

25 3001 - Building Automation Systems**1.1. General**

- A. Automation design and installation shall comply with all State Energy Codes, ISA Standards and ASHRAE Guideline 13. Any discrepancies between codes shall be brought to the attention of TTU - Operations for direction.
- B. Materials shall comply with VOC limits of authorities having jurisdiction. For adhesives and sealants, Contractor shall supply documentation including printed statement of VOC content.
- C. The campus furnished utilities will be measured by a Building Automation System Energy Measurement System that shall be built and calibrated by a single manufacturer. A certificate of NIST traceable calibration shall be provided with each system component. All equipment shall be covered by the manufacturer's two-year warranty.
- D. Building Automation Systems shall be compatible with existing Campus infrastructure and communicate with CHACP 1 (Central Heating and Cooling Plant I) located on the Texas Tech University - Main campus.
- E. The automatic temperature control system shall be a microprocessor based Direct Digital Control (DDC), Building Automation System (BAS) utilizing a combination of electric/ electronic components, as indicated. The entire system shall be provided by an approved Controls Manufacturer/ Contractor, Johnson Controls Inc. or ConTech. It should be designed by experienced engineers and installed by competent technicians, all of which are regularly employed in the specialty field of HVAC and building controls.
- F. The manufacturer/contractor shall maintain local qualified and experienced designer, programmer and service technician, familiar with the details of this project/system, to serve the project throughout the warranty period. Such personnel shall be available on a 24-hour, seven day a week basis, and the contractor/manufacturer shall provide equally qualified substitutes during such personnel's "absentee" periods. Response shall be provided without additional cost to the Owner.
- G. All software used in/supplied to this system shall be the manufacturer's current/latest version. All software upgrades applicable to system and offered by the manufacturer/contractor for this system shall be provided at no cost to the Owner throughout the warranty period plus four years. This no cost upgrade shall include installation, programming, (sequence, color graphics, reports, etc.) modifications to field equipment, data base revisions, etc., all as appropriate.
- H. Specified electrical materials and installation shall be in accordance with the requirements of the National Fire Protection Association (NFPA), the National Electrical Code (NEC), and the Project's electrical specification. All electrical work included under this section shall be complete with labor, materials and installations. Electrical Contractor is to install 120V power to each terminal box and each DDC panel per Division 16.

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- I. Label all instrumentation and controls and associated conduit and cabling with clearly visible and readable identification with respect to the control record drawings and the equipment served.
- J. Field quality control and testing is to be specified by TTU - Operations.
- K. All systems, new and retrofit, shall comply with all TTU standards and fully integrate with existing systems as defined by TTU - Operations.
- L. All control points must be clearly defined in the design drawings and sequence of operations (SOO).
- M. Point naming conventions must follow a consistent format based on system type (e.g., BLDG#_AHU-1_DSAT).
- N. All points, as defined by TTU Operations Controls Standards, must support 24-hour trending at 15-minute intervals.
- O. Alarms and alarm prioritization must be enabled for all points, using clearly defined high/low thresholds per TTU - Operations Controls Standards.
- P. Except as noted below, all wire/cable (in walls, chases, mechanical rooms, below grade, below slabs, above ceilings, etc.) shall be run in conduit. Conduit types shall match those in the electrical division with regard to types (e.g. RGS, IMC, EMT) in particular spaces. An exception may be allowed on certain situations with the Owners consent to run control wire/cable outside of conduit if all the following conditions prevail: allowed by NFPA 72; located above accessible ceilings; plenum rated cable is used; less than 24 VAC or 24 VDC (nominal) is used; where allowed by all applicable administrative authorities; where labeled "controls" and supported in accordance with code.

1.2. Prioritization shall follow the BAS tier levels of High, Medium or Low.**A. High Tier level**

- 1. Critical Need for Controls: Requires advanced systems to provide critical support for research activities or student housing and ensure continuous operation.
- 2. Energy-Intensive Usage: Significant energy demands (e.g., labs, data centers).
- 3. Large Scale: Buildings >75,000 sq ft.
- 4. Functionally Critical: Supports 24/7 run times and/or sensitive equipment.
- 5. Examples: Research labs, clean rooms, animal facilities with strict environmental controls, data centers, resident halls, facilities with high uptime needs, etc.

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1. Moderate Controls Needs: Partial systems to balance efficiency and functionality.
2. Balanced Energy and Usage: Suitable for variable occupancy spaces like classrooms and offices.
3. Moderate Scale: Buildings between 50,000 - 75,000 sq ft.
4. Shared Resources: Collaborative or mixed-use spaces.
5. Examples: Research spaces, academic buildings with lecture halls and seminar rooms, medium-sized residence halls with basic climate control, etc.

C. Low Tier level

1. Limited Controls Needs: Basic controls or monitoring due to minimal complexity.
2. Low Energy Consumption: Serves low-demand spaces such as offices or storage areas.
3. Small Scale: Buildings <25,000 sq ft.
4. Non-Critical Functions: Supports offices, maintenance or storage areas.
5. Examples: Storage space, maintenance workshops, administrative offices with low occupancy, etc.

1.3. Submittals - Prior to purchasing, the general contractor, vendor, etc. shall provide the following to TTU - Operations for approval:

- A. Sample of warranties.
- B. Documentation that the Manufacturer has been producing building automation systems and/or building automation components for a minimum of five years and has a record for financial responsibility and for performing the quality of work required by TTU - Operations.
- C. Shop drawings for the installation of all building automation systems and/or building automation component(s). To include, but not limited to, communication risers and locations, control hardware architecture, preliminary graphics, and installation equipment of all controllers and workstations. Show all anchorages and necessary ancillary items.
- D. Documentation for all software used in/supplied to this system shall be provided to TTU - Operations.

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- E. Provide an enlarged floor plan, which shall display room temperatures and provide links to Building Equipment Level graphics. On each floor plan graphic, provide navigation links to all building levels and menus with links to other building graphics. Provide one graphic for each HVAC system including fan systems, chilled water systems, hot water systems, steam systems, return fan systems and other systems as appropriate for project specifics.
- F. Specify to provide all sensors, thermostats, dampers (control), operators, microprocessors, controllers, transducers, switches, indicating devices, interface equipment, transformers, power supplies, fuses, wiring, cabling, and other devices/apparatus required to properly operate mechanical system and to perform functions specified and intended.
- G. Provide controllers that execute PID control loops at a frequency not to exceed 3 seconds. The process variable scan and updated calculated output is at the same frequency rate.
 - 1. Control Loop Stability: Air Pressure: $\pm 0.3''$ wg Airflow $\pm 5\%$ of actual flow, Temperature: $\pm 2^{\circ}\text{F}$, Humidity: $\pm 5\%$ RH, Fluid Pressure: $\pm 3\%$ of full scale, and Fluid Flow: $\pm 3\%$ of full scale
- H. At a minimum, each contractor and all materials/equipment suppliers shall guarantee all labor and materials furnished by respective entity for a period of one year unless otherwise noted. Warranty period shall extend from the date of substantial completion or upon written directive from the Owner, whichever occurs first. The warranty shall cover the repair or replacement, at the Contractor's expense, of any defective material, faulty workmanship, or incompleteness.

1.4. Commissioning**A. General Requirements**

- 1. Commissioning shall verify that all Building Automation System (BAS) components, sequences, and communications operate in accordance with the contract documents, including plans, specifications, and approved submittals.
- 2. The Controls and Mechanical Contractors shall fully participate in the commissioning process coordinated by the Utilities Leadership.

B. Pre-Functional Checks

- 1. Prior to startup, verify proper installation, labeling, and wiring of all control devices.
- 2. Submit point-to-point verification forms and as-built documentation for review.
- 3. Ensure all set-points and schedules are loaded per approved Sequence of Operations.

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4. Ensure all engines and trunks have longevity and capacity to support new/upgraded building equipment.
5. All software shall be presented to TTU Operations and TTU IT Services for review. Prior to connection to TTU Network, contractor shall identify all software vulnerabilities and shall address these in accordance with TTU requirements. Resolution to software vulnerabilities shall be presented to TTU Operations and TTU IT services for approval.

C. Functional Performance Testing

1. Participate in witness testing of BAS-controlled systems including but not limited to:
 - a. AHUs, VAVs, terminal units.
 - b. Chillers, boilers, and pumps.
 - c. Exhaust systems and energy recovery units.
2. Demonstrate that alarms, overrides, interlocks, and trends function as intended.
3. Test all control loops for stability and responsiveness.

D. Deficiency Resolution

1. Provide timely resolution of punch list items generated from testing.
2. Retest systems after corrections are made to verify compliance.

E. Documentation and Training

1. Submit final trend logs, graphics, sequence of operations, test and air balance reports, and tuning parameters.
2. Provide operator training covering system navigation, alarm management, and daily operation.

End of 25 3001 - Building Automation Systems