Yes No N/A

Division 15 – Mechanical Equipment

15000 - Design Checklist

General:

1. Have all of the design professionals' standardized specifications, controls and details been "tailored" to the project? Has it been verified that all unnecessary items have been removed?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

2. Where future expansion is contemplated, has it been noted in the contract documents the assumptions that have been made? An example would be air handling unit 1 is designed to provide 2,500 cfm for three additional classrooms in the future.
(Specific drawing sheet #/specification page #_____.) ☐☐☐

3. On remodeling projects, has phasing been planned? Has known constraints and objectives been discussed and coordinated with all disciplines?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

4. Have all mechanical requirements such as shaft vents and air conditioning been addressed for Elevator Equipment Rooms?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

5. Has equipment loads from the manufacturer been secured?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

6. Has a mechanical and electrical roof plan been included showing all equipment and connections required instead of attempting to show them on the floor plan drawing directly below the roof?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

7. Have all thermostats and humidistats been shown?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

8. Have all switchgear rooms been air conditioned?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

9. Have all telephone equipment rooms been air conditioned?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

10. Is emergency power required for cooling in telephone equipment room?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

11. Have all structural penetrations been coordinated with the structural engineer in new and existing buildings?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

12. Have ¼ inch scale mechanical rooms been shown with all equipment indicated?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

13. Has a minimum of one section been shown for all mechanical rooms and crowded areas such as above corridor ceilings?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

Yes No N/A

14. Has a minimum of 75 cfm pressure differential been shown for positive and negative rooms?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

15. Has a pretest and balance with drawings indicating what is required been provided?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

16. Has it been specified that no CFC-based refrigerants shall be used in new buildings' HVAC systems and that existing building HVAC systems with CFC's shall be replaced?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

15001 - Design Information

1. Does the Conceptual Schematic submittal contain technical narrative discussing options, advantages, disadvantages, relative costs and recommendations?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

2. Does the Advanced Schematic submittal technical narrative provide greater detail of the concept selected?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

3. Have all major technical decisions been made before end of Design Development; are these decisions recorded in the Design Development submittal, and do they form the basis for the Design Development cost estimate?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

4. Does Division 15 work comply with the FAU Professional Services Guide latest edition? Attention is drawn to the specific requirements for 100% outside air systems, fume hood exhaust systems, clean room systems and other unusual or complex mechanical systems.
(Specific drawing sheet #/specification page #_____.) ☐☐☐

5. Have ASHRAE/ESNA 62.1-2004 and all approved addenda been specified? Has positive means for measuring and controlling outside air quantities into VAV air handling units, such as outside air fans or outside air VAV box, been provided?
(Specific drawing sheet #/specification page #--_____.) ☐☐☐

6. Has it been specified that mechanical ventilation shall be provided per the Standard Mechanical Code?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

7. Has it been specified that combustion air shall be provided for all fuel-burning equipment in strict accordance with the Florida Building Code for Mechanical and Plumbing?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

8. Has it been specified to utilize the campus chilled water system for cooling when available?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

9. Has it been specified to utilize the campus steam system or hot water system for comfort heating, hot water heating (through building heat exchangers) and AHU reheat when available?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

Yes No N/A

Energy Savings Design and Required Life-Cycle Cost Analysis

10. The Owner is most interested in the A/E providing creative thinking to provide designs which will decrease annual operating costs. Many of these opportunities will be in MEP systems. The Owner requires discussion and consideration of these opportunities in a life-cycle cost analysis study which compares energy-saving options during Advanced Schematics. Does the life cycle cost analysis computer program and procedure comply with FAU Professional Services Guide requirements? Items found to be cost-effective shall be incorporated into the design in compliance with Section 255.251, F.S.
(Specific drawing sheet #/specification page #_____.) ☐☐☐

11. Have the building envelope, HVAC, lighting, and other systems been designed to maximize energy performance? Comply with both the mandatory provision (Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4) of ASHRAE/IESNA Standard 90.1-2004 (without amendments) AND the prescriptive (Sections 5.5, 6.5, 7.5 and 9.5) or performance (Section 11) requirements. This establishes the project minimum (Baseline) Level of Energy Efficiency.
(Specific drawing sheet #/specification page #_____.) ☐☐☐

12. Has the Baseline Level of Energy Efficiency been exceeded by at least 10.5 percent for new buildings and 3.5 percent for existing building renovations? Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance as compared to a baseline building.
(Specific drawing sheet #/specification page #_____.) ☐☐☐

Interconnection with the Central Chilled Water Utility

13. The central chilled water system is designed as a variable flow system to achieve maximum energy economics. Is the design of the building established to operate over a varying pressure range with variable flow and relatively constant temperature rise?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

14. Does the building design provide 15 degree F temperature rise across all air handling unit coils, and properly interface with the chilled water system to assure the needed temperature rise is achieved while satisfying the building design criteria? The interface will also insure that the building pump(s) and the distribution pump(s) will be completely decoupled.
(Specific drawing sheet #/specification page #_____.) ☐☐☐

15. The CUP is designed to provide not higher than 45 degree F chilled water leaving the plant. Has the A/E verified the project's design temperature? Have the air handling units been designed for not less than 46degree F entering chilled water temperature, to allow for distribution system temperature rise?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

16. Has it been specified that regularly occupied areas of the building shall have air filtration media installed prior to occupancy that provides a Minimum Efficiency Reporting Value (MERV) of 13 or better? Filtration shall be applied to process both return and outside air that is to be delivered as supply air. Has this been verified with FAU Engineering and Utilities Department.?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

Yes No N/A

17. Has the application of fan coil units been approved by the Owner? Fan coil units where approved shall not be installed above the ceilings unless FAU's Facilities Planning Project Manager also approves in writing. ☐☐☐
(Specific drawing sheet #/specification page #_____.)

18. Do the construction contract specifications require training/orientation of FAU's Maintenance and Engineering personnel on all installed equipment and systems? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

19. Has FAU approval been given for factory-prefabricated insulated chilled water piping for underground use? (It may be used with University approval.) It is the responsibility of the A/E to investigate to assure approved vendors are limited to those with proven acceptable service at other locations for not less than two years, and to document this investigation in a formal project submittal.
(Specific drawing sheet #/specification page #_____.)

20. Has it been indicated that all utilities are to be metered for each building, including electricity, water, and chilled water? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

21. Has it been specified that all utility metering must be coordinated with the FAU's Facilities Planning Project Manager both during design and with the Contractor prior to construction? All metering devices should have a pulse and 4-20 ma output for remote connection to a computer. ☐☐☐
(Specific drawing sheet #/specification page #_____.)

22. Has appropriate separation been provided (using both distance and material) of mechanical equipment and other noisy areas from academic and office areas? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

23. Have commissioning authority requirements been incorporated into the contract documents? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

15001.1 - Classroom Design Information ☐☐☐

1. Has the following design criteria for noise in classrooms been followed?
(Specific drawing sheet #/specification page #_____.)

2. Apply NC-30 criteria to all University classrooms unless the following special purpose classroom applies which should be NC-25. These include hearing-impaired students students who do not speak the native language, and foreign language classrooms. For drama or music classrooms, the design professional shall submit in writing his or her proposed design criteria before producing documents. ☐☐☐
(Specific drawing sheet #/specification page #_____.)

3. Have the following HVAC systems been avoided in classroom applications? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

   a. Self-contained AC units located in the classroom ☐☐☐
   b. Rooftop AC units located directly above the classrooms
   c. Water source heat pumps above the classroom ceiling.
   d. Any unit mounted in a window or wall.

4. Has a low velocity ductwork system been specified for the classrooms? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

5. For classrooms less than 1,000 square feet in area, have at least four 4-way ceiling diffusers been provided? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

6. Have the diffuser been selected for at least 9NC points less than the criteria (i.e. NC=21 for the diffusers)? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

7. Have all air devices been selected with no volume dampers at the device face or at the device inlet? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

8. Have all volume dampers been located at least six feet from the air device? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

9. Has three diameters of flex ductwork been specified to be in the straight section of ductwork between the branch takeoff and the diffuser? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

10. Has round ductwork been used as much as possible above classroom ceilings to minimize duct breakout noise? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

11. Has the air handling unit been located away from the classrooms? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

12. Has a sound attenuator been located in the air handling unit? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

13. Has internal spring vibration isolation been provided on the fan/motor assembly of the air handling unit? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

14. Has the unit been externally vibration isolated if a self-contained unit? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

15001.2 Mechanical Equipment Rooms

1. Has roof mounted equipment, exposed to the environment been avoided? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

2. Has a concrete vibration inertia base been specified for air handling units located anywhere above slab on grade? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

3. Has the University painting guide for MER's been specified? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

4. Has the MER been sized sufficiently so that maintenance access and coil pull is available? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

5. Has coil pull space been kept clear of any piping? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

6. Have the MER doors been sized large enough to be able to take coil, or fan out of the building?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

7. Have drywall MER walls been avoided?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

8. Has proper consideration been given to noise control such as concrete block walls?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

9. Has the design avoided using the MER as a return air or outside air plenum?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

10. Has access been provided to roof for rooftop equipment?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

11. Have sprinkler heads been located above and below wide sections of ductwork?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

12. Have smoke detectors been provided and wired?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

13. Have housekeeping concrete pads been specified or shown on the drawings?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

14. Are all pieces of equipment shown in the MER that will actually be located there? Items such as VFD's, temperature control panels, electrical panels (space requirements in front of panel) etc.
(Specific drawing sheet #/specification page #_____.) ☐☐☐

15. Has a supply and return grille been provided for some ventilation of MER (south Florida humidity)?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

16. Has a section been cut through the MER on the drawings?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

17. Have marine lights been shown and coordinated with the electrical?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

18. Has passage way around equipment and exit from room been given minimum of 7 feet headroom?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

19. Has a minimum of 8 inch concrete block and two layers of 5/8 inch gypsum board been used for mechanical room walls for noise prevention?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

20. If there are occupied spaces above or below the MER, has proper precautions been taken? (such as thickening the slab above and/or below)
(Specific drawing sheet #/specification page #_____.) ☐☐☐

21. Has a heavyweight door with gasketing been used for the MER?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

Yes No N/A

22. Has a minimum of 28 inches been left all around equipment per OSHA 1910 requirements?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

15001.3 – Laboratory Design Information

1. Has the air pressure in each laboratory been designed to be negative to the corridors or adjacent non laboratory area?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

2. Have the controls and dampers been designed to fail in an open position to assure a positive draft?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

3. Has the location of all diffusers been carefully selected to avoid air currents that would adversely affect performance of laboratory hoods?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

4. Has the use of fire dampers been avoided in hood exhaust systems?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

5. Has the use of interlocks to automatically shut down lab exhaust fans been avoided?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

6. Has it been specified to install airflow indicators and alarms on new laboratory hoods or, on existing laboratory hoods, when modified?
(Specific drawing sheet #/specification page #_____.)

7. *(existing buildings)* Has a second means of access to an exit been provided from the laboratory work area if a hood is located adjacent to the primary means of exit access? ☐☐☐
(Specific drawing sheet #/specification page #_____.) ☐☐☐

8. *(new buildings)* Have all laboratory hoods been located such that they are not adjacent to a single means of access or high traffic areas?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

9. Has any air exhausted from laboratory hoods or other special local exhaust systems been designed such that it will not re-circulate?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

10. Has NFPA Standard 45 been reviewed in detail?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

11. Has the design professional received a written hazard assessment from the FAU Environmental Health and Safety Dept?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

12. Have pressure independent supply and exhaust systems been specified or shown on the drawings?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

13. Has a study been done for wind effect on airflow around the buildings or adjacent buildings and the potential for reentry of exhaust into outside air intakes of the buildings?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

Yes No N/A

14. Has the use of auxiliary air type fume hoods been avoided? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

15. Has the use of low flow type fume hoods been avoided? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

16. Has it been determined in writing the types of effluents to be exhausted so that hood and ductwork materials may be appropriately selected? Perchloric hoods? Radioisotope hoods? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

17. Has all positive pressure exhaust ductwork been kept out of the building? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

18. Has it been determined whether insulation, watertight construction, or sloped and drained ductwork is required on any of the systems? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

19. Has the latest edition of ANSI Standard Z 9.5 been reviewed in detail? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

20. Have variable frequency drives been specified for all laboratory exhaust fans and air conditioning fans? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

21. Has the use of belt driven laboratory exhaust fans been avoided? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

22. Have fume hoods been located away from doors, operable windows, and in general located to minimize cross drafts and air disruption? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

23. Have laboratory exhaust systems been constructed of non-combustible materials; have all joints and connections sealed; and have materials resistant to acids, bases, solvents and corrosive gases? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

24. Are fume hood systems designed to keep noise levels less than 68db(A) one foot in front of hood face with hoods running? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

25. Have fume exhaust stacks been designed for termination 10 feet above the highest point of roof and for 3000 fpm discharge velocity? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

26. Has all exposed horizontal ductwork on the roof been designated round to avoid puddling of rain on top of ductwork? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

27. Have all laboratory fume hood exhaust fan motors been connected to emergency electrical service provided for building? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

28. Have all eye washes been plumbed to drain directly to sanitary or installed in a sink where sink is plumbed to sanitary? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

29. Have floor drains been kept out of Laboratories and Chemical storage areas? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

30. Has it been specified for laboratories to meet LEED EQc5 indoor chemical and pollutant source control? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

15001.4 Museum and Library Design

1. Has the collection space been designed with air being constantly circulated at full volume and with efficient air distribution? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

2. Has the outdoor air been kept to a minimum? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

3. Has pressurization been employed to minimize infiltration? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

4. Has the humidity levels been specified for a constant humidity of 45% to 50%? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

5. Have the humidity sensors been shown in the location of the collection and not in the return air duct? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

6. Has the design accomplished humidity levels with mechanical cooling rather than dessicant methods? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

7. Are reheat capabilities present so dehumidification can occur when space cooling is not required? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

8. Has incandescent lighting been used? (Lighting which has high UV is not recommended, nor is light which generates heat.) ☐☐☐
(Specific drawing sheet #/specification page #_____.)

9. Has it been specified to operate HVAC equipment and air purification continuously in collection spaces? (No unoccupied modes) ☐☐☐
(Specific drawing sheet #/specification page #_____.)

10. Has filtration of 80-85% bag filters with 30% pleated pre-filtering been specified? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

11. Has the space temperature been designed to provide 72-74 deg F? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

12. Has UV-C high output lights been specified to be downstream of the cooling coils in the AHU's? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

15010 - Heating, Ventilating, and Air Conditioning Equipment General Requirements
General Considerations:

1. Has utility work been coordinated through FAU's Facilities Planning Project Manager? Utility Work and connections to University utility systems must be properly planned to prevent disruption of classes and/or research efforts.
(Specific drawing sheet #/specification page #_____.) ☐☐☐

2. Has care been taken in placement of all outdoor air inlets to assure that odors and other pollutants (automobile exhaust; toilet/fume hood exhaust, etc.) do not enter/reenter the building?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

Site Utilities

3. Has the A/E discussed with the University the various utility's demands created by the Project and documented that sufficient capacity exists to serve the demands?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

4. Has the A/E investigated and determined the actual location of all underground utilities or obstructions at the building site before beginning design? This involves surveyor work, supplemented by further site investigation as needed.
(Specific drawing sheet #/specification page #_____.) ☐☐☐

5. Has it been specified that electrical, water, sewer and chilled water utilities during construction shall be paid for by the Contractor on a monthly basis as arranged through the University?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

6. Has it been specified that heat, air conditioning, humidity control and any other environmental factors shall be the responsibility of the Contractor throughout the construction period?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

Training

7. Has the Architect/Engineer discussed training needs with FAU's Engineering & Utilities Department and specified the required training in the Construction Documents?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

8. Has it been specified that training sessions should be videotaped and tapes given to the University?
(Specific drawing sheet #/specification page #_____.) ☐☐☐

9. Has the following minimum amount of training been specified for new mechanical systems:

   a. HVAC Control Systems - 32 hours divided into four sessions.
   (Specific drawing sheet #/specification page #_____.) ☐☐☐

   b. VAV Boxes - 16 hours divided into four sessions.
   (Specific drawing sheet #/specification page #_____.) ☐☐☐

   c. Variable Speed Drives - 16 hours divided into four sessions.
   (Specific drawing sheet #/specification page #_____.) ☐☐☐

d. Boiler and Associated Controls - 24 hours divided into four sessions. (Specific drawing sheet #/specification page #_____.) ☐☐☐

e. HVAC Air Handling Units, Fans, Other Mechanical - 16 hours divided into two sessions. (Specific drawing sheet #/specification page #_____.) ☐☐☐

f. Fire Sprinkler Systems - 16 hours divided into two sessions. (Specific drawing sheet #/specification page #_____.) ☐☐☐

Mechanical Rooms

10. Do the mechanical rooms have adequate openings to facilitate the removal and replacement of major pieces of equipment? (provide double 3'-0" doors which swing outward or larger, if necessary. Consider roll-up doors for rooms opening to outside with large equipment.) (Specific drawing sheet #/specification page #_____.) ☐☐☐

11. Is there adequate space in mechanical rooms to provide ample access space around all equipment for routine maintenance items and procedures, such as filter replacement, lubrication, and so on? (Specific drawing sheet #/specification page #_____.) ☐☐☐

12. Are lighting and utility receptacles provided for equipment servicing? (Specific drawing sheet #/specification page #_____.) ☐☐☐

13. Access to electrical rooms, mechanical rooms, telephone closets, elevator machine rooms, fan rooms, pump rooms, etc. shall not be through other rooms. Has access to these spaces been achieved from a main corridor and/or exterior space? Doors to these spaces shall comply with NFPA Fire Safety Codes. Vertical ladders shall not be used for this access. ("Ship's ladders", which are actually steep stairs, may be used only with the written approval of FAU Engineering & Utilities Dept.) (Specific drawing sheet #/specification page #_____.) ☐☐☐

14. Are mechanical rooms and similar spaces separated from storage areas? (Specific drawing sheet #/specification page #_____.) ☐☐☐

15. Are all power disconnects to equipment located as to be easily accessed? (Specific drawing sheet #/specification page #_____.) ☐☐☐

16. Are telephone system "backboards" installed in separate telephone equipment rooms? (Specific drawing sheet #/specification page #_____.) ☐☐☐

17. Has it been indicated to install drip traps before all thermostatic temperature regulating valves and pressure reducing valves? (Specific drawing sheet #/specification page #_____.) ☐☐☐

Basic Mechanical Requirements

18. Has it been specified to provide submittals including: (Specific drawing sheet #/specification page #_____.) ☐☐☐

a. Automatic temperature control system.
b. Concrete pads and foundations including anchor bolt and sleeve locations.

c. Fire protection systems.
d. Layouts for utility plant, fan rooms, and equipment rooms, including:

1. Room dimensions.
2. Support column locations.
3. Locations and dimensions of equipment foundations and pads required.
4. Locations and dimensions of equipment and apparatus, including electrical control panels and starters, and service and coil pull areas.
5. Dimensioned floor drain locations.
6. Locations of wall mounted equipment.
7. Trench locations and sizes.
8. Sleeve locations in mechanical rooms and equipment rooms.
9. AHU (fans) and duct layouts in AHU equipment rooms.
10. Roof layouts: Include air intakes, exhaust fans, plumbing vents, and boiler stacks.

15015 - Toxic/Hazardous Materials--General Guidelines

1. Has the A/E, Contractor and other related personnel contacted FAU's Environmental Health and Safety Department concerning instructions on all toxic/hazardous materials involved in a project? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

2. Where toxic/hazardous materials are involved, has all construction, maintenance, and/or investigative Work been coordinated with FAU's Physical Plant Department and FAU's Environmental Health & Safety Department? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

3. Has the A/E clearly specified that no asbestos, or any building material containing asbestos, shall be used in any building project? This requirement includes insulation, roofing materials, paint and related products among others.) ☐☐☐
(Specific drawing sheet #/specification page #_____.)

4. Has it been specified that all electrical transformers, switches, or other electrical equipment which contains polychlorinated biphenyls (PCB) or other equipment which has come in contact with PCB is to be returned to the University? Absolutely under no circumstances is the Contractor, Subcontractor, or other related personnel allowed to dispose of such equipment off the site. The A/E shall contact FAU's Physical Plant Department and FAU's Environmental Health and Safety Department regarding handling procedures for this equipment. ☐☐☐
(Specific drawing sheet #/specification page #_____.)

5. Has it been specified that any hazardous or toxic material, such as asbestos or PCB, which is discovered during the course of a project must be reported immediately to FAU's Facilities Planning Project Manager? All Work involving suspected asbestos, hazardous, or toxic materials must halt immediately and not resume until notice to resume Work has been given by FAU's Facilities Planning Project Manager. ☐☐☐
(Specific drawing sheet #/specification page #_____.)

6. Has the A/E contacted FAU's Environmental Health and Safety Department prior to the commencement of a renovation project in order to determine the extent of asbestos or other hazardous contamination in a particular building? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

7. Has only lead-free and low- or no-VOC paint been specified? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

15050 Basic Materials and Methods

1. Has it been specified to provide brass engraved valve tags for all valves? (Specific drawing sheet #/specification page #_____.) ☐☐☐

2. Has it been specified that the following piping within each mechanical room, fan room, boiler room, and utility plant shall be painted in its entirety. This piping shall also be stenciled for Identification. Sherwin Williams color codes are listed here as a University standard. (Specific drawing sheet #/specification page #_____.) ☐☐☐

    a. Chilled water: Circuit Breaker SW4077
    b. Condenser water: Emerald Ice SW4069
    c. Hot Water Heating: Power Orange SW4074
    d. Domestic Cold Water: Turbine Blue SW4064
    e. Domestic Hot Water: Recycled Red SW4073
    f. Natural Gas: Safety Yellow SW4084
    g. Propane: Plumb SW 4080
    h. Fire Protection: Safety Red SW 4081
    i. Fuel Oil: Copperplate SW4038
    j. Condensate Return: Corrugate Brown SW 4016
    k. Low Pressure Steam: Optic Yellow SW 4035
    l. Medium Pressure Steam: Junction Yellow SW 4034
    m. High Pressure Steam: Solar Yellow SW 4075

3. Has the following construction and pre-occupancy Indoor-Air-Quality (IAQ) Management criteria been specified? ☐☐☐

    1. Include in the specifications the items listed. Also required that all on-site equipment and components shall be protected from dust.
        a. During construction, meet or exceed the recommended design Approaches of the SMACNA IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3.
        b. Protect stored on-site or installed absorptive materials from moisture damage.
        c. If AHU's must be used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE 52.2-1999.

4. <u>LEED EQc3.1 : Construction IAQ Management Plan</u>:
Replace all filtration media immediately prior to occupancy. Filtration media shall have a MERV of 13, as determined by ASHRAE 52.2-1999 for media installed at the end of construction.

5. LEED EQc3.2: Construction IAQ Management Plan:
Include in the specifications the items listed below regarding to pre-occupancy IAQ.
    a. After construction and prior to occupancy, conduct a minimum 2-3 week flush-out with new MERV 13 filtration media at 100% outside air. After the flush-out, replace the filtration media with new MERV 13 filters, except for the filters solely processing outside air.
    -OR-
    b. Conduct a baseline indoor air quality testing procedure consistent with the U.S. EPA's current Protocol for Environmental Requirements, Baseline IAQ and Materials for the Research Triangle Park campus, Section 01445.

Yes No N/A

15060 - Pipes, Valves, Pumps and Pipe Fittings

1. Has it been specified that all HVAC air handling unit condensate lines shall be of insulated type "L" copper? ☐☐☐
(Specific drawing sheet #/specification page #_____.)

2. Has it been specified that all hot and chilled water taps shall be made without system interruption and each juncture shall be provided with a shut-off valve and valve box for easy access? Maximum acceptable "weldolet" size is six inches; use welding saddles or encirclement for greater than six inches diameter branch piping. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Has it been specified that all HVAC water coils shall have air eliminators installed (both hot and cold if separate)? All coils shall have both inlet and outlet pressure and temperature gauges. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Has it been specified to provide flow measuring element at all major air handling unit chilled water supply lines? Discuss with FAU's Physical Plant Department for their standard. Venturi type are preferred. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

5. Has it been specified that all piping will be identified in accordance with ASA A13.1, the American Standard Scheme for the identification of Piping Systems? Identification shall include color coding, labeling of piping contents, and flow arrows. Purchased preprinted labels are preferred. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

6. Has it been specified that chilled water pumps will usually be required to circulate chilled water throughout the building? A fine mesh monel or stainless steel strainer shall be installed in the chilled water supply line of each building to prevent contamination of the building chilled water system. All chilled water strainers should have a pressure gauge installed across the strainer so as to quickly determine when strainers are dirty. The pressure gauge should also have a 4-20 ma output for remote computer monitoring. Design of the interface between the building and central utilities systems shall be coordinated with the FAU's Facilities Planning Project Manager. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Steam and Hot Water Piping

7. Has it been specified that all flange studs, bolts and nuts shall be hex configuration and coarse threaded, and be of ASTM A-193, Grade B7 alloy steel such as USS Supertanium alloy, or equivalent? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

8. Has it been specified that all high pressure and low pressure steam piping shall be Grade A- ASTM A-106, schedule 40 seamless piping, and condensate return lines shall be Schedule 80 seamless pipe? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

9. Has it been specified that valves installed above grade as part of the high pressure steam system, and valves installed below grade shall be 300 lb. valves? Valves that are 2-½" and larger shall be flanged, and all valves less than 2-½" shall be screwed unless otherwise agreed with FAU's Facilities Planning Project Manager. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

10. Has it been specified that all piping that is 2-½" and larger shall be welded and flanged, not screwed? All underground fittings shall be welded by a certified welder. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

11. Has it been specified that steam piping with operating pressures greater than 50 PSIG shall use butt welded fittings with backing rings? Fittings that are 1-½" and smaller shall be forged steel screwed or socket weld fittings. Unions that are 2" in size shall be 300 lb. screwed; cast iron or forged steel. All high pressure steam nipples shall be schedule 80. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

12. Has it been specified that steam piping with operating Pressures 50 PSIG or less that are 2" and larger shall be schedule 40 butt welded fittings with backing rings, and flanges shall be slip-on or weld neck flanges? Steam fittings that are 1-½" and smaller shall be 150 lb. cast iron using 300 lb. cast iron unions and schedule 0 nipples. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

13. Has it been specified that condensate lines that are 2-½" and larger shall be schedule 80 butt weld fittings with backing rings and steel weld neck or slip-on flanges that are the same pressure class as the valves? Condensate lines that are less that 2-½" shall be forged steel or socket weld using 300 lb. screwed unions and schedule 80 nipples. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

14. Has it been specified that condensate return, when used, shall use above floor pumps? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

15. Has it been specified that all condensate receiver unit vents shall be run full size from unit to atmosphere through the building roof? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

16. Has it been specified that all steam condensate lines underground shall have properly sized expansion loops and shall be properly anchored? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

17. Has it been specified that all chilled water supply and return piping and heating hot water piping conforms to the specifications for Steam & Hot Water Piping in 15060.07 through 15060.16? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

18. Has it been specified that on multi-floor buildings isolation valves shall be supplied at each floor where chilled and hot water piping connects to vertical risers and also that taps for pressure gauges shall be provided on both supply and return lines. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

19. Has it been specified that pipe hanger & clamp materials shall be electrolytically compatible with materials with which they are in contact? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

20. Has it been specified not to use mechanically coupled joints for HVAC or plumbing systems? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

21. Has Type L hard copper been specified for the following? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

    a. Domestic hot water

b. Domestic hot water recirculating piping
c. Domestic cold water
d. HVAC reheat water
e. HVAC chilled water
f. Hydronic heat pump piping 1" and less

22. Has cast iron soil and vent pipe standard weight with drainage fittings been specified for the following?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

a. Waste, vent, and drainage pipe 2" and larger Storm water.
b. Rainwater leaders inside building.
c. Drain lines under buildings, and under exterior concrete or other paving. Extend cast iron piping at least 5 feet outside of building.

23. Have the following joints in cast iron pipe been specified?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

a. Below grade: Bell and spigot with neoprene compression gaskets.
b. Above grade: No-Hub using stainless couplings.

24. Has it been specified that PVC schedule 40, Type I, DWV, ASTM D-2665, 1120, 160 Psi at 73 deg F may be used for the following - Inside gravity, under floor slab sanitary and storm waste systems, with waste temperatures below 140 deg Fº?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

25. Has it been specified that PVC schedule 40 , Type-PSM, Sewer Pipe, ASTM D-3034 with SDR as gasketed slip type joints may be used for outside gravity, underground sanitary sewer drainage piping, from 5'0" outside the building to the connections point to local municipality?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

26. Has it been specified not to install water pipes in electric rooms, telephone rooms, transformer rooms, or elevator rooms?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

27. Has it been specified not to install water piping above electrical equipment such as starters, motor control centers, or disconnects?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

28. Has it been specified not to use "T" Drill Branch Tee connections for copper piping systems?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

29. Has it been specified to provide ceiling/wall access panels at shutoff and control valves for proper access and operation?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

30. Has it been specified that all branch piping shall be provided with a shutoff ball or butterfly valve where the branch leaves the main?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

31. Has it been specified that all equipment such as fan coils, terminal reheat coils, etc. shall be provided with a shutoff valve with which to isolate each piece of equipment?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Yes No N/A

32. Has it been specified to use flanges and unions throughout the pipe systems at all equipment?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

33. Has it been specified to make provisions for servicing and removal of equipment without dismantling piping?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

34. Has it been specified that all nonmetallic underground piping is marked with a metallic marking device to enable location by underground utilities locators in the future?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

35. Has it been specified that all branch piping is to come off top of mains to insure that sediment and metal particles, such as solder, welding material, threading remnants, and shavings do not normally enter the branch lines to cause clogging or damage to valves?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

36. Have dielectric unions been specified for connection of dissimilar materials?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

15100 Valves

1. Has it been specified that all butterfly valves are to be full lug?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

2. Has it been specified that butterfly valves 5 inches and larger shall have a hand wheel and closed housing worm gear and that less than 5 inches shall have a clamp lock hand lever?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

3. Has it been specified to provide chain operators for all gate valves, butterfly valves, and plug cocks located 7 feet or higher above finished floor?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

4. Has it been specified to provide valves in each piping connection at each piece of HVAC or plumbing equipment to allow equipment to be isolated from piping systems?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

5. Has it been specified to provide valves in HVAC circulating water piping to isolate each floor or main section of the building?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

6. Has it been specified to provide butterfly valves in water piping systems so that ordinary maintenance work can be performed on the equipment butterfly valves isolate, without having to drain the system beyond the butterfly valve?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

15250 - Mechanical Insulation

1. Is underground chilled water piping insulation foamglas with Owner approved outside wrap?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

2. Is chilled water piping above grade insulation foamglas covered with a .016 inch thick aluminum weatherproof jacket that has a factory applied integral vapor barrier?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Yes No N/A

3. Has it been specified that the foamglas should be glued to the piping and fastened with aluminum bands located not more than 12" apart? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Has it been specified that if condensation occurs on any cold surface at any time during the warranty period, or before substantial completion after systems are activated, the Contractor shall be required to rework the insulation until satisfactory, at no additional expense to the Owner? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

5. Has it been specified that if condensation occurs on the outside of insulated ducts, HVAC equipment, VAV boxes, flex ducts, etc. during the construction period, the Project Team shall take immediate action to determine the reasons, determine whether due to A/E error or Contractor error, and initiate corrective action? Substantial Completion shall not be approved until corrections are agreed to in writing, including responsibility for cost. (It is preferred to stop Work or delay completion, if necessary, rather than to delay resolution and correction.) ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

6. Has it been specified that all building hot and cold water piping shall be insulated? All cold AHU condensate piping shall be insulated. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

7. Has the pipe insulation thickness been discussed and approved by the Owner during the early design process? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

8. Has it been specified that insulation for high and low pressure steam and condensate lines above grade shall consist of calcium silicate? Below grade steam lines shall have a calcium silicate inner layer and a foamglas outer layer wrapped with glass fabric cloth and with proper mastics applied. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

9. Do condensate lines below grade have foamglas insulation wrapped with glass fabric cloth and with proper mastics applied? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

10. Are the attachments for the insulation below grade; stainless steel wiring, bands, or 16 gauge copper wire, on 9" centers? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

11. Has it been specified that below grade steam fittings are to be insulated with mitered segments of calcium silicate wired in place and that below grade steam flanges, unions, and valves are to be insulated with oversized pipe insulation? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

12. Has it been specified that below grade, all domestic hot and cold water piping shall be standard schedule 40 galvanized iron pipe or type "K" copper? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

13. Specifier certifies that galvanized iron pipe shall <u>NOT</u> be specified for domestic water piping. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

14. Has it been specified that the hot water lines should be coated, insulated with foamglas, and wrapped with glass fabric cloth? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15. Has it been specified that insulation on equipment and devices that require service such as strainers, pump bodies, etc. shall be removable? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

16. Has it been specified to insulate condensate drain lines? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

17. Has it been specified to insulate return air ducts where there is a roof directly above? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

18. Has it been specified that all systems will be insulated to the values required by the Florida Energy Code? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

19. Has it been specified that mechanical room duct systems will be insulated with semi-rigid fiber board and not blanket type insulation? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

20. Has it been specified for flexible tubular elastomeric pipe and fitting insulation when exposed to view inside building or exposed to the weather, to finish with two coats of fire retardant self-extinguishing vinyl lacquer type highly flexible coating equivalent to Armstrong “Armaflex Finish”, custom color blended to match surrounding surfaces? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

21. Has it been specified that ducts shall not be internally-lined or internally-insulated? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

22. Has it been specified that duct insulation on ducts concealed and/or above ceilings shall be ASTM C553, Type 1, Class B-4 flexible mineral fiber blanket with UL-rated integral vapor barrier? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

23. Has it been specified to use:
LEED EQc4: Low-Emitting Materials:
All interior adhesives and sealants must meet or exceed VOC limit requirements of South Coast Air Quality Management District Rule #1168 and sealants used as fillers must meet requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15400 - Plumbing Systems & Toilet Rooms

1. Has it been specified that water meters, meter boxes and taps shall be furnished by the Contractor? On sizes above 2", provide by-pass line and gate valve of the same size as the main line, if possible. These meters may be obtained from the local municipal authority with University approval. Water meter shall include remote monitoring capability, NEPTUNE TRU/FLO Compound meter. Flow rate will dictate if compound meter is necessary during design. Indicate elect conduit to the water meter from the elect monitoring panel. The Elect Monitor System panel shall include terminal points for this water meter. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

2. Has it been specified that water meters shall be installed with full size 3-valve by-pass piping? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Has it been specified to put access panels for all cutoff valves installed for each floor level behind all showers and other fixtures that must be maintained, or provide access panels into pipe spaces from which the fixtures can be maintained? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Has it been specified that all wye strainers shall be equipped with valves for blow down cleaning? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

5. Has it been specified that drains for water systems shall consist of gate valves and hose nipples, rather than hose bibs? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

6. Has it been specified that hose bibs shall be provided in toilet rooms, machinery rooms, and Wall Hydrants at 100 foot intervals in exterior areas for maintenance use? All exterior and machinery space hose bibs shall be key operated. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

7. Has it been specified that all water supply pipe shall be type "L" copper? Plastic piping is not acceptable for potable water service inside buildings. Plastic piping is not acceptable for exposed pipe above grade. All solder used in potable water systems shall be non-lead bearing in accordance with Code. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

8. Has it been specified that domestic water piping larger than 3” shall be ductile iron pipe. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

9. Has it been specified that waste piping shall be service weight cast iron pipe? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

10. Has it been specified that interior vent piping shall be galvanized steel or no-hub cast iron? No-hub joints shall include four band straps or more. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

11. Has it been specified that dielectric fittings shall be used for connections between dissimilar metal pipes? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

12. Has it been specified that backflow preventers shall be furnished by the contractor? Indicate (02) dual, parallel BFP assemblies for all science buildings. All others to receive valved bypass for servicing of BFP. Confirm this with FAU’s Engineering & Utilities Department at time of design. Indicate concrete pads under BFP assemblies. Indicate bollards protecting the exposed BFP assemblies. The contractors’ Close Out Documents shall include BFP test certifications, make-up water RPZ certifications, Fire Line DCDA test certifications, gas appliance certifications from manufacturer and contractor as required to register gas equipment with State Fire Marshal. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

13. Has it been specified that floor drains with trap primers or deep seal traps, as agreed with FAU, shall be provided in all toilet rooms, janitorial closets and rooms, and mechanical equipment rooms? Emergency showers shall not have floor drains. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

14. Has it been specified that floor drains shall have trap primers in all locations where constant water flow to keep the trap full is not otherwise assured? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15. Has it been specified that clean-out plugs in piping shall be set with Teflon sealer or other approved lubricant? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

16. Has it been specified that metal access doors shall be provided in walls and ceilings for all valves, regulators, and clean-out? (A piping chase is desired.) ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

17. Has it been specified that all exterior valves shall be fitted with a complete one-piece valve box unit having an attached hinge cover and set in concrete? Provide 24"x24" reinforced concrete collars with underground valve tags UVI WAGCO or equal. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Fire Safety Systems

18. Has it been specified that all fire safety systems shall comply with current State Fire Marshal Rules, including the NFPA Codes? This includes, but is not limited to underground site firewater piping/valves, building entry valves/fittings/test piping, extinguishers, sprinkler systems, and standpipes. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

19. Has it been specified that certification of the NFPA Code is required on all fire safety systems and pressure testing shall be provided on NFPA forms to the University? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

20. Has it been specified that connections for fire fighting equipment (location, thread standards) shall be accepted by both the University and the local fire fighting authority; and shall conform to NFPA requirements? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

21. Threadable Thin Wall Black Steel pipe, including XL pipe, is thinner than schedule 10 therefore, does not comply with NFPA requirements that threaded pipe shall be no thinner than Schedule 10 pipe. Specify that Threadable Thin Wall Black Steel pipe, including XP pipe, IS NOT ACCEPTED by SFM. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Toilet Rooms

22. Has it been specified that toilet rooms for men and women must be supplied on each floor? All restrooms are to be sized and equipped for the handicapped in accordance with ANSI and ADA standards. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

23. Has it been specified to provide valves at each floor level on hot and cold water, steam, condensate and gas lines? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

24. Has it been specified that isolation valves shall be installed in water supply lines to each toilet room grouping and at riser take-offs for each floor? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

25. Are all lavatories acid resisting enameled cast iron? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

26. Are all urinals of the flooded open throat type to avoid stoppages and odor problems? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

27. Are all floor drains provided in the proper location at the lowest point in the room into which all areas will drain? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

28. Are all fixtures and partitions wall or ceiling hung to keep floors clear for cleaning? Fastening is to be by means of toggle bolts and through bolts into studding, stringers, or joists to prevent attaching to the wall only. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

29. Has it been specified that toilet fixtures shall be floor-mounted? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

30. Are all floors ceramic tile with dark sealed grout? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

31. Are all lavatory faucets the type that will not flow over ½ GPM? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

32. Do all stall walls (1-inch solid plastic) have a graffiti-resistant finish? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

33. Is a wall mounted, key operated hose bib provided in each toilet room two feet above the floor? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

34. Is a ventilation fan with the minimum CFM required for the space (typically not less than 2 cfm per square foot) operated in conjunction with the lights provided? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

35. Toilet rooms should not be over-lighted. However, lighting should be adequate to encourage cleanliness and discourage graffiti. Is the average lighting at 40 foot candles with no dark corners? Lighting should use overhead troffers with acrylic lenses. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

36. Does the standard type wash basin have strainer type drain, lever handles equipped for handicapped use, cold water faucets, no hot water faucets (except in dormitories and service buildings) and soap dispensers? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

37. Has it been specified that drinking fountains shall be water coolers with self contained refrigeration systems and that basins and enclosures shall be stainless steel? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

<u>Custodial Closets</u>

38. Are the faucets single delivery mixing type with threaded spout equipped with a 3 foot hose and backflow preventor? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

39. Are faucets 30" - 36" above sink rim? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

40. Is this space separate from the building mechanical, plumbing, electrical, and telephone equipment and entered directly from a corridor and is not a passageway to any other room? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15450 – Plumbing Equipment

1. Have Technical Concepts Milano polished chrome #500481 “Surround Sensor” touchless hand faucets been specified? (4” centerset listed – other mounts are available) ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

2. Have Technical Concepts AutoFlush Sidemount chrome #401186 automatic urinal flushers to fit Sloan/Zurn flush valves (or #401207 to fit Coyne-Delaney) been specified? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Have Technical Concepts AutoFlush Sidemount chrome #401187 automatic toilet flushers to fit Sloan/Zurn flush valves (or #401206 to fit Coyne-Delaney) been specified? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Has a manual pushbutton flush been specified on all automatic toilet flushers? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

5. Has it been specified to use: LEED WEc3: and Water Use Reduction and LEED WEc2: Innovative Wastewater Technologies. Urinals using not more than 1/8 gallon per flush (Zurn or pre-approved equal) Waterless urinals, ceramic, when approved by the University, lower flow fixtures, or waterless fixtures where feasible, use a tamper-proof 2.0 gpm flow restrictor where feasible, and use reduced gpf flush valves where feasible. Discuss this option with FAU’s Facilities Maintenance. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15500 - Heating, Ventilating & Air Conditioning

1. Has it been specified that HVAC ductwork shall be fabricated from metal? Duct board is not acceptable. (outside insulation on metal ductwork is preferred.) ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

2. Has it been specified that fume hood exhaust systems require special care? Has Section 15001 of these Guidelines been reviewed and approved by the Owner? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Has it been specified that laboratory systems including fume hood exhaust systems shall comply with State Fire Marshal's requirements, including NFPA-45? (Fire dampers are not permitted in fume hood exhaust systems.)? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. As far as possible, control systems should allow for unoccupied set-back of both temperature and humidity; i.e., HVAC systems should stay off during unoccupied times unless either temperature or humidity levels reach pre-determined limits, or unless special building requirements require continuous operation. Has the Architect/ Engineer discussed this subject in formal submittals before Design Development is completed, and documented the discussion in the Design Development submittal? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

5. Has it been specified to provide air and water test and balance with written report before beginning remodeling or renovation work? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

6. Has a field evaluation been made to determine if a hot or chilled water booster pump is required for the building HVAC system? Have the results of this evaluation been furnished to FAU's Facilities Planning Project Manager? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

7. Has it been specified that all fans shall be stenciled, indicating "exhaust" or "supply" and area(s) served? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

8. Have all HVAC and thermostat control systems been discussed with and approved by the Owner to determine whether pneumatic, DDC or other systems shall be designed? In addition, has the latest lightning surge protection developed by the central control system manufacturer been provided? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

9. Have all major air handling unit coils been designed for not less than 15 degree Fahrenheit temperature rise, and provided with 2 way chilled water control valves, for energy conservation? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

10. Have all water valves that are 2-½" and larger been flanged 125 psi valves? Are all pressure gauges 4-½" face, bottom connection? Are all OS&Y (outside screw and yoke) valves 3" or larger (preferred)? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

11. Are all temperature gauges mounted in wells? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

12. Have all permanent metering devices been approved by the FAU's Facilities Planning Project Manager and the FAU Physical Plant Division? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

13. Are all condensate pumping units above grade unless otherwise approved by FAU? Are they duplex pumps with cast iron receivers and ceramic seals. The pumps shall be equipped with balanced mechanical seals (packing not allowed). ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

14. Are all hot water and chilled water pumps equipped with balanced mechanical seals? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15540 HVAC Pumps

1. Has it been specified that heating pumps shall be suitable for handling water at 230 deg F? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

2. Has it been specified that pumps casings shall be cast iron with replaceable bronze wearing rings and rated for 150 psig working pressure? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Has it been specified that the impeller diameter shall not exceed 90% of the maximum

		Yes	No	N/A
	diameter for which pump curves are published? (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
4.	Has it been specified to make hot alignment check on couplings between motors and pumps? (Operate equipment until components have reached operating temperature before hot check is made.) (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
5.	Has it been specified to provide pumps with soleplates, bedplates, or base plates carefully leveled, grouted, and bolted in place on concrete pads or foundations? (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
6.	Has it been specified to insulate all parts subject to condensation and heat? (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
7.	Has it been specified that pump construction is to permit complete servicing without breaking piping connections? (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
8.	Has it been specified that pump connections shall be flanged? (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
9.	Has it been specified that base-mounted pumps shall be provided on suction and discharge lines on pumps and that the valve on the discharge side shall be a balancing type (not gate or butterfly), and that the booster pumps shall have full line size valved bypasses? (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
10.	Has it been specified LEED EAp2: Minimum Energy performance and EAc1: Optimize Energy Performance, select pumps to operate at optimum efficiency as the primary selection criteria. (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
11.	Has it been specified mechanical shaft seals shall be used. Gland seals are **not** acceptable. (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
12.	Has it been specified LEED EAp2: Minimum Energy Performance and EAc1: Optimize Energy Performance pump motors with nominal horsepower in excess of ½ HP shall be premium efficiency. (Specific drawing sheet #/specification page #_____.)	☐	☐	☐

15650 Refrigeration Equipment

1.	Every effort shall be made to specify equipment which does not require any CFC refrigerants, including R-11, R-12, R113, R114, or R-500. HCFC refrigerants such as R-22 and R123 are discouraged. (Specific drawing sheet #/specification page #_____.)	☐	☐	☐
2.	Has it been specified LEED EAp3: CFC Reduction in HVAC & R Equipment and EAc4: Ozone Protection – use HFC refrigerants where possible. (Specific drawing sheet #/specification page #_____.)	☐	☐	☐

15687 Packaged, Air Cooled Reciprocating Water Chiller

1.	Have barrier walls for sound attenuation been provided in the construction documents? (Louvered panels or decorative walls with any amount of open area should not be used			

Yes No N/A

to attenuate sound. Solid walls of masonry with special sound absorbing cavities should be considered for critical applications.) ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

2. If the chiller is being located adjacent to a building with upper stories, has special consideration been given to the height of the barrier to other means of reducing noise levels such as double pane windows on the second floor which faces the chiller? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Has the unit location been selected next to an unoccupied space where there are no windows? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Has proper maintenance clearances been allowed between chiller and barrier walls? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

5. Has acoustical wrap for the compressors been specified? If so has care been taken not to block the air flow across the condenser coil face? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15710 Cooling Towers

1. Has a variable frequency drive been specified? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

2. Has an 81degree WB been used for selection? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Has a depressed bottom sump outlet been specified? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Has a bottom equalizer connection with shutoff valve been specified for maintenance of towers? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

5. Has stainless steel been specified due to proximity to salt air? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

6. Has the ladder provided by the manufacturer been extended as necessary to be within two feet of the ground? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

7. Have sound levels produced by the cooling tower been evaluated for the location that is being considered? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

8. Has vibration switch been wired by the electrical designer? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

9. Has the manufacturer's recommended clearances around the tower been followed by removing or relocating structures, signs, fences, dumpsters, etc. that interfere with exhaust or air intake? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

15791 Electric Duct Heaters

(Note: Electric duct heaters are not the preferred HVAC system, however, if they are used, the following guidelines shall apply.)

1. Has it been specified to provide the following built-in controls: ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

   a. Disc type automatic reset primary thermal cutout
   b. Manual reset secondary thermal cutouts.
   c. De-energizing controlling magnetic mercury contactors for each heater stage.
   d. Non-fused, disconnect switch with door interlock.
   e. Differential pressure type airflow switch.
   f. Fan relay for positive electrical interlock.
   g. Fuses to protect each circuit in any heater drawing more than 48 amperes.
   h. Control transformer: All safety devices shall be serviceable through the terminal box without removing the heater from the duct.
   i. Provide coil with number of circuits sufficient to not exceed 48 amperes full load current per circuit and equivalent to number of stages scheduled on drawings.

2. Has it been specified to maintain three feet working clearance in front of the heater terminal box in accordance with NEC Article 110? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Has it been specified to provide access doors in ducts on entering air side of each heater? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Has it been specified that the elements shall be open coil type constructed of high grade nickel-chromium resistance wire? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15853 Fan Coil Units

1. Have draw through type units been specified? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

2. Has double wall construction been specified?
(Specific drawing sheet #/specification page #_____.)

3. Has outside air to fan coil unit been preconditioned to as follows: ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

   a. If a system of fan coil units has been designed, has a 100% outside air unit been selected to precondition the outside air? If so, has it been selected to provide a leaving air temperature of 53 deg. dry bulb/52.5 deg. wet bulb from an outside design condition of 92 deg DB/80deg WB? ☐ ☐ ☐

4. Has auxiliary drain pan been specified? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

5. Has unit been selected to care for space load requirements using low fan speed? Do not select unit for high speed.
(Specific drawing sheet #/specification page #_____.)

6. Has copper condensate drain been provided? ☐ ☐ ☐

Yes No N/A

(Specific drawing sheet #/specification page #_____.)

7. Has the use of fan coil units been approved by the University? Fan coil use is discouraged in occupied spaces. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15855 Factory Assembled, Custom Handling Units ☐ ☐ ☐

1. Has factory mounted marine observation lights in all access section and fan section that are prewired in conduit to switch located on the exterior of the module adjacent to the respective access door been specified? (Switches shall be factory mounted complete with the outlet box for wiring connection by Div. 16 and switch face plate.
(Specific drawing sheet #/specification page #_____.)

2. Has access sections been specified to be between all unit sections with access doors on one side of section? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Has inlet and outlet silencers been specified for the unit? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Have the following been specified for air handling unit construction? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

A. Fan Housings:

1. Construct air handling unit casings using heavy gauge construction. All fan housings shall be equipped with removable spun inlet cones designed for smooth airflow into the accompanying venturi shaped inlet cone for the fan wheel.

B. Cooling Coil:

1. The cooling coil shall be rated in accordance with ARI-410.
2. The cooling coil shall be constructed of staggered copper tubing mechanically expanded into die formed continuous collars formed in plate type aluminum fin, brazed tube return joint and brazed copper header. The coils shall be of the continuous plate fin type and shall have 16 ga. stainless upper and tubing coil casing and 18 ga. stainless steel end plates.
3. The maximum face velocity shall not exceed 500 fpm.
4. Cooling coils shall be tested to 325 psig.
5. Coiling coils shall be installed in a vertical position (perpendicular to airflow) to minimize condensate carryover.
6. Coils shall have 5/8” diameter min. 020” wall copper tube, 0.006” aluminum fin, stainless steel casing.
7. The maximum water pressure drop shall be 15 feet, maximum air pressure drop 1.5 inches and maximum fins per inch 10.
8. Coils shall have a minimum of 6 rows.
9. The coil shall be located in a draw through configuration.

C. Heating Coils (Where Scheduled)

1. Provide hot water preheat and reheat coils, factory mounted in access section with hinged door.
2. Coils shall have: 5/8” diameter min. 020” wall copper tube, 0.006” aluminum fin, stainless steel casing.

D. Drain Pan

1. Construction: 16 gauge, type 304 stainless steel.
2. Design to extend entire length of cooling coil, including headers and return bends. humidifier section, fan section, and discharge plenum. Drain pan shall be double wall construction and insulated.
3. Provide IAQ drain pan in accordance with ASHRAE 62, sloped in all directions to drain outlet to prevent water from standing in pan.
4. Provide intermediate condensate drip pan on coils over 48" high. Factory pipe intermediate drain pans to primary condensate pan.

E. Fans

1. Provide supply fan section with centrifugal plug fan designed and suitable for class of service indicated in the unit schedule. Fan wheels shall be air foil or forward curved as scheduled. Fan shaft to be properly sized and protectively coated with lubricating oil. Fan shafts shall be solid and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. Fans shall be statically and dynamically tested as an assembly at the required RPM to meet design specifications. Fan wheel shall be properly secured to shaft to prevent slippage.

2. Provide self-aligning, grease lubricated pillow-block ball bearings with lubrication fittings. Provide extended grease lines to drive side of unit casing, for all fan bearings rigidly attached for easy service access. If extended grease lines are not provided, unit shall include an opposite drive side access door and service room must be allowed on the opposite side of the unit to perform regular maintenance. All bearings shall perform to L-10 200,000 hour average life.

3. Drive shall be multiple V-belt and sized for 1.5 times the fan motor horsepower.

   a. All sheaves shall be selected with a 1.5 service factor. Sheaves shall be machined from a close grain cast iron and statically balanced by the manufacturer. Drive belts shall be a V type. A fixed pitch sheave shall be provided on the motor. All drive belts shall be

precision molded raw edge construction. Belts shall be oil and heat resistant.

4. Fan Balancing

   a. Fan assembly balance shall be tested at design RPM with spring isolators adjusted to specified deflection. Test using an electronic balance analyzer with tunable filter/stroboscope, and scan frequencies from 500 cpm to 50,000 cpm to detect misalignment. bearing defects, mechanical looseness or foundation weakness. Measure vibration at each fan bearing (or motor bearings on direct drive fans), in all three planes. Maximum allowable vibration shall not exceed 0.125 inches per second, refer to chart below. Root mean square (RMS) measurements are unacceptable (peak to peak not RMS).

5. Fan Vibration Criteria

   a.

Fan RPM (peak to peak) Velocity (in/sec)	Mils (in each Plan)	
600 or less	4.0 max.	
900	2.6	0.125
1200	2.0	0.125
1800	1.3	0.125
3600 or greater 0.7		

6. Centrifugal fan shall be provided with inlet screens and an OSHA approved fan drive guard with provision for RPM measurement without removing the guard.

7. Fan and motor assembly shall be mounted on a structural steel base and shall be isolated from unit base utilizing 2" deflection, spring type isolators and neoprene duct connector.

8. Provide fan base, inertia type, constructed of structural steel, sized at not less than 10" section height and painted with 4 mils of alkyd enamel paint. Internal reinforcing bars and a steel bottom pan are included to contain the concrete during pouring. Included are the outboard mounted, height saving, isolator supports. The filled inertia base provides a base mass equal to 1.5 time the total rotating mass. The installing contractor will field fit the base(s) with 3000 psi concrete.

9. Fan Discharge: Fan discharge shall include a bell-mouth collar at cabinet penetration. Field fabricated collars or penetrations are not acceptable.

10. Fan section shall have plexiglass view port on each

side of unit for specific purpose of observation fan, motor, belts and in let vanes.

11. Fan shall be selected such that discharge velocity is low (i.e., no high rpm fans.

5. Has the following been specified for air handling unit exterior construction? ☐ ☐ ☐

A. Base Construction

1. Each module shall be constructed on a heavy duty steel base which shall support all major components. The base shall consist of electrically welded structural members. Internal members shall be properly sized to allow rigging and handling of the unit.

2. Unit base shall be provided with structural steel longitudinal base rails that provide adequate support to limit floor deflection to 1/200. Cross steel rails shall be no less than 10 gauge steel and shall be spaced properly to provide adequate support for internal components including access section support. The floor surface shall not be the source of strength for component and service personnel weight. Use welding procedures and welders certified for structural steel welding according to AWS Dl. 1.

3. After construction the base shall be cleaned primed with a rust inhibiting primer, and finished with a rust inhibiting exterior enamel equal to Rustoleum.

4. Each module shall be manufactured and shipped in a single piece. Construction shall be suitable to withstand rigors of shipping and rigging.

5. Each base shall include properly located lifting lugs or brackets.

B. Housing

1. The unit housing shall be constructed of 16 gauge galvanized, G-90 finish panels supported by galvanized steel internal channels.

2. Galvanizing shall be hot dipped, conforming to ASTM A525, and shall provide a minimum of .90 oz. of zinc per square foot.

3. The unit housing shall be tested for deflection and strength characteristics to ensure that proper design and engineering considerations have been implemented during construction. Test results shall verify that the unit housing panel deflections are limited to 1/200th of span dimension while under positive and negative design working pressures.

4. Include test parameters, procedures, and results in submittal data.

5. Fasten panels together with F-bolts and/or mechanical fasteners.

6. Apply sealant to all external seams. Floor sealant to be a high performance polyurethane which meets ASTM C-920, type S. grade NS, Class 25, USDA approved, EPA approved for potable water contact and paintable.

7. Interior Liner: 16 ga. steel BSG ASTM A 525-85, G90 finish.

C. Insulation

1. The walls and roof of the unit shall be insulated with adhesive fastened insulation.

2. Insulation shall be 2", 3 PCF fiberglass.

3. Insulation shall meet NFPA-90A smoke and flame spread requirements and shall be marked to show compliance.

D. Floor

1. The unit floor shall be constructed as described for housing above, except as follows.

2. The unit floor shall be constructed of 3/16" black steel tread plate.

3. Insulation: 1 in. thick. 1.8 pcf polyurethane foam, R 7.1.

4. Safety Screen over floor openings: Provide floor safety screen where specified on unit drawings. Floor openings or control dampers (>12" wide) in the floor of the unit shall be covered with heavy gauge galvanized, expanded metal steel screen to prevent people and large objects from passing through openings in the floor. Safety screen shall be removable and designed to support 300 lbs. at mid span.

E. Interior solid liner:

1. The unit shall include an interior liner which shall be attached to the housing supports. Liner shall be electrically and thermally insulated from the galvanized steel housing to prevent galvanic action of dissimilar metals by use of an acrylic adhesive/sealant, that also provides "no thru-metal" construction.

2. Liner inside the air handlers shall be 16 gauge steel [BSG ASTM A 525-85, G90 finish.

F. Doors

1. Provide full height (thru 77" tall doors), double wall and insulated (2" 1.5 #) access doors where specified on unit drawings. Door interior and exterior skin shall be constructed from minimum of 16 gauge steel and provided with similar materials/finish as specified for wall construction. Interior door skin will be solid liner, not perforated. The door frame shall be one piece, heavy gauge aluminum extrusion with high performance knife-edge and closed cell, replaceable neoprene gasket seal. Door assembly shall have an additional gasket to provide a double perimeter gasket system (one gasket on frame and one gasket on door) for superior leakage and thermal performance.

2. Door hinges and latches shall be easily adjustable to allow for a tighter seal between the door and door frame. Door hinges, latches and handles are to be bolted to the door and made with corrosion resistant materials. Bolts, nuts, and shafts for door latches, handles and hinges shall be made of 304 stainless steel. Hinge shall have 304 stainless steel removable pin to allow door to be easily removed. Door shall have handle on both the inside and outside of door. Door latch and pawl assembly shall be industrial grade, corrosion resistant and mounted on a square shaft. Door "hardware" that is held in place by set-screws is not acceptable.

3. All doors with access to moving parts shall have provisions for padlocking and meet UL 1995 mechanical protection guidelines. Safety "lockout" capable latches allow owner to padlock doors in closed position.

4. Provide view window in access doors where specified on unit drawings. View area shall be minimum of 6" x 6" with wire reinforced 1/4" safety glass, mounted in an extruded aluminum frame.

5. Provide thermal, double pane, view window in access doors where specified on unit drawings. View area shall be minimum of 6" x 6" with wire reinforced 1/4" safety glass, mounted in an extruded aluminum frame.

6. Provide thermal, double pane, view window in access doors where specified on unit drawings. View area shall be minimum 12" x 12" with wire reinforced ¼" safety glass, mounted in an extruded aluminum frame.

G. Acoustical Performance

1. The housing shall have been tested for acoustical performance by an independent laboratory that is accredited by the U.S. Department of Commerce, National Bureau of Standards under the National Voluntary Laboratory Accreditation

Program and shall meet the following criteria;

2. Test methods and facilities used to establish sound transmission loss values shall conform explicitly with the ASTM Designations E90-85 and E413-73.

    a. Sound Transmission Loss DB ATSM E-90-85 AND E413-73

    b. Construction 2 3 4 5 6 7 STC+

    c. No Metal Liner 23 27 35 49 50 49 39

    d. Perf. Alum. Liner 22 27 32 43 48 44 38

    e. Solid Liner, 24 Ga. 21 38 44 52 51 53 45

        (a) +Sound Transmission Class

        (b) Test and methods and facilities used to establish sound absorption values shall conform explicitly with the requirements of the ASTM Standard Test Method: ASTM C423-84A and E795-B3.

    f. Sound Absorption ASTM C423-84a & E795-83

        1) Construction 2 3 4 5 6 7 NRC+
        2) No Metal Liner, 1.5 .21 .44 .87 .94 .89 .80 .80 PCF insulation
        3) No Metal Liner, 3 .26 .71 1 .09 1.02 .96 .83 .95 PCF insulation.
        4) Perf. Alum. Liner .21 .43 .86 .92 .87 .79 .80 1.5 PCF insul.(calc.)
        5) Perf. Alum. Liner .26 .70 1.08 1.00 .94 .82 .95 3 PCF insulation
        6) +Noise Reduction Coefficient Based on 2" steel housing Per. galvanized essentially the same values as perf. aluminum.

3. Unit Air Leakage Rate:

    a. Provide data to prove the housing design has been previously tested to meet air leakage rates not to exceed the greater of the following values (1 or 2 below) at the design static pressure (not to exceed 8 in. wg).

        1) 1% of the design airflow

        2) SMACNA Leakage Class 6, which is defined by: F=CxP (to the .65 power), L=FxA. Where F-Leakage flow (CFM per sq.ft. housing area)1 C - Leakage class (equal to 6). P – Design static pressure (in wg)1 L - Total leakage

(CFM), A – Housing area (sq.ft.).

b. Determine leakage using the testing methods as described in SMACNA Publication l5d - HVAC Air Duct Leakage Test Manual (Air Distribution Equipment And Ducts).

c. Terms are defined as follows:

1) Design Static Pressure: The maximum positive or negative pressure referenced to the unit exterior (usually the design negative pressure will be the fan inlet static pressure, and the design positive pressure will be the fan discharge static pressure).

2) Design Airflow: The maximum unit total supplied airflow at the unit discharge connection.

3) Housing Area: The total area of the unit air containment, including the fan wall area on units having both positive and negative sections.

H. Electrical

1. Factory mount all motors.

2. Wire each motor and lighting to a motor control center.

3. Wiring: 600 volt rated type MTW/THWN stranded copper, enclosed in EMT or Liquidtite (max.3') conduit. All junction boxes shall be UL approved

4. Provide a minimum of 1 light in each module. Module lights shall be controlled from a unit light switch. Each unit will be provided with 1 convenience outlet, in combination with a light switch. Wiring from lights to switch shall be by unit manufacturer.

I. Variable frequency drives

1. Receive, mount and wire variable frequency drives which are furnished under Section 15171.

6. Have the following manufacturers been specified? ☐ ☐ ☐

A. Air Enterprise
B. CES Group (Ventrol, Webco)
C. Air Systems (Trane)
D. Ingenia
E. Haaken

Yes No N/A

15860 – Centrifugal Fans

1. Has it been specified that all fans shall be certified in accordance with AMCA Certified Air and Sound Rating Criteria Standard 210, 300 and 301?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

2. Has it been specified that all exhaust fans shall be provided with backdraft dampers and bird screens?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

3. Has it been specified that all direct drive fans shall have a variable speed controller?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

4. Has it been specified that bearings are to have a minimum AFBMA 1-50 life in excess of 200,000 hours for operating conditions?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

5. Have fans been selected in the middle of their operating range?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

6. Have belt drive fans been selected with adjustable pulleys?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

7. Have airfoil/non-overloading type been specified?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

15886 - Filters

1. In new construction has the following minimum filtration been specified for continuously occupied spaces?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

   A. 22-1/2 inch deep two-stage side access housing with 4 inch deep 30-35% ADS Efficiency (MERV 8) prefilters (0.25 in. initial static pressure) and 15 inch deep 80-85% ADS efficiency (MERV13) bag type filters (0.42 in. initial static pressure)

   B. Each filter bank equipped with an air filter pressure Differential gage kit to indicate when change out is required. One gage kit is required for each prefilter and final filter. Dwyer Series 2000 magnehelic type only.

2. In building renovations or existing air handling unit upgrades, has the following minimum filtration been specified?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

   A. For existing AHU's with less than 1 inch filter track: Use 2-ply internally wire supported heat sealed synthetic media panel type (Poly Ring Panel), MERV 5 Rated.

   B. For existing AHU's with 1 inch (nom) filter track: Use Pleated high velocity Hi-Capacity cotton blend media in die cut carrier board frame, MERV 7 (25-30% ADS Effy.) rated.

   C. For existing AHU's with 2 inch (nom) filter track: Use pleated

high velocity Hi-Capacity precharged synthetic media in die cut carrier board frame, MERV 11 (45-50% ADS Effy.) rated.

D. For existing AHU's with 4 inch (nom) filter track: Use pleated high velocity Hi-Capacity precharged synthetic media in die cut carrier board frame, MERV 11 (45-50% ADS Effy.) rated.

E. For existing AHU's with dual 2 inch and 4 inch filter tracks:
Prefilters-Use pleated high velocity Hi-Capacity precharged synthetic media in die cut carrier board frame, MERV 8 (30-35% ADS Effy.) rated.
Final filter-Use Microfine fiber glass minipleat media in die cut carrier board frame, MERV 11 (60-65% ADS Effy.) rated.

If less than 1.35 inches dirty filter allowance is available, use MERV 4, or MERV 3, 2 inch fiberglass T/A prefilter. If less than 1.1 inches dirty filter allowance is available, use MERV 11 (60-65% ADS Effy.) minipleat final filter also.

F. For existing AHU's with dual 2 inch and 1 inch filter tracks:
Prefilters-Use pleated high velocity Hi-Capacity precharged synthetic media in die cut carrier board frame, MERV 8 (30-35% ADS Effy.) rated.
Final filter-Use 15 inch deep (min.) 12 synthetic pocket, or equivalent media area (64 sq. ft. min.) longer bag filter, MERV 11 (60-65% ADS Effy.) rated.

G For existing AHU's with dual 4 inch and 1 inch filter tracks:
Prefilters-Use pleated high velocity Hi-Capacity precharged synthetic media in die cut carrier board frame, MERV 11 (45-50% ADS Effy.) rated.
Final filter-Use 15 inch deep (min.) 12 synthetic pocket, or equivalent media area (64 sq. ft. min.) longer bag filter, MERV 11 (60-65% ADS Effy.) rated.

H. Each filter bank equipped with an air filter pressure differential gage kit to indicate when change out is required. One gauge kit is required for each prefilter and final filter. Dwyer Series 2000 magnehelic type only.

3. Have the selections been made on the following criteria or guidelines? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

A. ASHRAE Std. 52.2-1999 minimum efficiency reported values.

B. ADS (Average Atmospheric Dust Spot) Efficiencies per ASHRAE Standard 52.1-92 shown are based on approximate efficiencies at 1.0 micrometers NOT on Size Range 1.0 to 3.0 micrometers used in the Standard 52.2 Appendix.

C. Initial static pressure differentials shown are at 500 fpm.

15890 – Sheet Metal Ductwork

Yes No N/A

1. Has all medium pressure ductwork been specified to be flat oval or round? (Rectangular medium pressure is not acceptable)
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

2. Has all medium pressure ductwork been designed for 2500 fpm or less velocity?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

3. Has coordinated sheet metal shop drawings been specified as a requirement of the project?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

4. Have all longitudinal and transverse joints and duct sidewall penetrations, regardless of pressure classification, been specified to be sealed?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

5. Has it been specified to have the same Test and Balance agency specified in Section 15990 witness all duct leakage tests and so certify in writing?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

6. Has it been specified to prepare the system for tests as specified in Section 15990 and to correct deficiencies found by the Test and Balance agency?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

7. Has a return air ducted system been specified?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

8. Has the outside air for all air handlers on the project been ducted to the units? (MER shall not be used as plenum.)
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

9. Has it been specified that all ductwork shall have access doors for future cleaning not to exceed 50 feet apart?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

10. Has it been specified or shown on drawings that fan discharge ductwork shall be transitioned to full size ductwork before first elbow?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

15896 – Special Ductwork

1. Has it been specified that dishwasher exhaust ductwork shall be welded aluminum above the ceiling and stainless steel from the ceiling to the dishwasher connection?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

2. Has it been specified that dishwasher ductwork shall be sloped toward dirty side of dishwasher?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

3. Has it been specified that kitchen exhaust ductwork shall be constructed of, and supported by, carbon steel not less than .054" (No. 16 MSG) or stainless steel not less than .043" (No.18 MSG) in thickness?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Yes No N/A

4. Has it been specified that the kitchen exhaust ductwork shall have a liquid tight continuous external weld and that cleanout doors shall be installed in the sides of the duct at each change of direction and in straight sections not more than 20 feet apart? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

5. Has it been specified that the openings asked for in .04 shall not be less than 1-1/2" from the bottom of the duct and that at each cleanout, a one-hour rated ceiling access panel shall be provided from which to access the cleanout door? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

15910 – Sheetmetal Accessories

1. Have these manufacturer's been listed as the only acceptable manufacturers? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

    1. Titus
    2. Anemostat
    3. Krueger
    4. Metalaire
    5. Price

2. Has Titus been used as the basis of specification? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

3. Have no return air grilles been located near chalkboards? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

4. Has it been specified to provide ceiling diffusers complete with opposed blade volume dampers only where diffuser is installed in inaccessible ceiling? Do not furnish volume dampers for air devices installed in accessible ceilings or exposed. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

5. Has it been specified that flexible ductwork may only be used for alignment and not used for turns and may only be used in lengths up to six feet which do not occur in corridor walls & fire or smoke partition? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

6. Have access doors in ductwork been located & sized for cleaning, control devices, heating coils, fire dampers, etc.? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

7. Have volume dampers been specified in locations to facilitate system air balancing, such as branch duct take-offs, main duct splits, etc.? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

15915 Kitchen Range Hood and Extinguishing System

1. Has it been specified to supply air downward through the canopy? (Front discharge supply air will not be acceptable) (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

2. Has it been specified to provide automatic fire protection system that complies to NFPA 96 and to state codes? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

3. Has it been specified that the hood shall be pre-piped at factory with all branch piping

concealed and exposed components to be chrome plated? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Has it been specified to furnish a roof mounted, factory assembled fan package to include the following? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

   a. Supply fan
   b. Intake air hood, screen and automatic damper
   c. Filter mounting frames for disposable filters.
   d. Upblast centrifugal exhaust fan
   e. Roof curb

5. Has the kitchen design including included proper dampering and controls to allow the kitchen hood to be turned off when not in use without changing the air balance in the kitchen? (This is an energy conservation requirement) ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

6. Has it been specified, in Division 16, to provide contactors, shunt trip breakers, and fire alarms interfaces for cooling equipment shutdown, fire alarm warning, and fan operation as required by NFPA 96 (Chap 5), and locally enforced requirements? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

15950/15960 - Mechanical Controls, Instrumentation & Energy Management Systems Remote Control/Monitoring of HVAC and other Building Equipment:

1. All construction is to be connected to the University's central energy management computer system with complete remote monitoring and control capability. The computer system should be hard wired to the remote Data Gathering Panels by a twisted pair of at least 16 AWG unless otherwise approved by the University. Are all sensors, transducers, and actuators that are connected to the Data Gathering Panels compatible with the University's energy management computer system? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

2. FAU's Engineering & Utilities Department is responsible for the maintenance, operation, and modification of the entire system. Have all modifications of the system, including the addition of new applications, been approved by FAU's Director of Engineering & Utilities Department? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Is this building connected to the control system and equipped with data gathering panels, sensors, and activators so that major energy consuming equipment can be monitored and controlled by the system? Fire, radiological, and intrusion alarms are to also be installed and connected to the system wherever the application of such alarms is appropriate. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

General

4. Is all hardware and software added to existing and new construction physically, mechanically, and electronically, compatible with the University's energy management computer system? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

5. Are data gathering panels and system sensors of the digital transmission type not requiring the addition of analog to digital converters within the panel? (Analog to digital converters are acceptable within lease line data gathering panels.)
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

6. Has it been specified that all point addresses, diagrams, graphics (color slides) shall be updated to include any additions made to the system?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

7. Has it been specified to provide: data gathering panels, controls, sensors, wiring, all materials, and labor to acquire and transmit data (temperatures, pressures, alarms, etc.)?
In addition has it been specified to provide address and command (start/stop, data and night switch, etc.) data from the central control monitor (existing)?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

8. Has it been specified that modification of the system's (including additions and/or deletions) service area, applications, functions, equipment, transmission network segments, and software or any other action that affects the operation of the system must be approved by FAU's Director of Physical Plant before commitments for the modifications or other action are made?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

9. Has it been specified to provide an Input/Output Summary of all data points?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Transmission Lines

10. Has it been specified that trunk signal cables inside the building must be installed as continuous runs from remote panel to remote panel, without splices or intermediate junction boxes, and all conductors must be terminated on the terminal strips?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

11. Has it been specified that transmission links between the central control monitor and the individual data gathering panels must not exceed length limitations specified by manufacturer? (Should it be necessary to exceed these transmission lengths, then repeaters must be utilized at appropriate locations in accordance the manufacturer's specifications.)
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

12. Has it been specified that maximum wiring runs between the data gathering panels and the remote sensors must not exceed 1,000 feet (except that when the manufacturer of special sensing instruments requires longer runs, then the manufacturers specifications will apply)?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

13. Has it been specified that transmission line runs external to buildings will utilize campus underground communication duct networks and manholes wherever possible? Transmission line runs within buildings should be through conduits. Existing power conduits must not be used for transmission line runs.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

14. Has it been specified that transmission line runs external to the buildings should take advantage of the existing transmission line network? Extension runs should be routed from the building to the nearest accessible communication manhole containing a triaxial

cable connected to the central control monitor.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

15. Has it been specified that each wire from a sensor to a data gathering panel and to intermediate points is to be identified on each end with a number? A numbered tag or tape may be used as long as it does not physically interfere with equipment as is permanently affixed.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Data Gathering Panels

16. Have the manufacturers approved for inclusion in the A/E's specifications all information pertaining To data gathering panels utilized in the system been approved by the Owner?
(Specific drawing sheet #/specification page #_____.)

17. Has it been specified that data gathering panels are to be supplied from the factory prewired for the intended functions? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

18. Has it been specified that data gathering panels are to be of a solid state, plug-in circuit card construction with no reed relays? (Reed relays are acceptable on intercom cards only.) ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

19. Has it been specified that data gathering panels shall be of all steel construction, 14 gauge with full front, hinged doors?" ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

20. Has it been specified that each data gathering panel will be supplied with a separately fused 115 volt, 60HZ, 15 Amp service? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

21. Have data gathering panels been installed in secure areas that discourage tampering by unauthorized personnel? Does the location selected provide a clean environment and moderate temperature and humidity conditions? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

22. Is each data gathering panel provided with its own internal power supply constructed so that sufficient power is available to supply all the cards when the data gathering panel is used to its full capacity?
(Specific drawing sheet #/specification page #_____) ☐ ☐ ☐

23. Has it been specified that for initial checkout (prior to connection to the central control monitor) and future servicing, data gathering panels shall have the ability to accept a data center simulator for complete diagnostic checkout of all sensors, panel inputs, outputs and electronics, including any necessary analog signal converters?
(Specific drawing sheet #/specification page # _____) ☐ ☐ ☐

24. Has it been specified that It should be possible to completely isolate any remote panel from the trunk wiring system? (It shall also be possible to connect or disconnect function cards individually as a checkout or trouble shooting aid.)
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Yes No N/A

Lightning Protection

25. Are the most effective lightning protection devices currently available installed on each triaxial cable entering and leaving the building? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

26. Are lightning protection devices installed to protect each data gathering panel's power supply? (An effective grounding system must be provided for each lightning protection device and data gathering panel.) Ground connections to steam, chilled water or soft water lines are not permitted. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Intercommunication System

27. Has it been specified to provide a solid state two-way intercommunication system with the ability to originate calls from remote stations and for multi-station paging from the central control monitor? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

28. Is the intercom system separate from transmission of data or command function operations? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

29. Is the intercom trunk cable two-wire twisted shielded wire size number 16 AWG? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Sensors

30. Are the temperature sensors installed in a manner that prevents condensation from making direct contact with the sensor's electronic components? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

31. Has it been specified that chilled water temperature sensors shall read within plus or minus one-half (1/2) degree F? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Start/Stop Function

32. Is a remote stop/start capability with status and alarm provided for following types of units:

.33-1 All air handling units in excess of two horsepower. ☐ ☐ ☐
(Specific drawing sheet #/specification page #____.)

.33-2 Chillers, water pumps and condenser water pumps. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

.33-3 Hot water pumps used for building heat. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

.33-4 Existing building chillers, chilled water and condenser water pumps that will be used as standby units. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

33. Has it been specified that Start/Stop function cards must be such that if power interruption occurs at the data gathering panel due to either a power failure or a damaged power supply, the equipment controlled by the card will not change status? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

34. Has it been specified that Manual/Off/Auto switches must be installed on all equipment equipped with a remote start/stop capability? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

35. Has it been specified that In cases where a building is not connected to the central chilled water distribution system, the chillers must be interlocked with condenser water pumps and chilled water pumps? (These actions shall be accomplished by the independent building control system.) (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Temperature Data

36. Has it been specified that a temperature data collection function with high/low alarms must be provided for each of the following:

.36-1 Building chilled water supply entering building. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.36-2 Building chilled water return temperature (leaving building). (Specific drawing sheet #-____.) ☐ ☐ ☐

.36-3 Condenser water supply temperature. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.36-4 Condenser water return temperature. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.36-5 Supply air temperatures for air handling units. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.36-6 Return air temperatures for air handling units. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.36-7 Hot deck temperatures where appropriate for air handling units. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.36-8 Cold deck temperatures where appropriate for air handling units. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.36-9 Hot water supply and return temperatures for hot water heating systems. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Yes No N/A

Environmentally Sensitive Areas

37. Has it been specified that environmentally sensitive areas in buildings must be monitored for all critical conditions including temperatures, humidity, and any other factors such as radioactivity as may be appropriate?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

38. Has it been specified that data supplied by the sensors in these areas will provide quantitative readouts of levels as well as high/low alarms as appropriate?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Alarms

39. Have critical alarm monitoring been provided in all of the following cases:

.39-1 Steam low pressure alarms connected on the low side of the steam pressure reducing valve.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.39-2 Pneumatic air used specifically as control air within buildings equipped with a digital alarm on the high pressure side.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.39-3 Fans that provide essential ventilation to areas equipped with off-status alarms.
(Specific drawing sheet #/specification page #____.) ☐ ☐ ☐

.39-4 Building chillers that are used either as primary or backup units and that are in excess of 40 tons. They must be equipped with at least 3 critical alarms of the digital type. The type of chiller involved (absorption, centrifugal, or reciprocating) will determine which of the following alarms will be selected.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.39-4-1 Low temperature cut-out (chilled water).
Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.39-4-2 Low temperature cut-out (refrigerant).
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.39-4-3 Oil pressure cut-out.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.39-4-4 High head pressure.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.39-4-5 Condenser pressure. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

.39-4-6 Sewage and sump pumps equipped with high level alarms. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

.39-4-7 Buildings which utilize boilers equipped with low

boiler cut-out safety alarms.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.39-4-8 Chilled water coils located at air handling units provided with freeze alarms.
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

40. Have alarm printout and annunciation lock outs been specified to prevent nuisance alarms when associated equipment is turned off?
(Specific drawing sheet #/specification page #____.) ☐ ☐ ☐

The following are examples of such situations:

.40-1 When a chilled water pump is off through programmed start/stop operation (specific chilled water supply and return temperature alarm should be inhibited).
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.40-2 When a hot water pump is off through programmed start/stop operation, (specific hot water temperature alarm should be inhibited).
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

.40-3 When an air handling unit is off through programmed start/stop operation, (specific return air temperature and discharge air temperature alarm should be inhibited).
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

<u>Optimum Start Time Selection</u>

41. Has an optimum start time selection capability for the building's heating, ventilating, and cooling systems been specified?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

42 Has the primary indoor temperature zones been identified? Have temperature sensors, (a minimum of one per floor), with Interconnecting wire back to the data gathering panel been specified. (Typically, one sensor should be installed on each floor of the building in a location that accurately represents the temperature conditions of that floor?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

43. Has it been specified to provide and install the necessary logic cards in the data gathering panel to provide for the optimum start time election function?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

44. Has it been specified to provide for the reassembly of the existing program to accommodate the building and the new points? (As part of the reassembly process, the Owner will provide information relative to occupancy hours, air handling units to be energized, and channel numbers).
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

<u>Testing</u>

45. Has it been specified that prior to connection to the transmission line and

the central control monitor, each data gathering panel must be fully tested utilizing a data center simulator to check out all sensors, panel inputs, outputs and electronics, including necessary analog converter signals? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

46. Has it been specified that upon the satisfactory completion of these tests, the data gathering panel will be connected to the transmission lines and another test will be initiated from the central control monitor to ensure that all command functions operate as intended? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

47. Has it been specified that each alarm condition shall be tested at the central control monitor to ensure that the alarm registers properly? Each temperature, humidity, and other types of quantitative sensors shall be checked in the field and at the central control monitor simultaneously to ensure that readouts at the central control monitor are accurate. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

48. Has it been specified that all tests shall be witnessed by a representative of the Owner? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Operating and Maintenance Literature

49. Has it been specified that the Contractor shall assemble and bind all manufacturer's operation and maintenance literature pertinent to the system? This material should be bound in a looseleaf type binder. Maintenance literature shall include wiring diagrams showing point-to-point identification. Engineering layout drawings must accurately reflect wiring and numbers used in the field installation. Wiring runs from digital sensors to the data gathering panels should be identified by even numbers. Wiring runs from analog sensors to data gathering panels should be identified by odd numbers. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

50. Has it been specified that the Contractor shall provide a complete set of updated and/or additional graphics (slides) for use at the central control monitor? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Flow Measurement

51. Has it been specified that for buildings served by the central chilled water system, provide a calibrated flow measuring device in the primary chilled water return from each building? A delta pressure transducer should be provided and wired to a data gathering panel with a flow measuring electronic function card at each building. Flow rate data should be transmitted to the central control monitor for display printout as and when required. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

52. Has it been specified to provide chilled water instantaneous (gallons per minute) and instantaneous ton-hours with building identification on the CRT of the central control monitor? Provide the central control monitor with the ability to accumulate ton hours for a selectable 24 hour period, the totalized value for the period to be printed out at the end of the 24 hour period. The intent of this is to enable the University to accurately measure and accumulate billing information on chilled water usage. ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Other Instrumentation

53. Has it been specified to provide local instrument displaying HVAC filter pressure drop with alarm? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

54. Has it been specified to provide temperature wells at the building chilled water inlet and outlet piping? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

55. Has it been specified to provide "air monitor" type air-flow measuring device with local readout in all central fume hood exhaust system, to readout the total system air-flow? ☐ ☐ ☐
(Specific drawing sheet #/specification page #____.)

15970- Facility Management System

1. Have these manufacturers been specified as the only acceptable manufacturers? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

   a. Johnson Controls, Inc.
   b. Siemens

2. Has it been specified that space conditions shall be kept at a 74 deg plus one minus two with a relative humidity of 45% plus or minus 5%? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

3. Have air flow stations been shown and specified for all VAV systems? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

4. Have all temperature control panels been shown on the drawings and coordinated for proper access? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

5. Has it been specified that system will be connected such that it is operable from the existing Physical Plant console location? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

6. Has it been specified that there shall be a leaving air temperature reset schedule based on outside air temperature? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

7. Has it been specified that there shall be an occupied/unoccupied mode programmed for the building management system? (During the unoccupied mode automatic outside air dampers shall close and air handling units shall cycle on to maintain both temperature and humidity.) ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

8. Has it been specified that all air handling units shall have automatic outside air dampers? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

9. Has it been specified that humidity control as well as temperature control shall be specified? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

10. Has it been specified that a building warm-up sequence shall be specified for cold days? (e.g. At a certain predetermined time in the early morning, the air handling unit shall operate at 100% and a hot water heating coil shall be activated in the unit. Outside air dampers shall be closed. Air shall be re-circulated to bring the building up to temperature before it is occupied in the morning.) (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

11. Has it been specified that the building shall be kept at a positive pressure with respect to the outside at all times? This means that during unoccupied modes (when outside air dampers are closed) that consideration must be given to the control of exhaust fans as well. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

Building Level Integration – BACnet

1. Has the system been specified to have the capability to automatically detect supported devices and their capabilities (BACnet: "Who is- I am, Who has – I have" services)?

2. Has the system been specified to have all devices accessible using a Web browser interface and communicate using ASHRAE 135 BACnet communications without the use of gateways?

3. Has it been specified that contractor provide a schematic showing the DDC system's entire BACnet Communication network, including addressing used for LAN's, LAN devices including routers and bridges, gateways, controllers, workstations, and field interface devices?

5. Has the following BACnet Naming and Addressing nomenclature been specified? ☐ ☐ ☐

   a. BACnet Naming and Addressing – provide the naming and addressing for BACnet networks, devices, and objects suing the following convention:
   b. MAC Address – Every BACnet device shall have an assigned and documented MAC Address unique to its network segment. For Ethernet networks, document the MAC Address assigned at its creation. For ARCNET, assign from 1-255. For MS/TP, assign from 1-127 for both master and slave devices, and from 128-254 for slave devices only.
   c. Network Numbering – Assign unique numbers to each installed network. The BACnet internetwork (of all possible connected networks) can contain up to 65,534 possible unique networks. Use Network Number = "BBBNN" where: BBB=Assigned BACnet regional project number (1-650) NN = Network segment (00 for project backbone, 01-99 for others).
   d. Device Object Identifier Property Number – Assign unique Device "Object_Identifier" property numbers for each device on the BACnet internetwork. BACnet allows up to 4,194,302 possible unique devices per internetwork. Use Device Object Identifier – "BBBDDD" where:
      i. BBB= Assigned BACnet project number (1-650) DDD=BACnet device (1-999).
   e. Device Object Name Property Text – The Device Object Name property field shall support 32 minimum printable characters. Assign unique Device "Object_Name" property names with plain-English descriptive names for each device. Follow a hierarchy using the system name, facility name, location within the facility, and the system monitored or controlled. The goal is to provide the shortest descriptive, but unambiguous, name. For example, the Device Object Name for the device controlling the chiller plant at Little Creek building 3408 would be: Device Object_Name = LCREEK.B3408.MECHRM.CW. A Device Object Names for a VAV box controller might be: Device Object_Name =

LCREEK.B3408.RM122.BOX25 e. Object Name Property Text (Other than Device Objects) The Object Name property field shall support 32 minimum printable characters. Assign Object Name properties with plain-English names descriptive of the application. Examples include “Zone 1 Temperature” and “Fan Start/Stop.”

f. Object Identifier property Number (Other than Device Objects) – Assign Object Identifier property numbers according to design drawings or tables if provided. If not provided, Object Identifier property numbers may be assigned at the Contractor’s discretion. In this case, they must be documented and unique for like object types within the device.

5. Has it been specified that BACnet routers shall have BACnet Broadcast Message Device (BBMD) capability on each BACnet internetwork communicating across an IP network? Configure each BACnet device and bridge, router, or switch to communicate on its network segment. ☐ ☐ ☐

6. Has it been specified that all BACnet controllers shall be certified by the BACnet Testing Laboratory (BTL) to an appropriate BACnet device profile and shall carry the BTL seal? ☐ ☐ ☐

7. Has it been specified that Application Specific Controllers (ASC) shall at minimum support BACnet ASC device profile? ASC shall support BACnet object types: Device, AI, AO, BI, BO, Notification, Calendar and Schedule. ☐ ☐ ☐

8. Has it been specified that Advanced Application Controller’s (AAC) shall at a minimum support BACnet AAC device profile? AAC shall support BACnet object types: Device, AI, AO, BI, BO, Notification, Calendar and Schedule. ☐ ☐ ☐

9. Has it been specified that Building Level Controller (BLC) shall at a minimum support the BACnet BC device profile? BLC shall support the following: ☐ ☐ ☐
   i. BACnet object types: Device, AI, AO, AV, BI, BO, BV, Notification, Calendar and Schedule.
   ii. BIBBS: D-COV-B, D-COVP-B.
   iii. Segmentation
   iv. BACnet/Ethernet and/or BACnet/IP physical layer connections.
   v. Act as BACnet/IP Broadcast Management Device (BBMD).

10. Has it been specified that they system shall have the following data sharing capabilities: ☐ ☐ ☐
   i. Provide values of any of its BACnet objects
   ii. Retrieve the values of BACnet objects from other devices.
   iii. Ability to allow modification of some or all BACnet objects by another device
   iv. Comply with the Data Sharing requirements as listed in Table A:

TABLE A:	
Data Sharing	B-BC
1	DS-RP-A,B
2	DS-RPM-A,B
3	DS-WP-A,B
4	DS-WPM-B
5	DS-COVU-A,B

11. Has it been specified that the system shall have the following Alarm Management capabilities: ☐ ☐ ☐
   i. Generate alarm/event notification and the ability to direct them to recipients
   ii. Maintain a list of unacknowledged alarm/events
   iii. Notifying other recipients that acknowledgements has been received

iv. Adjustment of event parameters
v. Comply with the Alarm and Event Management BIBB requirements as listed in Table B:

Table B:	
Alarm and Event Management	B-BC
1	AE-N-B
2	AE-ACK-B
3	AEE-ASUM-B
4	AE-ESUM-B

12. Has it been specified that the system shall have the following device management and network management capabilities: ☐ ☐ ☐
    i. Respond to information about its status
    ii. Respond to requests for information about any of its objects
    iii. Respond to communication control messages
    iv. Synchronization its internal clock upon request
    v. Perform re-initialization upon request
    vi. Upload its configuration and allow it to be subsequently restored
    vii. Command half routers to establish and terminate connections
    viii. Comply with the Device and Network Management requirements as listed in Table D:

Table D:	
Device Management and Network Management	B-BC
1	DM-DDB-A,B
2	DM-DOB-A,B
3	DM-DCC-B
4	DM-TS-B
5	DM-RD-B
6	DM-BR-B
7	NM-CE-A

13. Has it been specified that the system shall have the following trending and archiving capabilities: ☐ ☐ ☐
    i. Minimum trending interval is 1 second; maximum trending interval is 1 year. Trending data for a selected interval shall have the ability to be averaged, instantaneous, maximum or minimum.
    ii. The number of trends within a device/network shall be stated by the vendor in terms of how many trend arrays.
    iii. The time stamp shall contain at a minimum MM/DD/YYY-HH/MM/SS. Modification of the parameters of a trend log
    iv. Display and archive of trend data
    v. Comply with the Trending and Archiving requirements as listed in Table E:

Table E:	
Trending	B-BC
1	T-VMT-B
2	T-ATR-B

Yes No N/A

15990 HVAC System Test and Balance

1. Have these balancing agencies been listed as the only acceptable balancing agencies? FAU will approve the test and balance contractor. (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

2. Has it been specified that the Mechanical Contractor shall insure the building and systems are ready for test and balance and notify the TAB in writing of same? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

3. Have the following items been specified for the Mechanical Contractor to prepare for the Air Distribution Systems TAB? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

    1. Verify installation for conformity to design. Supply, return, outside air and exhaust ducts terminated and pressure tested for leakage per specifications.

    2. Verify that volume, fire and smoke dampers are properly located and are functional. Manual volume dampers gradients and spin damper handles shall be exposed through insulation. All dampers shall be verified to have locking devices installed. Verify that electric actuators have control power and are properly connected for full operation of system test. Verify installation of supply, return, exhaust, grilles, registers, diffusers, terminal units with controls and filters.

    3. Verify that air handling systems, units duct systems and associated apparatus, such as coils, filter sections, and access doors shall be blanked and/or sealed to eliminate bypass or leakage of air.

    4. Verify that all fans, while operating at full load, are free of vibration, are rotating in the proper direction, and have proper belt tension. Verify that heater elements in motor starter to be of proper size and rating. Check motor amperage and verify that it is not overloaded.

    5. Verify proper installation and location of duct mounted smoke detectors.

    6. Verify prior to system testing, that new pre-filters and final filters are installed on:
        a. Air handling units
        b. Fan coil units
        c. Heat pumps
        d. Return air filter grilles
        e. Fan powered boxes.

4. Have the following items been specified for the Mechanical Contractor to prepare for the Water Circulating Systems TAB? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

    1. Check and verify pump alignment and rotation. Verify location of gauge cocks or PT test plugs.

2. Verify that valves are in full open position and that bypass valves are in full closed position. Verify that mixing valves are in full flow position to system components.

3. Verify that all strainers have been cleaned and that all air has been purged from water lines including: coils, risers, heat exchangers and other equipment.

4. Verify expansion tanks are set for proper water level and that air vents are installed at high points of systems and operating freely. Verify that system static pressure is set 10 feet water column above highest system elevation.

5. Record each pump motor amperage on each phase and voltage after reaching rated speed.

6. Verify proper size and rating of electrical heater elements.

7. Verify that heat exchangers have been set at correct correct operating temperatures per design requirements.

8. Verify that piping to cooling coils is complete and set for counterflow. Verify location of thermometer wells, gauge cocks and balance cocks for coils.

9. Verify set points match design requirements for chillers and boilers.

5. Have the following Automatic Controls items been specified for the Mechanical Contractor to prepare for the TAB? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

1. Verify that control components are installed in accordance with project requirements and functional, including electrical interlocks, damper sequences, air and water resets, firestats, temperature/humidity sensors and high and low limit switches.

2. Verify that airflow and static pressure transmitters are installed and calibrated.

3. Insure proper startup and operation of variable frequency drives.

4. Verify that controlling instruments are calibrated and set for designed operating conditions.

5. Verify VFD's are adjusted in manual and bypass mode, to allow drive to meet rated motor nameplate amps.

6. Has it been specified that the following Notification of System Readiness items be given to the TAB contractor by the Mechanical Contractor? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

Yes No N/A

1. After completion of the work is done by the Mechanical Contractor in preparation for the TAB, a letter must be written to the TAB certifying that the work has been accomplished and that the building and the air conditioning systems are ready for testing, adjusting and balancing. Provide to the TAB all project drawings, specifications, addendums, approved HVAC related revisions, RFI's Div. 15 submittal data, approved shop drawings, approved HVAC wiring diagrams, control diagrams, and equipment brochures.

7. Has it been specified that, as part of this bid, Contractor shall include costs necessary to make any changes in the sheaves, belts, dampers and other devices required for correct balance by the TAB? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

8. Has it been specified that the Contractor shall install devices to provide access to all devices needed by the TAB for adjustment? ☐
(Specific drawing sheet #/specification page #_____.) ☐ ☐

9. Has it been specified that the Mechanical Contractor shall provide access as requested by the TAB firm if any device is not readily accessible? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

10. Has it been specified that the Mechanical Contractor shall provide lifts for access to high places for TAB personnel? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

11. Have the following TAB PROCEDURES been specified? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

1. That the TAB shall perform troubleshooting functions such as obtaining by measurement static pressure profiles, temperature and pressure readings, or additional traverse readings to assist in determining any system balancing problems.

2. That the TAB shall render to the Contractor and Architect suggested solutions to any balancing Problem which may occur.

12. Have the following TAB procedures for the airside been specified? ☐ ☐ ☐
(Specific drawing sheet #/specification page #_____.)

1. Supply Air:

a. Fans checked for rotation, measure and record motor amperage, fan static pressure drops, RPM etc. Measure and record supply outlets prior to fan or

b. VAV boxes set to maximum, minimum and outlets balanced within 10% of design CFM.

c. Measure and record final total supply air through a pitot tube traverse and record static pressure at traverse point. Adjust fan speed to produce design

CFM while maintaining minimum system static pressure for proper box operation. This procedure maintains required air quantities and minimum energy consumption.

d. If a pitot tube traverse is not practical, the summation of the outlet's may be used. An explanation why a traverse was not made must be presented on the appropriate data sheet.

a. Inspect supply air system and identify system air leakage through traverse and outlet summation.

b. If traverse quantities and outlet summations differ more than 10% then an explanation must be presented with appropriate recommendations. Report traverse and outlet totals compared to reading from airflow measuring station. If necessary, coordinate the recalibration of the airflow transmitter to insure proper operation of the control functions. Coordinate with the temperature control vendor to insure traverse and airflow station reading are in agreement.

f. Measure final static pressures across each component under full load condition.

2. Return Air:

a. Fans checked for rotation, measure and record, motor amperage, fan static pressure, drops RPM etc. Measure and record return inlets prior to fan or damper adjustments.

b. With supply system in the maximum mode, proportion return inlets.

c. With supply system in the maximum mode, traverse and adjust return fan to design cfm. Remeasure and adjust return inlets within 10% of design cfm.

d. Measure and record final total return air through a pitot tube traverse and record flow and static pressure at traverse point.

e. If a pitot tube traverse is not practical, the summation of the outlets may be used. An explanation of why a traverse was not made must be presented in the appropriate data sheet.

f. Identify system air leakage through traverse and inlet summation.

g. If traverse quantities and outlet summations differ more than 10% then an explanation must be presented with appropriate recommendations. Report traverse and outlet totals compared to

reading from airflow measuring station. If necessary, coordinate the recalibration of the airflow transmitter to insure proper operation of the control functions. Coordinate with the temperature control vendor to insure traverse and airflow station reading are in agreement.

3. Outside Air:

   a. With constant volume supply system in the maximum mode, adjust minimum outside air damper to design through pitot tube traverse. Measure and record traverse and static pressure. If a pitot tube traverse is not practical the percentage of outside air maybe determined by calculations from the return air, outside air, and mixed air temperatures. Make allowances for heat of compression and motor heat where applicable. Record all temperatures.

   b. After completion, take total air handling unit static profile and record all final statics, motor amperage and rpm, and cfm.

4. Exhaust Air:

   a. Fans checked for rotation, measure and record motor amperage, rpm, fan static pressure drops etc. Measure and record exhaust inlets prior to fan or damper adjustment.

   b. Insure backdraft damper is open and has free operation.

   c. Perform pitot tube traverse for total air, and proportion main branch lines on major exhaust systems and hooded fans, where possible.

   d. Proportion exhaust inlets.

   e. Adjust fan speed to achieve design CFM and adjust inlets to within 10% of design.

   f. Measure and record final total exhaust air through a pitot tube traverse and record static pressure and flow at traverse point.

   g. If a pitot tube traverse is not practical, the summation of the outlets may be used. An explanation of why a traverse was not made must be presented in the appropriate data sheet.

   h. Inspect exhaust air system and identify system air leakage through traverse and inlet summation.

   i. If traverse quantities and outlet summations differ more than 10% then an explanation must be presented

with appropriate recommendations.

5. Ventilation and Pressurization Verifications:

   a. Balance each supply, return and exhaust air outlet within 10% of design. On systems with volumetric fan control, insure supply and return air fans are tracking to maintain design outside air.

   b. Check and/or adjust pressure relationships so that each positive pressure and each negative pressure area is at least 10% positive or negative as appropriate. Calculate and record room volumes, record actual air changes per hour versus design and record pressure differential for the following spaces:

      1) Laboratories

6. Duct Mounted Smoke Detectors:

   a. Measure and record pressure differential across intake and exhaust tubes. Pressure differential must be within manufacturer's recommendation for specific duct velocity.

   b. Report pressure differential for each duct mounted smoke detector on final TAB report.

13. Have the following Tab Procedures for the waterside been specified? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

    1. Chilled Water:

       a. Check system for cleanliness.

       b. With all chilled water valves calling for full cooling, set balance and isolation valves 100% open and coil bypass valves at 50% open; set and record pump gpm and total dead head. Record all suction and discharge pressures.

          1) Balance chilled water pumps and all coils to within 10% of design requirements

       c. Test and set pressure drops to submittal specifications on all cooling coils. If flow measuring stations are installed, the measuring station shall take precedence over the pressure drops for flow determination. Record all final results. Re-verify final pump gpm, head pressures as well as chiller pressure drops and record.

       d. If main flow measuring device is available, record total flow and position of flow indication and measure pressure drop.

e. Test and record pressure and temperature drops through chillers. Record chiller GPM.

f. Test and set pressure drops to submittal specifications on all cooling coils. If flow measuring stations are installed, the measuring station shall take precedence over the pressure drops for flow determination. Record all final results.

g. Verify that piping risers are vented and system purged of air. This includes all coils.

h. Verify removal of pump start up strainer and replacement with operating strainer or existence of suction diffuser.

i. Re-verify final pump gpm head pressures as well as chiller pressure drops and gpm.

j. Measure and record final motor amps, heater sizes and nameplate data of pump and motor.

k. Permanently, mark settings of balancing valves and record all data after completing the flow readings and coil adjustments.

2. Hot Water:

a. Check system for cleanliness.

b. With all hot water coils (including VAV box reheat coils) calling for full heat, set balance and isolation valves 100% open and coil bypass valves at 50% open; set and record pump gpm and total dead head. Record all suction and discharge pressures.

1) Balance hot water pump and all coils to within 10%of design requirements.

c. Test and set pressure drops to submittal specifications on air handling units and preheat coils. If flow measuring stations are installed, the measuring station shall take precedence over the pressure drops for flow determination. Record all results including GPM, measured pressure drops and position of flow indicator.

d. Measure and set distribution flow stations. Record final settings.

e. Refer to specific instructions specified herein for VAV coils.

f. Test and record pressure drops and temperature drops through heat exchangers and boilers. Calculate and record GPM.

g. If main flow measuring device is available for total pump flow, record total flow position of flow indicator, and measured pressure drop.

h. Verify that piping risers are vented and system purged of air. This includes all water coils.

i. Verify removal of pump start up strainer and replacement with operating strainer or existence of suction diffuser.

j. Re-verify final pump gpm, head and pressures.

k. Measure and record final motor amps, heater sizes and nameplate data.

l. Permanently mark settings of balancing valves and record all data after completing the flow readings and coil adjustments.

3. Condenser Water:

a. With strainers clean and all valves wide open, set pump head and gpm.

b. Proportion hot water basins in tower for even distribution.

c. If flow measuring stations are installed, the Measuring station shall take precedence over the pressure drops for flow determination.

d. Reset pump head and gpm if necessary, and record final results including gpm, suction/discharge pump pressures, motor amps, motor nameplate and heater sizes.

e. Record pressure drop through condenser; calculate and record GPM.

14. Have the following TAB procedures for Controls been specified? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

1. AHU Controls:

a. TAB shall notify Architect of any control device not properly installed, calibrated or functioning to meet the full intent of the Contract Documents.

b. For DDC systems, the TAB shall work closely with the controls supplier to verify calibration of all control, sensing and measuring devices. Actual measurements at devices shall match readouts at the FMS computer.

c. Check temperature controls for proper calibration and setpoint. Record final temperatures.

d. Check economizer controls for proper damper operation and control calibration (outside air conditions may preclude actual calibration test).

e. Check and test calibration the supply/retum volumetric synchronization system. Check differential setpoint between supply and retum fan volumes to insure design outside air is introduced into system.

f. Determine system static pressure set point and coordinate with controls supplier.

g. Check static pressure control, under maximum and minimum conditions, for proper operation.

h. Determine and adjust high limit fan discharge static pressure switch; coordinate set point with controls supplier.

2. Chiller Controls:

a. Verify leaving water chiller control loop for design leaving water temperature. Record final entering and leaving water temperatures.

b. Verify lead-lag sequence for proper staging of chillers.

3. Hot water boiler control:

a. Verify operation of boiler 3 way control valve for calibration and outdoor air temperature reset schedule. Record final entering and leaving water temperatures.

4. Thermostats and Controllers:

a. Check for proper control of valves, VAV boxes, supply fans, exhaust fans, ventilation fans, and unit heaters.

b. Determine calibration setpoint of all thermostats.

c. Set at design set point.

5. Controls Contractor shall:

a. Provide in writing that all terminal units are operational.

b. Provide to the TAB Contractor all necessary hardware and software required.

c. Provide when requested by the TAB Contractor, personnel to operate or assist DOC box/system operation.

15. Have the following TAB procedures been specified for testing capacities and performance?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

1. Cooling Coils:

   a. Measure and record entering and leaving dry and wet bulb air temperatures.

   b. Measure and record entering and leaving water temperature if thermometer wells are installed. Otherwise, measure water temperatures by bleeding water through a nipple arrangement. If P.T. plugs are installed, use a bi-metal thermometer which reads in 1 degree F. increments and use the same thermometer for both supply and return water temperatures measurements.

   c. Readjust flow through coil until heat transfer test indicates proper gpm. (Heat transfer test takes precedence over coil pressure drop.)

   d. Record final air and water temperatures, Btuh/HR and GPM.

   e. Convert actual test condition to design entering temperatures to insure design coil capacities at design temperatures. (Winter test may have entering temperatures too extreme to accurately convert to design summer loads).

2. Heating Coils (Air Handling Unit and Preheat Only):

   a. Measure and record entering and leaving dry bulb temperature thermometers accurate to 1/2 degree F.

   b. Measure and record entering and leaving water temperature thermometers accurate to 1 degree F., if thermometer wells are provided. If P.T. plugs are installed, use a bi-metal thermometer accurate to 2 degrees F.

   c. Compute BTUH and GPM from heat transfer test.

   d. Readjust flow through coil until heat transfer test indicates proper GPM. (Heat transfer test takes precedence over coil pressure drop.)

   e. Record final and water temperatures, BTUH and GPM.

   f. Convert actual test conditions to design entering temperatures to insure design coil capacities at design temperatures. (Summer temperatures may have entering temperatures too extreme to accurately covert to winter loads.)

3. VAV Heating Coils:

   a. Adjust manual balancing devices to achieve

design rated pressure drop at each coil. Record design and actual gpm. (Heat transfer takes precedence over coil pressure drop.)

b. Measure entering and leaving air temperatures. Use thermometers with 1 degree F. accuracy.

c. Compute BTUH at minimum CFM through box and compare to design BTUH.

4. Chillers:

a. Record full load entering and leaving chilled water temperatures with thermometers accurate to ¼ degree F.

b. Record pressure drop and GPM at time of test.

c. Record amperage and voltage.

d. Perform log-test for a minimum of one hour taking readings at least every ten minutes.

e. Average all readings and compute test capacity in BTUH and in tons.

f. Average all readings and compute actual kw/ton of chiller.

5. Cooling Towers: (Test performed simultaneously with chiller test):

a. Record full load entering and leaving condenser water temperature with thermometers accurate to ¼ degree F.

b. Record condensing temperature of refrigerant at time of test.

c. Record GPM at time of test.

d. Record a minimum of four tower inlet wet bulb readings.

e. Record a minimum of four tower leaving wet bulb readings.

f. Perform log-test for a minimum of one hour taking readings at least every ten minutes.

g. Average all readings and compute actual BTUH and tons rejected.

h. Convert actual approach at entering wet bulb conditions back to design temperatures to insure design capacity. (Those tests during winter months may not be

possible due to extreme reduction in ambient wet bulb conditions and building load.)

6. Thermostat Calibration:

   a. Measure and record dry and wet bulb temperatures at each thermostat.

   b. Note any thermostat which is not controlling with +/-1-1/2 degree F.

7. Control Temperature Readouts:

   a. Test actual temperature next to sensing bulb (if possible) and compare to read-out gauge. BAS readout.

   b. Report any gauge out of calibration.

16. Has the following TAB Report Procedures been specified? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

A. Problems Encountered:

   1. Report any items not installed, improperly installed or not functioning properly.

   2. Items which have not been corrected by Friday of each week will be officially turned over to the Contractor with a copy to the Owner.

B. Final Report:

   1. The test-and-balance report shall be complete with all pertinent information such as logs, data, and records as required herein. All logs, data, and records shall be typed on white bond paper and bound. The report shall be certified accurate and complete by the balancing agency's certified test-and-balance engineer or certified supervisor.

   2. The report shall contain the following general data in a format selected by the balancing agency:

      a. Project number
      b. Project title
      c. Project location
      d. Project architect
      e. Project mechanical engineer
      f. Test and balance agency
      g. Test and balance engineer or certified supervisor
      h. Division 15 contractor
      i. Dates tests were performed
      j. Certification

   3. The test-and-balance report shall be recorded

on report forms conforming to the recommended forms in the AABC National Standards or NEBB Procedural Standards. At a minimum, the report shall include:

a. Preface - A general discussion of the system, any abnormalities and problems encountered.

b. Instrumentation list - The list of instruments including type, model, manufacturer, serial number, and calibration dates.

c. System Identification - In each report, the VAV boxes, zones, supply, return, and exhaust openings, and traverse points shall be numbered and/or lettered to correspond to the numbers and letters used on the report data sheets.

4. Any unresolved problems will be reported in a general remarks section in front of the test and balance data.

5. Any unusual operations or pertinent remarks which may aid the maintenance personnel or ease the reading of the report will be made in the general remarks section of the report.

6. Report operating data and final tests in final report. This data will include, but not necessarily be limited to the scope of work outlined above.

C. Air handling equipment test-report forms. Record the following on each air-handling equipment test form:

1. Manufacturer, model number, and serial number.

2. All design and manufacturer-rated data.

3. Total actual CFM by traverse if practical. If not practical, the sum of the outlets may be used, or a combination of each of these procedures.

4. Static pressure profile - Suction and discharge static pressure of each fan component as well as unit total and external static data.

5. Outside-air and return-air total CFM include traverses.

6. Actual operating current, voltage, and brake horsepower of each fan motor as well as starter and heater data.

7. Final RPM of each fan.

8. Fan and motor sheave manufacturer, model, size, number of grooves, and center distance.

9. Belt size and quantity.

10. Static-pressure controls - Final operating set points.

11. All unit components identified including filter data, etc.

D. Pump test forms - Submit pump curve showing design – operating - and no-flow points of operation. Also, record the following items on each pump test form:

1. Manufacturer, size, and serial number.

2. All design and manufacturer's rated data.

3. Pump operating suction and discharge pressure and final total dynamic head.

4. No flow (pump discharge valve closed) suction and discharge pressure and corresponding total dynamic head. This procedure is to determine actual impeller size.

5. Rated and actual operating current voltage, and brake horsepower of each pump motor as well as starter and heater data.

E. Chiller test forms - Record the following items for each chiller:

1. Manufacturer, model number, and serial number.

2. All design and manufacturers' rated data.

3. Rated and actual pressure drop across evaporators and condensers and related GPM.

4. Entering and leaving water temperatures for the evaporator and condenser.

5. Rated and actual operating current and voltage.

F. Heat-exchanger test forms - Record the following items on each heat exchanger test form:

1. Manufacturer and model number.

2. All design and manufacturers' rated data.

3. Service and location.

4. Actual pressure drop and related GPM or steam pressure, primary side.

5. Actual pressure drop and related GPM, secondary side.

6. Primary side entering and leaving temperatures.

7. Secondary side entering and leaving temperatures.

8. Temperature control setting.

G. Heating and cooling-coil test forms - Record the following items on each test form:

1. Manufacturer

2. All design and manufacturers' rated data.

3. Rated and actual water pressure drop through each coil and related GPM.

4. Rated and actual static pressure drop across each coil.

5. Entering and leaving water temperatures.

6. Wet-bulb and dry-bulb temperatures entering and leaving each cooling coil; dry -bulb temperatures entering and leaving each heating coil.

H. Electric Heating Coil/Duct Heater test forms – Test and record the following on each electric-heating-coil test form:

1. Manufacturer and model number.

2. All design and manufacturer rated data.

3. Actual operating current and voltage.

4. Coil location and identification number.
5. With VAV systems determine minimum air flow at which thermal cutouts will shutdown heater.

6. Entering and leaving air temperatures with actual cfm.

I. Cooling-tower test forms - in accordance with AABC Standards or NEBB Procedural Standards.

17. Has the following final inspection and call back TAB procedures been specified? (Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

A. At the time of final inspection, the balancing agency shall recheck, in the presence of the owner's representative, specific and random selections of data recorded in the certified test -and-balance report.

B. Points and areas for recheck shall be selected by the owner's representative.

C. If random tests demonstrate a measured flow deviation of 10 percent or more from that recorded in the certified test-and-balance report, the report shall automatically be rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, a new certified test- and-balance report submitted, and a new inspection test made, all at no additional cost to the owner.

D. TAB firm shall provide for one callback request to retest any unresolved problems noted in the final report. The revised results are forwarded through channels, after completion of test.

E. During the TAB work, the temperature regulation will be adjusted for proper relationship between controlling instruments. Advise Owner of any instruments out of calibration

F. Make one inspection within ninety days after occupancy of the building to insure that satisfactory conditions are being maintained throughout and to satisfy any unusual conditions.

18. Have the following special FAU requirements for test and balance services been specified?
(Specific drawing sheet #/specification page #_____.) ☐ ☐ ☐

A. For VAV systems, total air shall be set to fan or outlet design as applicable. This shall be done with minimum static pressure to operate or maintain design airflow at the most remote VAV box.

B. The minimum static pressure at the most remote box shall be recorded and provided in the test and balance report. It shall be recorded in two operating modes.

1. In the fan or outlet design mode for total air.
2. In the normal operating mode under static pressure control.

C. The system operating static pressure shall be recorded and provided in the test and balance report.

If fan design is less than outlet total, then total air is set to fan design. If outlet is less than fan design then total air is set to outlet total.

D. For VAV systems without constant flow outside air systems, outside air quantities shall be set with the VAV system operating at the average speed to maintain comfort. If this can not be determined, then the outside air quantities shall be set with the system operating 75% of the fan or outlet design as applicable.

E. All balancing dampers shall be marked in a manner that the balanced condition can be reset as needed.

Yes No N/A

F. Any test and balance performed for FAU shall include a pre-balance review of the 100 percent construction documents.

End of Division 15 – Mechanical Equipment.