SECTION 3 MD: MECHANICAL DIVISION

Latest Update 2-3-16, See underlined text

PART I: GENERAL DESIGN REQUIREMENTS

1. SCOPE:

1.1. This division outlines the general objectives and criteria for designing mechanical systems. It deals with general office, research and institutional buildings; however, principles herein shall be followed, where applicable, for special-purpose buildings. Many of the existing systems serving the UM buildings may not be in compliance with these current standards due to their age. However, it is the intent that all design of both new and renovated systems be done in accordance with these Design Standards. Instances where existing conditions preclude compliance with the standards should be brought to the attention of the UM OFM Project Manager for discussion and resolution.

2. DESIGN SUBMISSIONS:

2.1. The A/E shall submit design documents, proposals, drawings, sketches, calculations, specifications, etc. at various stages in the design process. For mechanical requirements of each submission, refer to this division and the UM Procedure Manual for Professional Architectural and Engineering Services for UM Construction and UM Service Centers, latest edition.

3. CODES, STANDARDS AND REGULATIONS:

3.1. **Codes:** The design shall comply with the codes, standards, and regulations listed in Section 2 of these Design Standards, and at a minimum, with the most recent edition of all the codes that have been adopted by the State of Maryland. The technical requirements of these codes shall supplement all other standards, codes and regulations imposed by the University which may be initiated subsequent to the program preparation. The Office of Environmental Health and Safety (EHS) is the appointed campus Occupational Safety and Health Coordinator and the University Fire Marshal and as such will review all design documents. When a specific project warrants variance from the governing codes and regulations, a request shall be submitted in writing to UM at the Schematic Design Phase. Unless otherwise noted the latest edition of the codes in effect at the time the design contract is awarded will be used throughout the design and construction of that project.

3.2. **NFPA Codes:** The design shall comply with the codes listed in Section 2 of these Design Standards, and the following NFPA codes:

(1) NFPA 54, National Fuel Gas Code, 2006 and ANZI Z223.1 or latest edition.

(2) NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2002 or latest edition.

(3) NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems, 2006 or latest edition.

(4) NFPA 99, Standard for Health Care Facilities, 2005 or latest edition.

(5) For NFPA Codes pertaining to fire protection see Fire Protection System Design of these Design Standards.

3.3. Standards and Regulations: The design shall comply with the standards and regulations listed in Section 2 of these Design Standards and the following standards and/or regulations shall also apply to all designs:

a. ASHRAE Standards as follows:

(1) ASHRAE Standard 15-2007, Safety Standard for Refrigeration Systems.

(2) ASHRAE Standard 34-2007, Designation and Classification of Refrigerants.

(3) ASHRAE Standard 62.1, 2007, Ventilation for Acceptable Indoor Air Quantity.

(4) ASHRAE Standard 90.1, 2007, Energy Standard for Buildings Except Low–Rise Residential Buildings (ANSI ASHRAE Approved).

(5) ASHRAE Standard 90.2, 2007, Energy Efficient Design of Low–Rise Residential Buildings (ANSI ASHRAE Approved).

b. Procedures for Implementation of Energy Conservation, Md. Dept. of Health Food Service Requirements.

c. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), and American Society of Mechanical Engineers (ASME).

3.4. Pressure Vessel Inspections by the State of Maryland: For the purpose of obtaining and having UM buildings insured by any commercial insurance carrier, specify that the contractor shall arrange for the inspection of all pressure vessels installed during construction. The contractor shall contact the Office of Boiler and Pressure Vessel Inspections of the Department of Labor, Licensing and Regulations (DLLR), State of Maryland, and arrange for the inspections. The DLLR shall be notified at least 30 days prior to installation. After such inspections are carried out by the State Inspector's office, Certificates of Compliance issued to the contractor of record shall be turned over to the UM OFM Project Manager for compliance with current insurance regulations as part of the Project Documents.

a. Examples: Examples of pressure vessels include chillers, boilers, heat exchangers, converters, expansion tanks, water heaters, hot water generators and storage tanks. Chillers are also covered under AHRAE Guidelines.

b. Specify that the contractor shall confirm that all pressure vessels are installed in full compliance with the requirements of the Sate Inspector's Office for Boilers and Pressure Vessels.

c. The A/E shall use UM's master mechanical specifications for the project. The above information is included in the master specifications. If, for some reason, the A/E is not using UM's master mechanical specifications for the project, then the above information must be included in the A/E's mechanical specifications. UM has developed a standard detail for use along with the above information. This detail is available on the UM website and shall be included in the design documentation.

4. COORDINATION:

4.1. Mechanical Design: The mechanical design must be coordinated with architectural, structural, fire protection and electrical, and specialty designs to permit the A/E submissions and reviews by UM to be made effectively. It is essential that the work of mechanical engineers not lag unduly behind that of other disciplines. The engineer shall compile a list of all long lead items required for the project identifying those that may threaten the anticipated construction schedule.

4.2. Site Visits: On a renovation or alteration project, the engineer shall make visits to the site to ensure coordination with existing work and to make certain that there is adequate space and service clearance for the proposed layout and equipment. The engineer shall not rely solely on original construction document or earlier renovation drawings, as they may not represent the actual existing conditions. The A/E team shall check building dimensions to confirm the accuracy of archived record drawings.

5. ECONOMICAL DESIGN:

5.1. General: Mechanical systems shall be designed to permit acceptable competitive bids. Equipment and systems shall be efficient and economical for construction, operation and maintenance. Where economic justification is required for mechanical work, the analysis shall be in accordance with life cycle costing methodologies as required in the UM Procedure Manual for Professional Architectural and Engineering Services for UM Construction and UM Service Centers, latest edition.

5.2. Economic and Energy Analysis:

a. In the preliminary analysis, identify alternates that appear sufficiently promising to warrant detailed analyses. Use block loads, unit prices, and engineering judgment in their preparation. This analysis must be included with the A/E's design development submission, unless waived by UM OFM.

b. Life-cycle Cost: Unless waived by UM OFM, conduct a life-cycle cost economic analysis for each new building project and for each alteration project requiring a new heating, refrigeration, or air-conditioning system. For new HVAC systems, the A/E shall evaluate the requirements for heating and air-conditioning on an integrated basis.

c. Annual Energy Consumption Estimating Procedures and Equipment Sizing: Base energy use projections and equipment sizing on calculation methodologies addressed in ASHRAE Handbooks.

d. UM - Approved Alternates: Detailed analysis of UM approved alternates shall be submitted with the design development submission. All estimates of first cost, replacement costs, energy use/costs, maintenance impact/costs, and other issues shall be quantified and evaluated.

5.3. Equipment Selection: Equipment specified should be nonproprietary, except where no other source is available to meet performance requirements. Where a proprietary selection is deemed necessary, a request shall be submitted in writing to UM early in the design stage. Materials selected shall be suitable for the application and shall be coordinated with other aspects of the project. Equipment such as fans and pumps shall be selected in their mid range of operation to allow for field adjustments and future capacity expansion.

5.4. Fuel Selections: Operating equipment shall use fuels in accordance with the following criteria

a. Availability and Reliability: Consider fuels which are readily available and free of restrictions in supply and use.

b. Selection: Fuel selection shall be made part of the economic selection requirements of the associated equipment. Use actual fuel prices associated with the specific site in lieu of regional or national averages.

c. Type: Consider any available fuel or form of energy if it can be obtained from normal sources of supply and meets air pollution standards. District Steam generated by Trigen-Baltimore Energy Corp. is commonly used. Fuel selection shall be subject to UM review and approval.

6. GENERAL DESIGN CONSIDERATIONS:

6.1. Electronic Drawing Files: The A/E shall prepare electronic design drawings, utilizing the UM standard drawing templates, in accordance with Section 4 of these Design Standards. The UM standard drawing templates can be accessed through the UM web page address included in the Section 2 of these Design Standards.

6.2. General Project Files: Non CAD type project files such as fee proposals, studies, reports, cost estimates, calculations, and specifications shall be submitted to UM on a CD-R as part of the project closeout document requirements. For additional requirements see Section 4 of these Design Standards.

6.3. Floor Plans and Details: Full size floor plans shall be drawn to a minimum scale of 1/8 inch per foot. Floor plans for mechanical equipment rooms, main electric room, electric rooms, BDF & IDF rooms, server rooms, emergency generator room, fire command center and all other areas where space conditions are such that close coordination between all disciplines is necessary shall be drawn to a minimum scale of 1/4 inch per foot. Where scaled details are necessary to indicate coordination between materials and equipment utilize a minimum scale of 1/2 inch per foot.

Drawings shall be coordinated with the respective trades, and cross-sections and elevations provided. All floor plans shall include room numbers as indicated on the architectural drawings. Where partial floor plans, sections and elevations are utilized for projects, these floor plans shall be developed at a minimum scale of 1/4 inch per foot for each discipline.

6.4. Sustainability and Green Building Policy: In accordance with the UM Green Building Policy outlined in Section 1 of these Design Standards, UM encourages the integration of sustainable and green building practices in the design of all renovation and new building projects, regardless of the intent to meet LEED™ certification requirements. The A/E team is encouraged to investigate and recommend the use of innovative and state-of-the-art use of materials, equipment, systems, and design approaches that hold promise for increases in energy efficiency, resource reuse and recycling, reduced energy consumption, and improved indoor air quality, operational efficiencies, and thermal performance of the project space. Where the intended use of such design practices conflicts with these Design Standards, the A/E team shall notify the UM OFM Project Manager during the Schematic Design phase, or as soon as possible thereafter, so that a discussion of the issues can be held and resolution can be reached. The engineer shall explore opportunities for the integration of discipline specific initiatives for sustainable design in the project as the design effort progresses. Specific design initiatives in the area of the mechanical design could include, but are not limited to, use of recycled and salvaged materials and equipment, use of recyclable materials, use of sensible cooling systems for equipment loads such as cool beams, use of local unitary equipment to permit local control and operation, water cooled compressorized equipment for concentrated sensible loads, low-flow or waterless plumbing fixtures, collection and use of storm water and grey water, alternate energy systems such as solar thermal, photovoltaic, and wind, and integration of raised floors for future flexibility and ease of utility routing. In addition, the A/E shall include requirements for recycling of demolition and construction waste materials in the construction documents.

6.5. Pipe System Locations: On each submission the location of all pipe systems and routing shall be shown as nearly as possible to the location where the systems are intended to be installed. In general pipe systems shall be indicated on floor plans by single line representation for horizontal runs, with circles for risers and/or and half circles for drops. For sections, and elevations piping systems shall be indicated utilizing the same system representation used for the floor plans. Where piping systems, fittings and valve sizes are eight (8) inches and larger, said components, shall be indicated as double line, to scale,

6.6. Duct System Locations: On each submission the location of all duct systems shall be shown as follows:

a. SD & DD Submissions: Main duct systems, twenty four (24) inches in width and larger, including risers, representing existing and/or new ductwork shall be indicated as double line, to scale with appropriate sizes noted. Duct systems intended to be demolished shall be indicated as single lines with appropriate sizes noted. Portions of duct systems less than twenty four (24) inches in width can be represented by single line with appropriate sizes noted.

b. **50%, 95% and 100% Submissions:** All duct systems, new and existing including risers shall be indicated as double line, to scale with appropriate sizes noted on all floor plans, sections, and/or elevations.

c. On all submissions each duct system, and duct routing shall be shown as nearly as possible to the location where the systems are intended to be installed.

6.7. Interferences: Coordinate the design with the structural and architectural system components to avoid interference and conflicts. Particular attention shall be given to avoidance of structural components, including beams, columns, bracing, column caps and concrete reinforcement, and to ensure that all equipment and distribution systems fit adequately above intended ceiling heights. Coordinate the routing of all systems with all work of other disciplines. Consider space required for access for maintenance and repair of equipment.

6.8. Sleeves:

a. All penetrations through floors, walls, partitions and roofs shall have sleeves. All sleeves and openings shall be sealed. All fire/smoke sealants for penetrations through rated fire/smoke assemblies shall be as described in the Architectural Division to maintain all work under one subcontractor.

b. Coordinate with the structural engineer to ensure that structural working drawings show sleeves for pipes and ducts passing through footings, beams, and exterior walls below grade. The elevation of sleeves on foundation drawings must be given.

6.6. Floor Penetrations: All mechanical pits, cleanouts, manholes, trenches, etc., shall be shown on the structural plans. If membrane waterproofing is used, waterproofing under basement toilet rooms shall be dropped far enough to permit running the soil and waste pipes above the waterproofing so as to reduce the number of pipes passing through the membrane. Drainage piping required in connection with pressure slabs, and locations of pipes and sleeves passing through or under pressure slabs, shall be fully coordinated with the structural design.

6.7. Foundation Drawings: If construction of a foundation is to proceed in advance of completion of the superstructure drawings, separate working drawings of foundations are required. These drawings shall show:

a. Mechanical work that cannot be installed later. This includes piping and conduits below or through foundations, slabs, etc.

b. Later installation of mechanical work, including, but not limited to, sleeves, openings, chases, and trenches.

7. SPECIFICATIONS, SUBSTITUTIONS AND DETAILS:

7.1. General: In addition to the requirements in this section see the UM Procedure Manual for Professional Architectural and Engineering Services for UM Construction and UM Service Centers, Latest Edition for submission requirements.

7.2. Mechanical Specifications:

a. A project specification incorporating sections for mechanical work shall be prepared, coordinated with drawings, and submitted. UM has developed a complete set of master specifications for mechanical and electrical divisions, and selected architectural sections, and general requirement sections. The A/E shall review the UM master specifications table of contents, included in Section 5: Appendices of these Design Standards, and select from the UM web page all appropriate specification sections necessary to suit the current project scope. The A/E shall edit the UM master specification sections to suit the requirements of the project. The A/E shall utilize their own specifications and/or other resources only in those cases where the UM master specifications do not include the required equipment, materials, or construction procedures to suit the current project. The UM master specifications can be accessed through the UM web page address included in Section 2 of these Design Standards. All text in the header, footer and body of each specification section shall be “Times New Roman, Size 12”.

b. For UM design projects that do not require a full set of mechanical specifications, UM has a condensed version of mechanical specifications that should be used for these projects. The UM condensed specifications can be accessed through the UM web page address included in Section 2 of these Design Standards.

7.3. Substitutions: For specification sections provided by the A/E that are not based on the UM master specifications, the specification sections shall include the names of at least three manufacturers for every product. The engineer shall ascertain that every manufacturer listed is acceptable to UM, and that every manufacturer listed can provide a product that is acceptable in terms of performance, quality, size, service access and orientation. Even though the engineer may identify one manufacturers’ product as the design basis, the other manufacturers’ product will not be viewed as substitutions, but as equals. In addition, other manufacturer’s products which are not listed, but can be considered as approved equals, shall not be viewed as substitutions. Only manufacturers’ products which are not approved equals because of a deficiency in one or more significant aspect of the product will be considered to be substitutions. The design shall include sufficient space and service clearance such that all equal products can be used.

7.4. Mechanical Details: UM OFM engineering staff has developed a series of mechanical details, schedules and system diagrams in CAD. These CAD files identify the required components and how UM requires the equipment and systems to be installed and how UM wants the equipment scheduled. These details shall be included in all construction documents. See Section 5: Appendices of these Design Standards for a list of mechanical details. The UM standard mechanical details can be accessed through the UM web page address included in Section 2 of these Design Standards.

8. ACCESSIBILITY:

8.1. Access to Machines and Equipment: Clearance shall be provided around machines and equipment to remove parts for repair or replacement. Door or window

openings, removable panels in building walls, and corridors shall be arranged so that large machines or equipment parts can be removed or replaced without structural changes or movement of other equipment. The engineer shall arrange with the architect to provide openings and passageways of sufficient size so that standard equipment can be used. Particular attention shall be given to equipment such as boilers, large tanks, refrigeration machines, air handlers, and condensers. Water cooled chillers shall be located in an accessible at grade or below grade mechanical equipment room, and not on the roof or on upper floors. The placement of operating equipment over ceilings shall not be used, with the exception of terminal units. Requests for variance from this shall be submitted in writing to UM early during the design process. Accessible utility core spaces shall be provided for all major mechanical and electric utilities. Access through full-size man doors shall be provided. These spaces shall have adequate clearance for maintenance and future replacement of the equipment, risers and conduits with a minimum of three (3) feet between equipment and structural components or as in compliance with manufacturer's recommendations. Adequate space must be provided for possible future additional duct and pipe risers, conduits and equipment. Provide adequate clearance for filter replacement, coil pulling, and tube cleaning. Designs which indicate the routing of piping or ductwork across the floor within the path of travel for service or maintenance personnel will not be acceptable to UM, nor shall piping or ductwork be designed which would create a low clearance hazard. There shall be a minimum of seven (7) feet vertical clearance within the path of travel. Where the path of travel is not obvious, or where directed by UM, indicate the path of travel around all equipment requiring service access on the construction drawings. UM reserves the right to require a total or partial redesign of equipment layouts, at no additional cost or time delay, where the submitted design is, in the opinion of UM Facilities Management, not in the best interest of UM. Coordinate with the electrical engineer to provide adequate lighting levels in all mechanical spaces for service and maintenance. For additional access requirements for specific HVAC equipment see Section 3 MD.

8.2. Parts Handling: A suitable means shall be provided for lifting and moving cooler and condenser heads, fan sheaves, pump casings, strainer covers, motors, gear boxes, compressor casings, and similar parts weighing over fifty (50) pounds. The type of lifting equipment used in each case must be determined on the basis of the number of machines in a group, size and weight of parts, accessibility, and estimated use. Typical means of lifting included in past designs have included monorails, davits, and provisions for portable cranes.

8.3. Overhead Equipment:

a. Mechanical Rooms: Catwalks, ladders, chain wheels, etc., shall be provided, as required, in mechanical rooms to provide access to material and equipment that cannot be accessed from the floor without the use of a ladder or lift. Overhead piping and equipment in high rooms shall, if possible, be arranged to permit grouping the maximum number of valves and other operating devices within reach of a short platform, catwalk, ladder, etc., or to permit orderly grouping of valve chains where they will not be hazardous obstructions. Where valves are not within seven (7) feet of the floor or catwalk, specify that valve chains shall be provided. This requirement includes all HVAC, plumbing and specialty valves. Where chains are not

available; design the piping layout to bring the valve within seven (7) feet of the floor or catwalk. In addition, all piping strainers, control valves, and other fittings and equipment requiring periodic service shall be designed to be located within seven (7) feet of the floor or catwalk.

b. **Water Lines:** Water lines on equipment shall not be installed over electrical panels, switchgear, or transformers.

c. No air handling equipment, pumps, or any mechanical equipment requiring filter changing or other periodic maintenance shall be located above ceilings.

8.4. Access Panels or Doors:

a. Panels or doors shall be provided for access to valves or other equipment requiring periodic service, access, maintenance, or examination above ceilings. The panels shall be a minimum size of 18 inches x 18 inches. For smaller ducts, specify that one side of the access door shall be a minimum of eighteen (18) inches in length.

b. Where access doors are provided as part of the HVAC equipment, such as in AHU's, these doors shall be large enough for the removal/replacement of coils, fans, fan motors, filter racks etc. The engineer shall arrange with the Architect to provide sufficient floor space for the maintenance and operation of the equipment. All such space shall be subject to approval by UM.

8.5. Accessibility: Design the locations of all traps, cleanouts, dielectric fittings and other fittings requiring service such that they are accessible.

8.6. Demonstration of Access: The 50% submission shall show sketches demonstrating that at least three (3) manufacturers' equipment is accessible and will fit with adequate clearance, as deemed acceptable by UM.

9. BUILDING OPERATION:

9.1. Except for selected shutdown holidays, UM campus buildings are open to the public for business from 7:00 am to 6:00 pm, Monday through Friday, but many of the buildings on campus are occupied to a lesser extent at all hours of the day and night, seven days per week. In buildings where public spaces and/or research spaces adjacent to the project area require other hours of operation, the design shall identify construction phasing that has the least impact on the adjacent occupied areas. The design shall include requirements for off-hour work as required for work involving the shut down of systems or equipment serving the occupied areas.

10. REDUNDANCY:

10.1. Where the program or design scope requires the provision of backup or redundant equipment, the mechanical design shall provide all necessary valves, controls, bypass piping, to permit independent operation of each piece of equipment. The design shall include all provisions necessary to permit isolation and removal of one unit while allowing the second unit to operate. Coordinate with the electrical engineer to ensure that all necessary disconnect switches, starters and isolation

equipment, conduit and wiring is provided to permit independent operation. This includes the requirement for individual motor disconnects for every motor on packaged equipment with multiple motors and power connections.

11. ROTATING EQUIPMENT:

11.1 All equipment with rotating parts shall be specified with complete guards as required by EHS. Obtain from the UM OFM Project Manager the EHS Guidelines for complete guides, which generally exceed those required by OSHA, and provide complete guarding of all moving parts as required by MOSH.

12. DEMOLITION:

12.1. The A/E shall include all necessary provisions for demolition in the construction documents. Demolition shall include disconnection and removal of all equipment and distribution systems serving the project area. For areas served by equipment and systems which also serve other areas not included in project scope, the design shall include demolition of distribution systems back to mains which must remain active for other areas. All removed branch systems shall be identified to be capped, or prepared for new branch connections to serve the project area as appropriate. The design shall include direction for all balancing and adjustments required of the main building systems affected by the project design as well as other components on the same system but located outside the project area. A list of all equipment and systems anticipated to be demolished, and those to be reused in the project design shall be submitted to the UM OFM Project Manager for approval. The A/E shall request from the UM OFM Project Manager a list of equipment to be identified as salvaged material to be turned over to the University.

12.2. The A/E shall include a phasing plan in the construction documents that indicates a method by which the work in the occupied building can be accomplished with the least possible disruption to the occupants of surrounding and adjacent spaces. The plan shall include provision for all temporary piping, ductwork, power, equipment and systems necessary to provide HVAC and plumbing services to all occupied areas interrupted by the construction work. The plan shall also include the requirement for off-hour work for all outages and disruption of all services to the occupied areas. The plan shall utilize, to the extent possible, the change of seasons in the calendar year to lesson the impact of system outages, performing work on heating systems in the summer months and performing work on cooling systems during the cold weather months. The plan shall consider the anticipated disruption to adjacent occupied areas that will be caused by work that involves the generation of excessive noise, dust, and vibration**.**

13. MECHANICAL EQUIPMENT ROOM LAYOUT:

13.1. General: The engineer shall work with the architect at the outset of the project to identify the sizes, shapes and locations of required spaces and dedicated equipment rooms for installation of all mechanical equipment. All mechanical spaces shall be designed to accommodate the required equipment in accordance with the manufacturer's operating and service clearance requirements, and in accordance with the accessibility requirements of these Design Standards. Equipment layout shall include space for efficient and economical transitions and connections to all

equipment in accordance with good engineering practice. Provide a telephone outlet in each mechanical room. Coordinate the locations with the A/E team and UM.

13.2. Office Area: Include in the mechanical equipment room an office area approximately one hundred (100) square feet with a work desk, electrical receptacle, lock box, telephone, and PC work station with a data outlet. This area shall be enclosed by a wire cage system for the walls, and ceiling, and a door with a lock.

13.3. Stock Storage Area: Include in the mechanical equipment room a storage area sized appropriately for a stock of maintenance materials to serve the equipment in the room.

13.4. Separate Chiller Room: Where refrigeration equipment is included in the design, a separate mechanical room shall be provided to house the refrigeration equipment to isolate and contain potential refrigerant leaks.

13.5. Separation of Mechanical and Electrical Rooms: Separation of mechanical and electrical rooms shall be maintained, with appropriate physical barriers to prevent flow or migration of fluids from mechanical to electrical spaces.

13.6. Future Equipment Space: When directed by UM, or as required by the project program, provide space for future equipment such as chillers, pumps, and cooling towers. For future roof mounted equipment the design shall include the necessary structural supports and roof penetrations for piping and conduits.

14. VIBRATION AND NOISE CONTROL:

14.1. Provide vibration isolation connections for all mechanical system components subject to vibration from rotating equipment such as fans, pumps, chillers, compressors etc. Design engineer shall use a combination of spring isolation hangers, neoprene pads, or floating isolation bases to control transmission of vibration to the surrounding structure. Equipment mounted directly on slab on grade construction with a house keeping pad typically does not require isolation from the floor slab. Provide spring isolation hangers on piping within the first ten (10) feet from the vibrating equipment. Provide a flexible connection for the electric service connection to the vibrating equipment.

14.2. In mechanical equipment rooms where the designed construction mass is not sufficient to provide a proper noise barrier, the engineer shall coordinate with the A/E team and UM to ensure that the appropriate acoustical treatment of the mechanical equipment room in included in the design. To prevent excessive use of such treatment, the A/E shall consider placement of such spaces adjacent to unoccupied and transient spaces to use as buffer zones to assist in attenuating sound transmission. The location of such spaces shall be considered in the layout of spaces on each floor, as well as location on floors above and below critical spaces.

14.3. The mechanical system components shall be selected and/or acoustically treated to meet indoor space requirements. Prior to selection of all equipment and devices,

the maximum noise level criteria for all spaces shall be submitted for UM approval. Use noise levels as outlined in ASHRAE Standards.

15. EXPANSION AND CONTRACTION COMPENSATION:

15.1. Provide a complete designed expansion and contraction system for each piping system, indicating the locations of all expansion loops and/or expansion compensators, all pipe guides and anchor points. UM prefers the use of expansion loops over compensators. Where pipe risers are anchored to the building structure coordinate those locations, and the anchoring designs, with the structural engineer. All necessary details and specifications are to be included in the contract documents.

16. FIRE STOPS AND SMOKE SEALS:

16.1. Provide fire stops and smoke seals for all plumbing, fire protection and HVAC piping systems and ductwork that pass through floor slabs, utility shaft walls, and roof levels. Coordinate with the A/E team and UM to ensure all code requirements are complied with.

17. INSULATION:

17.1 All piping and equipment containing medium hotter or colder than inside design temperature shall be insulated, including all horizontal rain leaders. All piping carrying air conditioning condensate shall be insulated. Insulation shall have a vapor barrier, installed continuous through the hangers, for all piping, ducts, and equipment with surface temperatures that will be below the anticipated worst case dew point temperature of the space in which they are located. Specify hangers and supports designed for insulated piping. Specify appropriate insulation blocking for supporting insulated piping in hangers.

18. ELECTRIC MOTOR REQUIREMENTS:

18.1. Each motor, ten (10) hp or larger and/or motor-driven equipment shall have a composite Power Factor (PF) of 95% to 100% when the motor is operating at its rated full load capacity or 90% to 100% when operating at the design duty defined on the drawings. PF correction equipment, interconnection wiring, and connections shall be provided as part of the respective motor or motor-driven equipment whenever required to meet this requirement. Internal to the PF correction equipment, each branch circuit of the capacitor shall have a fast acting current limiting fuse. Also, each capacitor branch circuit fuse shall be provided with a blown fuse indicator consisting of a fused neon light which illuminates when a capacitor branch fuse has blown. The neon light shall be visible from the front of the enclosure with the door closed. A nameplate identifying the associated branch capacitor fuse shall also be included with each light. Provide an externally mounted molded case circuit breaker for over-current protection and isolation switching. PF correction devices shall be located as close as possible to the motors they correct.

a. For motors or motor-driven equipment requiring other than full-voltage starting, PF correction capacitors shall be connected to the motor terminals via a contactor (controller) with a 120 VAC coil. The 120 VAC coil shall be

energized via an auxiliary contact on the contactor (controller) used to establish the “run” operating mode for the motor.

b. For two (2) speed motors, PF shall be corrected at each speed via separate groups of capacitors for each speed. Each group of PF correction capacitors shall be connected to motor terminals via a separate contactor (controller) with a 120 VAC coil. Each 120 VAC coil shall be energized via an auxiliary contact on the contactor (controller) used to establish “run” operation at each speed.

c. For variable frequency control (VFC) and associated motor-driven equipment, these two items are defined as a unit (one package) and the composite PF shall be the PF at the power input to the VFC for the respective unit. No PF correction shall be provided for motors controlled by VFC’s.

18.2. Require shop drawings to be provided for each motor that include the following information:

a. Unit or motor data defining efficiency and PF at incremental loads (10% or smaller increments) from full load to no load without PF correction.

b. Maximum allowable PF correction capacitance which will not cause over-excitation at no load.

c. PF correction capacitance to be provided to comply with required PF correction.

d. Data on each component used to achieve required PF correction.

e. Data to enable calculation of motor load at design duty.

f. Value of full load amperes (FLA) with correction capacitance provided and connected.

19. EMERGENCY POWER REQUIREMENTS:

19.1. In addition to the life safety equipment and/or systems required by Code, include the following equipment and systems in the design of the emergency power distribution system that may apply to the project unless otherwise directed by the UM OFM Project Manager:

a. Preheat pumps and system.

b. Process cooling water pumps.

c. Fire pump.

d. Fume hood exhaust fans.

e. General exhaust fans.

f. AHU supply air fans as needed for make up air for smoke evacuation Systems.

g. Atrium smoke evacuation systems.

h. A/C units, dry coolers and pump packages serving computer rooms, data rooms, IT closets, elevator machine rooms, electric rooms, Tela-Data, BDF, and IDF rooms.

i. Stair pressurization systems.

j. Controlled environment rooms.

k. Foundation sump pumps.

l. Fire alarm systems.

m. Domestic water booster pump package.

n. ATC controls for the above equipment and systems, including but not limited to, cabinets, TEC's, transformers, and ATC air compressor. Coordinate with UM for additional requirements.

o. One (1) building elevator.

20. SPECIAL USE AREAS:

20.1. Equipment Space Cooling Requirements:

a. General Requirements: Provide A/C systems to condition mechanical, electrical, elevator equipment rooms, computer rooms, server rooms IT closets, and Tela-Data and IDF rooms. These A/C systems shall be separate and independent from the general building systems as follows:

(1) The A/C systems serving mechanical rooms, electrical rooms, and elevator machine rooms must be able to operate on a twenty four (24) hour, seven (7) day schedule. Provide heating and ventilation systems for these areas for periods of mild and cold weather. Consideration should be given to providing emergency power for the A/C systems and controls serving these rooms.

(2) The A/C systems serving computer rooms, server rooms, Tela-Data and IDF rooms must be able to operate on a twenty four (24) hour, seven (7) day, three hundred sixty five (365) day's per year cycle. Consideration should be given to providing emergency power for the A/C systems and controls serving these rooms. The UM Telecommunication Department shall provide the A/E with the equipment loads for all computer rooms, server rooms, IT closets, Tela-Data and IDF rooms. Include in the design provisions for

additional heat loads for future expansion and coordinate with UM for additional requirements.

b. **Process Cooling A/C Systems:** For equipment space cooling it is UM's desire to utilize water cooled A/C units located in the rooms. These units shall be connected to a building process cooling water system. See Section 3 MD: Part III of these Design Standards for additional requirements for process cooling water systems. The A/E shall specify that these A/C systems are to be controlled through the UM building automation system.

c. **Glycol A/C Systems:** Where process cooling water systems are not available the engineer shall utilize glycol (40%) A/C systems with water cooled A/C units located in the room, a dry cooler and pump package located on the roof, and the necessary piping distribution system. The A/E shall specify that these A/C systems are to be controlled through the UM building automation system. The system design shall be coordinated with UM.

d. **Mechanical, Electrical and Elevator Machine Rooms:** Design the A/C systems to maintain an ambient temperature of 85^0F for these rooms.

e. **Tela-Data, BDF, IDF Computer, Server, and IT Rooms:** Design the A/C systems to maintain an ambient temperature of 75^0F @ 50% RH for these rooms.

20.2. Biological Safety Level 3 (BSL- 3) Facilities:

a. See Section 3 AD of these Design Standards for codes and requirements not included in this Section.

20.3. Animal Biological Safety Level 3 (ABSL- 3) Facilities:

a. See Section 3 AD of these Design Standards for codes and requirements not included in this Section.

21. COMMISSIONING:

21.1 The A/E team shall include the requirement for commissioning of all mechanical, electrical, and appropriate building systems by an independent commissioning agent to be hired by UM or the CM, as directed by the UM OFM Project Manager. The design specifications shall include all descriptions, commissioning forms, reports, and procedures required to completely test and demonstrate the operation of systems provided by the project. The testing and demonstration of each system shall include, at a minimum, normal operation and control sequences, failure modes, monitoring and control systems, life safety operations, security operations, and all remote monitoring and notification.

END OF SECTION 3 MD - PART I