APPENDIX G

MECHANICAL CRITERIA

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A. GENERAL REQUIREMENTS

1. The UT System Design Guidelines and Guideline Specifications for mechanical services shall be utilized by the Architect/Engineer in preparation of the contract documents. The specifications shall be edited to conform to the particular project, systems, and campus.

2. The criteria for a particular mechanical system will vary somewhat from campus to campus which may change certain parameters of initial design considerations. Design engineer is responsible for acquiring a local campus standard, if one exists, and adjusting design to standard as appropriate and as approved by the OFPC Project Manager.

3. Do not assume the Owner will provide, connect, or otherwise perform any services without specific prior agreement.

4. Room names and numbers shall appear on all mechanical, plumbing, and fire protection floor and partial floor plans. Column lines or designations shall appear on all Mechanical, Electrical and Plumbing (MEP) floor plan sheets, sections, and partial floor plan drawings (e.g., vaults and mechanical rooms) as they appear on Architectural sheets; such drawings shall also have graphic scales and north arrows as applicable. All MEP drawing sheets shall have the OFPC project name and number shown in the title block.

5. Systems shall be designed to comply with ANSI standards, including supplements.

6. Flow diagrams shall be drawn for each piping system including but not limited to steam, heating water, chilled water, domestic hot and cold water, distilled water, fire standpipe, oxygen, compressed air, condenser water, gas, vacuum, and refrigerant systems. Mains and major branches shall show quantities of flow with size. All valve sizes shall be indicated.

7. Plumbing and air conditioning systems shall be drawn as separate drawings. These systems may be combined on common drawings only by written permission of OFPC. A complete roof plan shall be included both for air conditioning plans and plumbing plans; one plan may serve for both.

8. Where piping systems are to be installed underfloor, these shall be shown on an underfloor plan and not on the plan prepared for the space above. Floor plans for mechanical systems shall be drawn to show pipes, ducts, etc., on the floor in which they are installed.

9. Fume hoods, kitchen hoods, and all other specialized mechanical equipment shall be included in the mechanical sections under the responsibility of a Professional Engineer.

10. UT standard details will be furnished in both AutoCAD and hard copy and shall be used as part of the contract documents. The standard details shall be carefully reviewed and redrawn on the construction drawings and revised as required to suit the project.

11. All construction details shall be shown on the drawings and shall not be bound in the specifications.

12. All equipment and material specifications shall be bound in the specifications and shall not be shown on the drawings.

13. Performance data schedules for all equipment shall be shown in schedules on the drawings.

14. All MEP review drawings shall bear the responsible engineer's name and registration number, but not necessarily his seal, at all stages of the design. Please refer to The Texas Engineering Practice Act , Occupation Code Title 6, Subtitle A, Chapter 1001 Engineers. The intent of this section is clarified as follows:

    Sealing Requirements: The registrant shall affix his seal, sign his name, and place the date of execution, only on engineering documents that have been issued by the registrant as completed work. Such documents should be accepted by clients for their purposes and/or by public authorities for final approval or issuance of a permit. Documents considered as incomplete by the registrant may be released temporarily for interim review and do not need to have the registrant's seal or signature affixed, but shall be dated; bear the responsible engineer's name, registration number, and professional engineer designation; and be clearly stamped to indicate the documents are for interim review and not intended for construction, bidding, or permit purposes. The use of signature reproductions, such as rubber stamps, or computer generated or other facsimiles shall not be permitted in lieu of actual signatures.

15. Variable Frequency Drives (VFD's): Shall be provided on all air moving fans and pumps of two horsepower and above. This does not apply to constant volume fans and pumps. The designer shall use care in the provision of VFD's and shall not arbitrarily provide for VFD's where not appropriate.

16. Provide complete flashing and trim details for all thermal and moisture protection systems to include assemblies, system transitions, and termination points.

B. DESIGN REVIEW SUBMITTAL REQUIREMENTS

1. The A/E will be required to present the plans and specifications for review to OFPC at the intervals outlined in the A/E Agreement. Intermediate reviews may be required if the scope of the project has been changed or if an earlier review found the plans and specifications unacceptable either as a whole or in part.

2. The Mechanical, Electrical, Plumbing and Fire Protection Engineering consultant(s) will participate in all reviews, work sessions and presentations where this discipline is involved. Items to be included for review at each phase or stage of completion are outlined below.

3. Schematic Design: Refer to Appendix L.

4. Design Development: Refer to Appendix L.

5. Construction Documents:

   a. Contract bid documents for plumbing systems shall as a minimum include: (1) all plumbing fixtures shown and identified by a number; (2) isometric riser diagrams for all plumbing risers in the building (each main stack identified by a number on both the plans and the riser diagram); (3) flow diagrams for all pressure systems including heating and cooling, water, steam, gas, oxygen, air, vacuum, fire protection, etc.; (4) all spaces identified by name and room numbers; (5) column numbers; (6) sections where space is limited; (7) details such as fire hose cabinet, lavatory connection, pump connection, hot water generator, water softener, acid dilution basin, sewer manholes, backflow prevention, water header, etc., (8) specifications complete in final mark-up form (final typing can be delayed until bid document issued); (9) schedule all major equipment on drawings. Plumbing fixtures may be scheduled but must also be described in detail in the specifications as guidelines to invite competition; (10) if project requires fire sprinklers, the drawings will include main piping sizes and head locations in architecturally sensitive areas. (11) MEP plans shall have all fire and smoke walls and partitions (and their ratings) clearly indicated.

   b. Contract bid documents for HVAC systems shall as a minimum include: (1) all air conditioning systems drawn to scale including all ductwork in two lines with all fittings to scale; (2) sections through mechanical rooms to adequately describe the construction requirements; (3) schedule of all major items of equipment to indicate performance characteristics; (4) all piping systems complete with necessary sections to clarify routing; (5) applicable details from OFPC Standard Details set modified to suit project; (6) all columns numbered; (7) all rooms numbered; (8) flow diagrams for each piping system except drains - show quantities in each

major branch take-off and the base of each main; (9) north arrows and graphic scales shown; and (10) specifications complete in final mark-up form (final typing can be delayed until bid documents issued).

c. Final update of "BASIC DATA" form.

C. ENERGY CONSERVATION

1. Initial Design Requirements for new building construction

a. Every project of new construction and major remodel/renovation is required to meet the energy performance standards established by the State Energy Conservation Office. It will be the design engineer's responsibility to submit the appropriate documents to verify compliance.

2. Mechanical System

a. The following criteria shall govern for the design of mechanical systems in remodeled buildings and in new buildings regardless of whether or not the features are required to meet the Design Energy Budget:

(1) Except where potential funding sources may be put at risk due to higher ventilation rate requirements, it is recommended that one (1) CFM of air be exhausted from each square foot of laboratory floor area. This does not preclude higher rates necessary to offset exhausts from equipment located within the laboratory, or higher rates necessary to maintain acceptable space temperature. A laboratory is defined as a workspace where chemicals are used and/or stored.

(2) The number of air handling units in a building shall be as few as feasible to serve the building. Each system shall be provided with a return air fan or relief fan to discharge air to the outside in direct ratio to the outside air being introduced into the system. The system shall be capable of exhausting 100% of the building return air when the system is on a controlled ventilation cycle.

(3) On projects where generation of steam or chilled water for heating and cooling is part of the design of the building, provide life-cycle cost analysis to determine the most economical primary fuel to use, with consideration given for the anticipated availability of fuel during the life expectancy of the generating equipment.

(4) All new and remodeled building projects shall conform to ASHRAE Standard 90.1.

(5) The mechanical systems within the building shall be designed in accordance with this section and sections of the Design Guidelines unless more stringent requirements are indicated in the standards of the State Energy Conservation Office.

(6) All projects utilizing campus chilled water, heating hot water, and/or steam shall be specified to have BTU meters, or flow meters and supply and return temperature sensors, depending on campus preference.

D. CONTROLS

1. Controls air flow diagrams, indicating air handler configuration and equipment arrangement shall be provided with location of all control devices shown. Dampers and control valves shall have their normal (fail) position indicated on the diagram. These diagrams will be used by the controls contractor to develop the system graphics.

2. Chilled water and hot water piping controls diagrams, indicating pump and equipment configuration, shall be provided with location of all control devices shown. Control valves shall have their normal (fail) position indicated on the diagram.

3. A complete controls input/output points list shall be provided on the drawings.

4. A detailed sequence of operation shall be provided on the drawings, on the same sheet as the diagram for each system.

   a. Provide AHU system description, including all components such as supply fans, return or relief fans, coils, dampers, filter sections and terminal devices.

   b. Provide pumping system description, including all components such as pumps, heat exchangers, control valves, and bypass valves.

   c. Provide normal start-up sequence for each system and start-up sequence after power failure restoration. State normal position of all control dampers and valves when system commanded OFF and when system trips off due to safety or power failure. Detail equipment system response for each potential equipment alarm and failure.

   d. Indicate percent of full load that pumps/fans are sized and if they operate in lead/lag or both operate simultaneously.

   e. Provide CO2 demand ventilation sequence for high occupancy areas.

f. Provide economizer cycle sequence when applicable.

g. Detail all alarms, alarm limits, and identify critical alarms.

h. List initial settings for all operator modifiable control parameters, such as, but not limited to, set-point, dead-band, offset, and equipment start/restart delay.

5. Show temperature sensor locations for all terminal boxes with dashed line from each sensor to respective VAV box.

6. Show dashed line at each VAV to indicate 3 feet maintenance access required for controls. Locate VAVs so that maintenance access area is not above fixed furniture or lab casework, preferably above door entry for the room.

7. Show location of VFDs and control cabinets on mechanical plan. Provide VFD schedule for pumps and fans.

E. UTILITIES

1. The Engineer shall be specific and show all points of connection and flow rates precisely for utilities. The utilities shall be connected to a campus distribution system or a combination of campus distribution and public services. Inverts when applicable shall be determined and indicated.

2. Direct burial of chilled water, hot water, or steam pipe is not generally acceptable. Any circumstances requiring an exception must be approved by OFPC.

3. Sanitary and storm sewers shall show invert elevations at manholes and other critical points.

4. Buildings shall be designed to permit gravity drainage of sanitary sewage. The pumping of sanitary sewage is prohibited unless there is absolutely no other alternative. Where sewage ejector or sump pumps are to be provided, these shall be so located that there is sufficient head room to pull the pump shafts straight up through the floor plate. Lifting eyes shall be included in or near the ceiling to facilitate this operation. Rail mounted pumps should be considered.

5. Buildings shall be designed to permit gravity drainage of storm water. The pumping of rainwater is discouraged and, where it becomes necessary, an assignable area could be flooded on pump failure. An emergency generator shall be provided with adequate room for ventilation, a fuel supply, exhaust to roof, and radiator cooling duct. Submersible type heavy duty pumps with extraction rails shall be used in lieu of vertical type sump pumps.

6. In general, storm and sanitary distribution systems outside the building are civil engineering projects. If distribution is complex, such consultant shall be retained to do this work.

F. PLUMBING

1. All toilet rooms shall be equipped with at least one floor drain. Drains shall be furnished with trap primers. (Check requirement of particular UT component institution.)

2. All janitors' closets shall be arranged with the sink near the door and a floor drain in the room.

3. All mechanical rooms containing air conditioning equipment shall have a floor drain. Do not locate floor drains under machinery. Floor drains shall be 4" minimum size, with a deep seal.

4. Pipes penetrating exterior walls below grade must be installed so as to prevent breakage due to building settlement and to maintain a watertight seal.

5. Easy access shall be provided to all working parts of all plumbing devices. Items of plumbing requiring periodic maintenance or repair shall not be permanently sealed in masonry walls.

6. Drinking fountains shall be electric, wall type, surface mounted into a wall recess 30" wide x 14" deep except where ADA requirements dictate a different configuration. Do not construct fountains into the walls so that a building alteration is required in the event an exact duplicate is not available.

7. Gas lines shall be of a welded black steel construction up to emergency shut-off valves within reach of occupants. Gas lines from emergency shut-off valves to lab tables or appliances may be screwed if not larger than 3/4" and if they are exposed. Gas lines shall be installed exposed below ceilings throughout a building.

8. Waste lines from lavatories or any other fixtures shall not be on arms. The wastes shall discharge directly into a stack directly behind the fixture. Back to back lavatories are permitted if connected to sanitary tapped crosses. Straight taped crosses will not be permitted.

9. Plumbing riser diagrams must be drawn with one for each riser on the project. The risers must show all piping from the underfloor through the roof.

10. Floor drains shall be 4" in size serving 80 or larger square foot area. Smaller area shall contain 3" or 2" floor drains as required. Mechanical room floor drains shall be 4" size, minimum and shall be connected with trap primers.

11. Cleanouts shall be shown on plans and on riser diagrams.

12. Vent pipes shall be carried up adjoining soil and waste pipe, and they shall be connected into the main stack at top and bottom. Vents may be one size smaller than the traps they serve, except that no vent shall be less than 1-1/2". The size of vent lines accommodating more than one fixture shall be sized in accordance with the International Plumbing Code.

13. Roof drains shall be run separately from all other storm water sources to a manhole outside the building. Downstream from this manhole, the piping shall be sized sufficiently large to prevent roof drain water from impeding the proper flow from area drains. All piping dropping more than 50' shall be welded construction.

14. Specified fixtures shall conform to the requirements of the Texas Department of Health water saving performance standards.

15. Provide automatic flush valves for water closets and urinals.

G. HEATING, VENTILATING, AIR CONDITIONING

1. General Planning Criteria

   a. Do not use mechanical rooms or air handling unit equipment rooms as return air plenums. No pumps, panel boxes, etc. can be installed in a plenum. Each component of an air handling system shall be spaced in the unit so that there is ample room on all sides for inspection and maintenance and man size hinged access doors shall be provided for ready access to these spaces.

   b. Ventilate mechanical rooms.

   c. All mechanical rooms shall have locks and a common key system not accessible to building personnel.

   d. Provide lifting eyes or trolley rails for heavy equipment.

   e. Combinations of mechanical rooms and janitor closets, or mechanical room with storage spaces, are not acceptable. Main electrical switch gear shall be in a separate room and avoid liquid conveying pipes above the gear. Where such an arrangement is not possible, consult OFPC.

f. Access shall be provided to mechanical room spaces without going through any assigned area such as a janitor closet.

g. Walkways shall be provided for roof-mounted machinery so that equipment may be serviced without traffic directly on roof. Roof-mounted equipment shall be accessible by a stair. Hatches without stairs or use of external ladders are not acceptable.

h. Equipment rooms shall be large enough to provide access to all equipment for maintenance and a means to remove and replace equipment. Adequate "pull spaces" shall be provided for coils, shafts, filters, etc.

i. The standard HVAC system preferred by the owner is the double duct VAV terminal unit ("mixing box") that performs to the owner's satisfaction. If for some reason double duct systems are not appropriate for the project, then the designer shall design a single duct system with hot water coils for temperature control. This exception will only be allowed via written permission from the owner's Mechanical Engineer.

j. When the air conditioning system is operating on the refrigerated water cycle, the outside air shall be dehumidified by a separate air unit before releasing into the return air plenum of the main unit. This requirement is mandatory in the coastal areas and may be required on other campuses, depending on the building usage and the dewpoint of the design outside air conditions.

k. All coils shall be ARI rated. Fins shall be no more than 8 per inch. Cooling coils shall have copper fins; if spiral wound, they shall be solder dipped. Maximum number of rows in a single bank shall not exceed six.

l. All strainers shall have blow-down valves with 3/4" hose end connections.

m. All preheat steam coils should be vertical tube "non-freeze" type.

n. Cooling coils shall be sized for a maximum face velocity of 450 feet per minute.

o. All air handling equipment shall be installed so that bearings can be replaced without equipment demolition and be serviced through hinged access doors.

p. Electric motor speeds 1800 RPM and less are preferred for fans. Pumps may be directly coupled to motors with speeds as high as 3600 provided the highest efficiency of the pump is attained.

q. Equipment located above finished ceiling shall have adequate ceiling access panels or other means of access to equipment for maintenance and removal. Except for lift out ceiling installation all access panels shall be hinged. Equipment using water shall have auxiliary drain pans.

r. All storage spaces shall be ventilated and should preferably be served with building exhaust air or a treated air supply.

s. Toilet rooms shall have supply air, exhaust and transfer air. Janitor's closets shall have exhaust.

t. Exhausts from adjacent toilet rooms shall be arranged to prevent sound transmission between men's and women's areas.

u. Transformer vaults shall have separate ventilating fan or fans connected to emergency power supply. Vault shall be vented to outside in accordance with the National Electric Code.

v. All connections between dissimilar materials in the piping system shall be made with dielectric unions or couplings.

w. Pressure piping, including gas piping, shall not be located under slabs within buildings. Where such placement is unavoidable, the piping must be run in a sleeve and vented at each end so that leakage can be channeled off without pressurizing the underside of the slab.

x. Piping shall not be run in concrete floors. Piping shall not be buried beneath the lowest floor level with the exception of soil pipe.

y. At every point where piping and ductwork penetrate a floor slab, except slabs on grade, a cast-in sleeve or other waterproof curbing at least 2" high shall be provided.

z. All air conditioning unit chilled water coils shall be provided with control valves, either of the 3-way or 2-way type as required by the system. No wild coils will be permitted. 2-way valves are preferred except as required at the end of a main to maintain flow through the system and/or pumps.

aa. Fire dampers shall be installed in all duct penetrations of rated walls or enclosures in conformance with the International Building Code and NFPA code requirements.

ab. All condensate piping shall be designed to flow by gravity back to condensate receiver. Traps are <u>not</u> to kick or lift condensate up.

ac. All ductwork shown on plans shall be indicated as clear air stream size. Ducts shall be shown in two dimensions to scale with fittings, dampers, splitters, outlets and offsets clearly illustrated. Include large scale details of duct fabrication where necessary to show construction methods. (On final plans single line ductwork is prohibited except where specific prior approval is given by OFPC.)

2. Ductwork: When ductwork is drawn, keep in mind the following additional requirements:

a. There must be a minimum of three diameters of straight rigid ductwork entering terminal units. A detail will be required to emphasize this requirement to the Contractor.

b. Ductwork taps to supply diffusers shall be made using bellmouth or "boot" connections. Boot connections shall be from the side of the duct, not the bottom. This will allow for a better location for the volume dampers. Also, flexible duct shall be limited to 5 foot lengths or less. All other ducts shall be rigid.

c. All volume dampers shall be shown in the plans.

d. No more than 3 rooms of similar size, orientation, and function should be on the same zone. Director's offices, corner rooms, conference rooms, and other special purpose rooms should be on an individual zone. Note that a small corridor area or storeroom may be added to almost any small zone. Zones requiring large amounts of air (such as auditoriums or laboratories) may require more than one terminal unit, and may be controlled by a single thermostat. Terminal units are limited to 2,000 cfm maximum.

e. Use short radius vaned elbows in lieu of square 90° fittings with turning vanes. It is preferred that long radius sweeps be employed where space permits.

f. Show all ductwork on the same plan for each floor: high pressure, low pressure, exhaust, etc.

g. Lab exhaust ductwork material shall be 304 stainless steel from fume hoods to main branch exhaust duct and galvanized sheet metal on main ducts to fans.

3. Testing and Balance: The owner will contract for TAB (HVAC Testing and Balancing) services separately from the construction contract. The design professional shall provide only for the contractor coordination required in Section

23 05 93.A. Representatives of the TAB agency will participate in the progress reviews and will be provided appropriate review documents.

4. Controls: The controls for all projects shall be interfaced with the campus FCMS computer. Specific instructions for the specification of controls will be customized for the specific project.

H. FIRE SPRINKLER SYSTEMS

1. It is the strong desire of UT System to provide fire sprinklers for all buildings, whether or not required by code. Most buildings where fire sprinkler systems are considered by code to be optional may contain cost "trade offs" in building construction which may help to justify the use of fire sprinkler systems. Smaller buildings with severely limited budgets may not be able to afford sprinkler systems, and will be addressed individually. When the engineer is assembling plans, there shall be a separate set of drawings for fire sprinkler system and with OFPC Project Name and Number, north arrows, and graphic scales.

2. The engineer shall, in the plans, indicate the general piping arrangement. Head locations are required to be shown in critical or architecturally sensitive areas of the building. In addition, main piping shall be sized to assure the owner that the A/E team has investigated possible conflicts involved in the fire sprinkler systems, and coordinated the piping, HVAC, electrical, and structural systems throughout the project. (Conflicts are most frequent where the fire sprinkler systems are located.) A note shall also be added to the plans which states:

   "The fire sprinkler piping shown is intended to indicate the locations of the main supply piping, and larger runouts, as well as the areas intended for fire sprinklers. The inclusion of this information in the drawings shall in no way diminish the responsibility of the Contractor to provide a fully designed, sized, and installed fire sprinkler system, as required by the project specifications and the laws of the State of Texas."

3. Applicable national fire codes, as published yearly by the National Fire Protection Association, shall be used as guidelines for fire-fighting equipment. There are variations in requirements between campuses -- check before designing. In general, at least a Class II standpipe system shall be designed for the building occupants' use and a dry standpipe system in the fire stairs for the fire department's use.

I. COORDINATION OF DESIGN

1. The A/E shall make every effort to coordinate the design between disciplines. The final drawings shall, as a minimum, be checked for the following:

   a. To assist in the coordination the reflected ceiling plan shall show all electrical lighting fixtures, including exit lights, air diffusers, ceiling grilles, ceiling type speakers, ceiling grid, etc. Sprinkler heads need to be shown only in architecturally sensitive areas.

   b. Duct work shall be checked for clearance between ceiling construction and underside of beams, recessed lighting fixtures and other interferences where space is limited.

   c. Large mechanical system piping shall be coordinated with building construction, beams, etc., to assure clearances and accessibility for maintenance. Piping and electrical switchgear locations are to be coordinated.

   d. Coordinate requirements for louvers, equipment supports and other devices serving mechanical systems but furnished under the general construction section of the project.

2. Coordinate special types of equipment for correct rough-in requirements.

Revision Log
Appendix G

Rev. Date	Remarks
10/1/10	Added building controls section