valve packages for coordination in the field with existing conditions. Fan coil units shall have single point power connections and unit mounted disconnect switch. Units shall be factory tested prior to shipping, and all fans shall be certified by the AMCA. Units shall be AHRI 440 rated.

C. Condensate Drain Pans shall be IAQ, non-corrosive, positively sloped in every plane for efficient draining. Field fabricated or equipment supplied secondary drain pans shall be provided for all fan coil units located above the ceiling. Filters shall be MERV 9 efficient based on ASHRAE 52.2. Filters shall be easily accessed and removable. Condensate pumps serving individual HVAC units shall be fed from the same electrical circuit as the unit.

D. Fan coil units shall be controlled by either BAS or thermostat, depending on the project. Fan coil units shall be selected based on low or medium fan speed. Fan Coil Unit shall have a cabinet-mounted, factory-wired disconnect switch. The fan motor assembly shall be easily removable.

2.8 Humidifier Equipment

A. If campus steam is available at the project site, a Steam-to-Steam (or Steam Exchange) Humidifier is to be used. The Steam Exchange humidifier shall pass house steam through an internal stainless steel heat exchanger producing clean steam vapor at atmospheric pressure with modulating control. The humidifier shall be provided with stainless-steel steam distribution components and an internal 1” air gap and vacuum breaker to prevent siphoning.

B. If campus steam is not available, an Ultrasonic humidifier with a complete water treatment system shall be utilized. The ultrasonic humidifier shall be a self-contained unit with modulating control. The humidifier shall be provided with an AHU system vertical mounting rack (for multiple units).

C. Follow manufacturer’s guidelines for location and sizing of humidifiers.

D. 6’ of stainless-steel ductwork shall be installed where humidifier is installed within ductwork. Slope ductwork to allow drainage and provide a piped drain to the nearest reasonable drainage location.

E. Provide an access panel with a glass vision panel on the downstream side of the manifold.

F. Heat wheels shall be designed for total energy recovery (both latent and sensible) and ensure laminar flow. Heat wheels shall be constructed of lightweight polymer media with a desiccant coating to minimize cross-contamination. The polymer media shall be mounted on a stainless-steel rotor for corrosion resistance. Wheel design shall consist of removable segments for ease of replacement and/or cleaning. Heat recovery drive belt material shall be high strength urethane and shall be factory installed in a pre-stretched state eliminating the need for field belt tension adjustment. Link style belts are prohibited. If carry-over contamination is a concern (other than non-process related relief air, all other heat reclaim exhaust air is a contamination concern), provide a purge section to clear exhaust gases.

2.9 Direct Expansion Rooftop AHUs

A. Direct Expansion (DX) Rooftop Air Handing Units (RTUs) shall be a factory standard packaged or custom packaged, in compliance with the AHU requirements of this FC, combination heating and cooling unit suitable for mounting on the roof of buildings. The package shall consist of one or more refrigerant compressors with electric motors, cooling coils, heating coils (as required), condensers, supply fan(s), return fan(s), access doors, control wiring and piping assembled in a weatherproof enclosure (complete with ground fault current interrupter (GFCI) receptacle) mounted on a structural steel base ready for connections to utilities and ducts.

B. All filters shall have a minimum efficiency of MERV 13. All sections shall have hinged access doors with cam or door handle latches. Provide utilities through the base.

C. Unless VFDs are used, units are to be belt driven and provided with an extra set of belts. Casings are to be factory painted enamel, with double wall insulated (minimum 2 inches rigid) construction.

D. All roof mounted equipment installations shall be provided with vibration isolation. For units mounted on roof curbs, they shall be supported a minimum height of 24” above the roof. For units mounted on structural steel, the minimum height shall be 42” above the roof.

2.10 Split System AHUs

A. Where chilled water is unavailable, a combination split system AHU and Condensing unit or a self-contained AHU may be used. AHU shall comply with the standard Air Handling Unit requirements, unless commercially unavailable, and shall be suitable for vertical or horizontal mounting.

B. Self-contained AHUs shall consist of one or more refrigerant compressors, contained within the AHU, with electric motors, cooling coils, heating coils (as required), condensers (contained within the AHU or remote), supply fan(s), return fan(s), access doors, control wiring and piping assembled on a structural steel base ready for connections to utilities and ducts. Split system units shall have a package AHU with matching condensing unit, with electric motors, cooling coils, heating coils (as required), condensers, supply fan(s), return fan(s), access doors, control wiring and piping assembled on a structural steel base ready for connections to utilities and ducts.

C. Refrigerant piping size and routing shall comply with manufacturer's installation requirements, but in no case shall the length exceed 100'.

2.11 Make-Up Air Units

A. Make-up Air Units normally work in conjunction with other systems to provide ventilation air (for make-up air supporting kitchen exhaust for example). These units shall be interlocked with associated exhaust systems to maintain proper building pressure. Make-up Air Units shall comply with the AHU requirements where commercially available.

2.12 Computer Room Air Conditioners

A. CRAC units shall be configured for down-flow operation with EC Motor Technology (preferred, but shall be evaluated) for raised access floor systems and spaced properly per manufacturer's requirements, cooling load demands and engineering analysis. Provide adequate clearance for servicing. The Up-flow Configuration shall be used for solid, non-raised floor applications such as electrical rooms and other areas or depending on the specific application.

B. For belt driven fans, Variable Speed Drives shall be provided for airflow adjustment and equipped with two belts for more reliability in case of a single belt failure. After Testing and Balancing has been completed and accepted by JHU, the contractor shall replace the factory-supplied variable pitch sheaves with fixed pitch sheaves. Units shall be furnished with one spare set of belts and filters or an EC motor/fan. Filters shall be MERV 8 efficient based on ASHRAE 52.2. Filters shall be easily accessible and removable.

C. Optional field mounted Turning Vane shall be provided where required. Provide factory installed condensate pumps to meet drainage requirements. Provide factory furnished Disconnect Switch (locking type). If required, coordinate Emergency Power-Off (EPO) Station operation requirements with NFPA. Fire-stat and Duct Detectors shall be factory furnished. CRAC units installed in occupied locations shall be provided with closed cell interior insulation (if available).

2.13 Heat Pumps

A. Heat pump units shall be assembled with heavy gauge metal zinc coated cabinets with weather resistant baked enamel finish. Two compressors shall be provided, unless not commercially available. Each refrigeration circuit shall have a factory installed thermal expansion valve. All units shall be equipped with some means of capacity control such as hot gas bypass or compressor unloading.

B. Heat pumps shall be provided with the following safety controls: coil defrosts control, low-ambient operation, and head pressure control down to 0°F ambient. Heat pumps that control sequence(s) shall be configured to prevent simultaneous heating and cooling. During cooling mode, the electric heating coil shall be locked-out. For all water- cooled units, low-limit temperature sensors shall limit the incoming condenser water temperature (~65°F) during heating mode. If condenser water temperature falls below set-point, the water regulating valve shall close and electric heating coil shall energize. Provide factory supplied electrical disconnect. Unit performance shall comply with AHRI 310/380.

2.14 Condensing Units

A. Condensing units can be part of a package assembly or split-system where the condenser is located remote from the Air Conditioning unit it serves. Use digital scroll compressors if available in the size required. If digital scroll compressors are not available, then multiple compressors are required at a minimum, unless commercially unavailable for the desired equipment. Each condensing unit shall be provided with vibration isolation when located on the roof or connected to the facility structure. At a minimum, condensing units shall be provided with hot gas bypass circuit for capacity control, charging valve, suction line shut-off valve, liquid line shut-off valve and unit mounted disconnect switch. Condensing unit shall be AHRI 350 rated.

2.15 Series Fan-Powered VAV Terminals

A. Series Fan-Powered VAV Terminals shall be pressure independent primary airflow control, equipped with multi-point inlet velocity sensor with center averaging. Flow controllers shall control minimum and maximum primary CFM. The temperature sensor signal shall reset the flow control device to control primary air CFM to match load requirements. The fan shall run continuously distributing mixed plenum and primary air to the space.

B. Terminals shall have enhanced sound attenuation, for example heavier insulation and flexible mountings for fan, to maintain room NC levels given in the table in Section 230500 when rated in accordance with AHRI 885-90 at 0.5” inlet pressure.

C. Terminals shall be the "Low Profile" type and shall not exceed 11” in height and equipped with SCR fan speed controls with minimum voltage stop. Provide reheat coil if required, using heating hot water to the maximum extent practical. Electric coils, with SCR controls, shall be the alternative in applications where heating hot water is not practical.

D. Terminals with reheat coils shall be provided with MERV 8 Filter and frame to protect the coils from dirt. Terminals without reheat coils shall be provided with filter frames for future installation of filters if deemed necessary. Provide an air boot on the plenum inlet with 1” acoustical lining for each terminal to control sound coming from the terminal fan. Unit performance shall comply with AHRI 880.

2.16 Single Duct VAV Terminals

A. Terminals shall be pressure independent primary airflow control equipped with multi- point inlet velocity sensor with center averaging. Flow controller shall control minimum and maximum primary CFM. The temperature sensor signal shall reset the flow control device to control primary air CFM to match load requirements. Provide reheat coil if required, using heating hot water to the maximum extent practical. Electric coils, with SCR controls, shall be the alternative in applications where heating hot water is not practical. Unit performance shall comply with AHRI 880.

2.17 Unit Heater

A. Manufacturer for unit heaters may be from outside of those listed in 2.1.A.

B. Unit Heaters are available in vertical or horizontal discharge configurations, and shall be employed where aesthetics are not a concern (e.g., mechanical rooms, warehouses, utility rooms, etc.).

Units consist of heavy gauge metal enclosure, propeller fan and hot water or steam heating coil. Units shall be provided with built-in overload protection.

C. Optional integral thermostats are available or units may be controlled by a remote wall-mounted thermostat. Refer to manufacturer's literature for recommended mounting heights and application considerations.

D. If available, add controls-lock for heat setting.

2.18 Package Through-Wall Air Conditioning

A. Package through-wall air conditioning (PTAC) units, either for cooling only or for heating and cooling (i.e., heat pump), may be used for utility facilities, small stand-alone facilities or for temporary duty so long as humidity control is not a concern and physical or contaminant concerns are not present (or protective measures are cleared by the Project Manager). Units are to have self-contained controls, condensate discharge and ventilation provisions. Unit performance shall comply with AHRI 310/380.

2.19 Heat Tracing

A. JHFRE preference is to use alternate configurations in order to avoid situations where heat tracing is necessary. When necessary, follow the conditions below.

B. For systems subject to freezing conditions, such as cooling tower piping, provide heat tracing along the full length of exposed piping including all valves, fittings and drains. The heat tracing system shall be a self-regulating heating cable that consists of (2) bus wires embedded in a parallel self-regulating polymer core that varies its power output to respond to the ambient temperature along its length. The cable shall be designed such that it can be crossed over itself and cut to length in the field.

C. Provide a controlling thermostat for circuit that energizes/de-energizes for circuit cycling. Provide heat-tracing manufacturers dedicated heat-tracing power distribution panels with controls, ground-fault protection, individual breaker monitoring and alarms, panel door disconnect and ambient sensing thermostat. Each panel shall be provided with one spare circuit for future use. Provide alarm to BAS when heat trace fails while commanded on.

D. In order to conserve energy and to prevent overheating, the heating cable shall have a self-regulating factor of 90%. Heating cables used for freeze-protection of metal pipes shall operate on line voltages of 120v, 208v, 220v, 240v, or 277v without the use of transformers. Refer to manufacturer's selection criteria for required wattage based on pipe size and ambient temperature. All cabling shall be UL listed and/or Factory Mutual (FM) approved. Component enclosure shall be NEMA 4X rated to prevent water intrusion and corrosion.

2.20 Chilled Beams

A. Chilled beams shall be of the active type, relying on airflow from an AHU to induce airflow over the chilled beams whenever possible. Passive type may be considered for transient spaces (lobbies and corridors) only.

B. Chilled beam length shall be consistent over the open floor plate (limited to zone, column bay, and perimeter zone). Chilled beams shall include boarder options, drain pans at U-Bends, internal insulation, chains and latches for the removable diffuser, and hard pipe connections at beams.

C. Chilled beams shall be monitored and controlled by the BAS, including space temperature, dew point, condensation on chilled water piping, and modulating control valve operation. Valves shall be normally closed.

D. Provide supply isolation ball valve and a return calibrated positive shut-off isolation ball valve at each chilled beam.

2.21 Heat Exchangers

A. Maintain manufacturer's recommended clearances for service and maintenance. Install piping adjacent to heat exchangers to allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of heat exchangers.

B. Install shutoff valves at heat-exchanger inlet and outlet connections. Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain. Install hose end valve to drain shell.

C. Install thermometer on heat-exchanger and inlet and outlet piping and install thermometer on heating-fluid inlet and outlet piping. Install pressure gages on heat-exchanger and heating-fluid piping.

Part 3 – EXECUTION

3.1 Leak Detection

A. All suspended units (e.g., fan coils, air handlers or spot coolers) shall have a secondary means of condensate containment should the primary condensate pan fail (e.g., drain blockage or pan leakage) and shall be equipped with a moisture sensor that will disable unit operation.

B. All computer room units shall have looped water sensing cable around the perimeter of the unit under raised floor. Leak detection shall disable unit operation (unless the unit is of a critical operational nature, then unit shall continue in operation –JHFRE shall determine units or areas of critical operational nature) and alarm the BAS upon detection of water.

C. Secondary containment pan shall be easily removable to allow for filter changes and component access. Provide quick connects for the removal of leak detection devices and cabling to accommodate secondary containment pan removal. Provide spare cables.

3.2 Thermostat Placement and Control

A. A single thermostat shall serve a maximum of three offices, which must have similar size and occupancy.

B. Common areas, lounges, etc. shall have a dedicated thermostat for control.

C. Desired space temperatures, humidity and maximum NC based on the area usage is in SECTION 230500.