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250000 - Building Automation System

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SECTION 25 0000 – BUILDING AUTOMATION SYSTEM

1.1 SUMMARY

A. The information in this Section represents current standards as of the date indicated. Due to frequent advances in BAS technology, designers are responsible for obtaining the latest BAS standards from the FD&C Project Manager.

B. Related Sections

1. Refer to Chapter 5, Division 23, Section 231800 for BAS monitoring requirements associated with district utilities.

2. Refer to Chapter 5, Division 01, Section 019115 for commissioning related requirements.

3. Refer to Chapter 5, Division 26, Section 262923 for BAS monitoring requirements associated with VFDs.

4. Refer to Chapter 5, Division 26, Section 265100 for lighting control requirements.

5. Refer to Chapter 5, Division 01, Section 017700.1.1.B.1.i Closeout Procedures - Project Record Documents for equipment list requirements for all equipment provided in this section.

C. Building Services Identification Labeling – The University has adopted a comprehensive label identification for the distribution systems for all plumbing, fire protection, air, mechanical piping, electrical, fire alarm, controls, telecommunications, audio/visual, and security. The specific label colors, text, and directional flows for each component part are described in a single comprehensive table that is Chapter 5, Appendix A, Building Services Identification labeling. This labeling system must be part of any construction project, even those that are limited to a portion of a building or a single utility system.

D. Notes to Designers:

1. The designer shall provide a proposed BAS point list to University for pre-approval prior to completion of specifications and as part of the Design Development Document submission.
2. Specialized, field or factory-installed, non-Schneider Electric Andover Continuum microprocessor control packages (e.g. automated lighting control systems, chiller control packages, roof top units, split systems) will be allowed only with special permission from the University, and will be reviewed and approved to ensure adequate provisions for communication of necessary information to the Schneider Electric Andover Continuum BAS. If UNH Facilities approval is granted, Modbus and BACnet-over-Ethernet are the only acceptable communication protocols between the Schneider Electric Andover Continuum BAS and other University-approved, non- Schneider Electric Andover Continuum devices. In general, all HVAC and lighting control functions shall be performed

by the Schneider Electric Andover Continuum BAS and UNH Facilities approval for BACnet is generally granted only for large chillers.

3. Long or irregular occupancy zones shall be served by separate HVAC systems from those for normal "office hours" type occupancy zones.
4. Local Hand-Off-Auto (HOA) switches on motor starters for BAS-controlled equipment are not acceptable if the associated BAS controller has built-in override switches. The integral, status reporting, override switches built into the BAS controllers shall be used for the HOA function. Coordinate with Chapter 5, Division 26.
5. Discharge air temperature sensors shall be provided downstream of all heating and cooling coils (air handler coils, reheat coils, unit ventilators, fan coil units, etc.). Control of modulating terminal unit valves shall be via room and discharge reset control.
6. Provide an anti-freeze safety routine for all heating water pumps and heating zones to protect against failure of temperature sensors. Heating equipment shall be indexed to the "full heat" mode if the outdoor air temperature sensor indicates a value greater than 110 degrees F., if the associated hot water supply temperature sensor indicates a value greater than 250 degrees F., if the associated discharge air temperature sensor indicates a temperature greater than 180 degrees F., or if the associated space temperature sensor indicates a value greater than 110 degrees F.
7. Temperature Control.

    a. Room temperature control with the capability of automatic unoccupied setpoint shift shall be provided for all spaces with heating and/or air conditioning. Wall mounted individual room temperature sensors are preferred. Zone temperature sensors controlling several rooms shall not be allowed unless pre-approved by the University and all rooms in each zone have equal heating and cooling load characteristics and equal functional uses.
    b. Perimeter radiation or local fan coil units shall be used to maintain night setback temperatures, rather than turning on large air handling systems when only a few rooms need unoccupied mode heating. An individual temperature control sensor shall be provided for each room for unoccupied heating control. Zone control for heating is not acceptable for unoccupied heating control.
    c. Each temperature sensor shall have a push button override button programmed for two hour intervals of delivered heating when the system is in the night, weekend or holiday setback program. All temperature sensors in offices shall have setpoint adjustment sliders.
    d. Space Temperature Settings for all spaces with heating and/or cooling systems:
        1) During Occupied Hours:
            a) will be heated to keep temperatures from going below 68° F during the winter.
            b) will be cooled to keep temperatures from rising above 78° F in centrally air conditioned spaces during the summer.
        2) During Unoccupied Hours:
            a) will be heated to keep temperatures from going below 55° F during the winter.

b) will be cooled to keep temperatures from rising above 90° F in centrally air conditioned spaces during the summer.
c) if outdoor temperature falls below 12° F, all heating setbacks shall be cancelled until outdoor temperature rises above 15° F.

3) Exceptions to these temperature targets will be where there is a demonstrated work requirement for maintaining higher, lower, or more consistent temperatures/humidity. These demonstrated work requirements need to be documented and occupants must be given the opportunity to identify such requirements during the design process.

e. Self-contained thermostatic radiator valves cannot provide automatic temperature setback, and shall not be allowed except in spaces which require a constant room temperature 24 hours a day, seven days per week, during the entire heating season.

f. In renovations, the level of temperature control and mechanical ventilation provided by the existing building HVAC system shall be maintained or improved.

1.2 MANUFACTURERS

A. The University requires that all Primary Building HVAC systems be controlled by a complete DDC Building Automation System (BAS). The BAS system shall be Schneider Electric Andover Continuum product line. Secondary buildings shall be considered on a case by case basis. Approval from the UNH Facilities Operations Zone 3 Manager is required for any HVAC equipment not directly controlled by the Schneider Electric Andover Continuum BAS.

B. The BAS shall be fully integrated with the existing campus Schneider Electric Andover Continuum BAS system, and shall be fully compatible in all aspects with the existing campus BAS system hardware and software including alarm systems, energy monitoring, and hard-wired/fiber-optics communication links. The designers shall coordinate with UNH Telecommunications to ensure that the necessary fiber-optics services are included as part of the project.

C. The BAS contractor shall have a minimum of five years' experience as a factory authorized Schneider Electric Andover Continuum dealer, with a fully staffed service office within 50 miles of Durham, New Hampshire.

1.3 SUBMITTALS

A. In addition to normal review, BAS contractor construction submittals shall be provided to UNH Facilities Operations Zone 3 Manager for review. The designer shall receive written review comments from the UNH Facilities Operations Zone 3 Manager before granting final submittal approval.

1.4 SPARE PARTS

A. Contractors will be required to provide the following numbers of Infinity controllers, Net I/O modules, and EMX expansion modules to UNH prior to completion of the project. SPARE PARTS SHALL BE DELIVERED TO ENERGY OFFICE WITH SIGNED RECEIPT DELIVERED TO PROJECT MANAGER.

Number of devices used on a project	Number of spares
0-4	0
5-10	1
11-20	2
20+	3
50+	5
100+	10

1.5 CONTROLLERS

A. Schneider Electric Andover Continuum “Net I/O” is allowed only where directly plugged into Net Controllers. Remotely wired Net I/O is not allowed except for special applications pre-approved by the University in writing. Net I/O use in quantities greater than eight total I/O modules per building shall be pre-approved in writing by the UNH.

B. The Schneider Electric Andover Continuum network controller shall be a Continuum Net Controller with 8MB minimum RAM and a node limit capacity allowing for 10 percent future node number expansion. 4MB RAM Net Controllers are allowed only with written pre-approval from the University. The Net Controller power supply shall be 120/240 VAC with the UPS option.

C. I2-800 series controllers shall be the I2-810 model with integral output override switches. I2-800 model controllers without override switches are not acceptable.

D. All BAS controllers shall be of the latest version Schneider Electric Andover Continuum Continuum/Infinity system architecture and shall be fully compatible with the existing University Continuum Cyberstation workstations.

E. All BAS controllers shall include battery-backup to maintain software programs for a minimum of twenty-four hours.

F. UL listed and labeled metallic interface panels with hinged, locked doors shall be provided for all BAS controllers, except VAV box controllers incorporating an integral damper actuator. All Control assemblies shall display third party certification and label acceptable to the New Hampshire State Fire Marshall.

G. All BAS controllers shall include LED pilot lights and software-reporting HAND-OFF-AUTO override switches for all output points. Override switches are required on all outputs for trouble-shooting by University plumbers and electricians, and for equipment testing by University preventive maintenance technicians. The only exception to the requirement for output override switches shall be for VAV box controllers, gas-fired heating equipment, unit ventilators and small fan coil units, where pre-approved by the

University. HOA overrides shall not be combined with system status feedback inputs unless the combination device can differentiate (and report to the Cyberstation workstations) whether an inverse status was caused by loss of the status feedback input or by operation of an HOA override switch. Devices such as "MOB" units with a separately wired input point indicating use of override are acceptable.

H. All software to fully meet control and data logging requirements of the specifications shall be contained within a building controller. Storage of logged data is permitted on a BAS server if large volume extended logs are required.

I. Input points shall be wired to the same controller as the associated output point. Relying on an Infinet or other communications bus for input/output/setpoint control information transfer is not acceptable except in the case of global control points such as outside air temperature and humidity, building KW demand, and central plant hot and chilled water system status. Global control points shall be pre-approved in writing by UNH.

J. All input/output points and numerics associated with a specific system or piece of equipment shall be located on the same BAS controller. All BAS controllers shall include battery-backup to maintain software programs for a minimum of twenty-four hours.

1.6 BUILDING OPERATOR INTERFACE

A. Projects under 100,000 gross square feet will utilize existing UNH portable and stationary Cyberstation workstations.

B. On projects over 100,000 gross square feet the BAS contractor shall provide one desktop PC per current University specifications for that device with Continuum Cyberstation software key and Cyberstation software. This workstation shall be located on a suitable counter, with one duplex receptacle and one BAS network connection within the building, in a dedicated maintenance room, away from all water and steam piping and major mechanical/electrical equipment, with keyed door access limited to authorized personnel only.

C. The BAS contractor shall purchase any computers required by this Section for UNH from the UNH Computer Store per the existing agreement with UNH Information Technology.

1.7 BAS NETWORK REQUIREMENTS

A. The BAS has a dedicated Ethernet network system that is independent from the campus general Telecom network. The Designers must coordinate with the University to identify the BAS network connection path to building from the appropriate point in the existing BAS network. The BAS contractor shall provide interior Ethernet network wiring from the point at which the BAS network enters the building to the BAS network controller and the BAS Cyberstation if required by the project. The project shall provide labor and materials as required for connection to the existing UNH BAS fiber optic network. The project shall include external fiber optic cabling to the existing BAS fiber

network, and that work shall be coordinated with UNH Telecommunications at the beginning of the design process. The designer shall determine and specify which portion of the network connection is the responsibility of the BAS contractor, and which portion is the responsibility of UNH Telecommunications.

B. The BAS contractor shall provide all Ethernet media converters, hubs, Ethernet switches, etc. required for connection of the network controller (and local Cyberstation desktop workstation, if required) to the campus BAS network.

1.8 OUTPUT DEVICES

A. All BAS output devices shall be configured/wired for "FAIL-SAFE" operation. The BAS contractor shall obtain the desired failure mode (open, closed, or “hold last position”) for each output device from the University. Engineers shall specify during Design Development all output devices for the University to review and approve prior to the execution of Construction Documents. Each output device shall revert to the designated failure position on loss of BAS controller power, loss of secondary control device power, and/or loss of controller software. A separate “Failsafe” digital output shall be provided on all BAS controllers with hot water pump control outputs. Pump output control wiring shall be in series through normally open failsafe output and normally closed pump output to normally closed control relay, without software inversion of the output point. Upon loss of power or control signal, all hot water and steam control valves and return air dampers shall fail in the open position; and outside air and exhaust air dampers shall fail in the closed position. (Exception: steam valves on steam to hot water heat exchangers shall fail closed.) The fail position feature shall be spring-driven. Failure mode operation relying upon a battery or other non-spring driven device is not acceptable.

B. All valve actuators shall have sufficient power and response time for the application. All valves shall have sufficient power to close against system pressures. The primary district heating system supply pressure against the primary control valve inlet port can be as high as 85 PSI at 220 degrees F. Ball valves with spring-return “Schneider Electric DuraDrive” actuators, or University approved substitutes, may be required for buildings with high heat loads. All ball valves shall have stainless steel ball & stem.

C. All control relays shall have integral LED indicator lights.

D. All BAS output devices shall be electric/electronic. Pneumatic control devices are not acceptable.

E. Electric modulating actuators shall directly accept either a variable voltage or 4-20 milliamp control signal. Pulse-width modulation or other methods of modulating control are not acceptable. (Exception: tri-state pulse width modulated damper actuators are allowable on VAV boxes, provided a true damper position feedback input is provided.)

F. Electric actuators shall be as manufactured by “Schneider Electric DuraDrive,” or “Belimo non-MFT-type”, no exceptions.

1.9 INPUT DEVICES

A. BAS water sensing elements shall be dry type, installed in immersion wells.

B. Duct sensing elements (except freeze stats) shall be averaging type in large ducts, or in locations where air stratification may result in an unreliable reading from a probe type sensor. Averaging sensor elements shall be of sufficient length for the application.

C. Freeze stat elements shall not be averaging type. Freeze stats shall be manual reset, and shall trip if any one foot section of the sensing element falls below setpoint. Freeze stats shall be installed on all hot water and steam coils. Freeze stats shall be double pole. One pole shall be hardwired to shut off fan, open coil valve, and close outside air damper independently of the BAS. The second pole shall provide freeze stat status as a BAS input.

D. Temperature sensors shall be provided for return air, mixed air, and supply air on all air handling units. Mixed air sensing elements shall be of sufficient length to provide full coverage of the mixing box. As a minimum, averaging type sensors shall be required for all mixed and supply air ducts over 8 square feet in cross sectional area. Averaging sensors may be required for smaller ducts if the duct configuration may cause air stratification at the sensor location.

E. All temperature sensors shall be electronic thermistor type. Pneumatic devices connected to electronic transducers are not acceptable.

F. One carbon dioxide sensor calibration kit shall be provided for each model of carbon dioxide sensor used on the project.

G. Humidity sensors shall be +/- 2% RH accuracy, fully electronic with no moving parts.

H. Outside air temperature and humidity sensing elements shall be located on the building exterior, north exposure, away from windows, doors, exhaust openings, roof surfaces, and other areas that may affect accuracy. Sensors shall be located at least 15 feet above grade, and shall have physical protection for the sensing element.

I. Window switches with a BAS input with positive indication that a window is open, or UNH approved alternative technology, will shut down air conditioning/ventilation equipment and put heating equipment into the unoccupied mode (e.g., fan coils, fin tube radiation, VAV boxes, valance units) when the window is opened, whereas the minimum setback temperature of 55°F will be maintained. Window switches trigger a Level 8 Dispatch BAS alarm if the window is open and the outside air temperature is below 30°F. Window switches trigger a Level 6 BAS alarm if the window is open and the outside air temperature is above 85° F in an air conditioned building. The outdoor temperature conditions affect only the alarms, not the switching of the heat/ac/ventilation to unoccupied mode.. Window switch inputs shall be ON=closed, OFF=open with no input invert.

J. Devices to provide positive feedback status inputs shall be installed on all fans and pumps controlled by the BAS. Pump status shall be provided by a motor current sensing transducer or load current input from VFD. All current switches shall meet UL

assembly listing requirements. Fan status shall be provided by a differential pressure switch with duct sensing probes on high and low sides of the fan (exception: current switches may be used on small units without ductwork).

K. All direct-wired dedicated alarm input devices (e.g. sump level switches) shall have normally-closed contacts.

1.10 INSTALLATION

A. The New Hampshire State Fire Marshal's Office (NHSFMO) has ruled that all enclosures containing 2 or more electrical devices (regardless of voltage) are assemblies that require approval and labeling by an independent third party testing company that is approved by the NHSFMO. This requirement applies to both custom-built panels, and instances where an electrical device (e.g. relay or current switch) is added to an already labeled assembly (e.g. motor starter, motor control center, control panel). Adding one or more electrical devices to an already labeled assembly requires that the assembly be re-examined and re-labeled with the added components. The contractor shall be responsible for all costs associated with obtaining all electrical assembly labeling required by the NHSFMO including, where necessary, on-site field inspection and labeling by a representative from a NHSFMO-approved independent third party testing company such as UL. The University prefers that all such equipment installed on the campus have all components installed at the factory and that all third-party labeling occur at the factory when possible.

B. Provide access through ceilings, walls, and ductwork to all HVAC and control equipment requiring maintenance service or inspection. Access doors shall be 24x24 inches minimum, and labeled to indicate type of equipment inside. Provide hinged and latched access doors for service of all dampers, coils, sensing elements, and other equipment located inside ductwork or air handlers. Access openings shall be readily accessible and large enough to reach any area of the equipment that may require inspection, cleaning, lubrication, tightening, adjustment, replacement, or other maintenance service. Any access doors located in occupied spaces of the building shall have locked approved by UNH Hardware Services and keyed to meet the UNH PK525 key standard.

C. All BAS associated 120 VAC power wiring (including all input and output power supplies) shall originate from clearly-marked, BAS-dedicated circuit breakers. If UPS power or emergency power is available in the building, all BAS network connection devices and 120 VAC power wiring shall be powered from that source. If a desktop PC is required for the Building Operator Interface, the electrical contractor shall provide a duplex receptacle powered by the UPS or standby power source at the desktop PC location. All input/output transducers shall be powered from the same circuit that supplies power to the associated BAS controller. All BAS equipment shall be fused in accordance with manufacturer's recommendations.

D. Outside air temperature and humidity sensing elements shall be located on the building exterior, north exposure, away from windows, doors, exhaust openings, roof surfaces, and other areas that may affect accuracy. Sensors shall be located at least 15 feet above grade, and shall have physical protection for the sensing element.

E. All safety devices such as freeze stats, humidity high limits, and high static pressure switches shall be manual reset and shall perform all associated shutdown/failsafe actions via hardwiring. Software shall not be used to exclusively perform any shutdown/failsafe actions from safety devices. For example, freeze stats shall shut off fan, fully open coil valve, and close outside air damper via hardwiring without relying on any software functions. Software shutdown/failsafe shall be provided as a redundant backup to the required hardwired shutdowns.

F. All Schneider Electric Andover Continuum controllers shall be mounted with sufficient free space below the controller to allow for future installation of the maximum allowable number of expansion modules. Field panels shall be appropriately sized, with no wiring or other equipment located in the expansion area below the controllers.

G. BAS software shall meet University standard conventions for PID loops, optimum start/stop, alarms to the Durham/UNH Dispatch Center, BTU and energy monitoring and data storage, and other control routines. BAS contractor shall meet with UNH Facilities Operations Zone 3 Manager to discuss software strategies and conventions prior to software development and as required during project duration. UNH shall review typical software code before contractor installs code in BAS controllers.

H. The BAS contractor shall provide all system alarms, schedules, and optimized start/stops in accordance with current UNH BAS conventions. Alarm, schedule, and control program strategies and configuration shall be discussed with and approved by the UNH Facilities Operations Zone 3 Manager before programming. BAS contractor shall not designate any alarms as “Level 8.”, but shall work with UNH staff to configure Level 8 Dispatch alarms.

I. Optimized start/stop shall be provided for all heating and cooling equipment. Separate optimized start calculations shall be performed for the heating season and the cooling season. Start and stop target times shall be provided by a schedule that allows different target times for each day of the week, and for holidays and vacation periods. Provide a link to a global campus holiday numeric for certain zones as directed by the University. Schedule strategies and configuration shall be pre-approved by the University prior to beginning software development.

J. All BAS controller and point names shall reference final University room numbers, not construction document room numbers. The BAS contractor shall submit all naming conventions to the University for approval by the UNH Facilities Operations Zone 3 Manager prior to writing final system software.

K. The BAS contractor shall provide graphical floor plan displays with final University room numbers (not construction document room numbers) on the existing University Cyberstation workstations. Additional graphic panel displays of all mechanical systems and terminal HVAC equipment shall be linked via mouse click to the floor plan displays. Spreadsheet and/or schematic type graphic panels shall be provided in accordance with standard University practices for graphic panels. Generally, animated graphic panels are not required, spreadsheet text panels are used for all systems, and schematic diagrams are used from complex systems such as large air handlers, chiller plants, and pumping/piping systems. Floor plans shall show color coded control zones with room sensors and terminal units.

L. The BAS contractor shall be responsible for maintaining, and storing off-site, contractor's own control software and Cyberstation-related software back-ups until the end of the warranty period. The BAS contractor shall be responsible for duplicating any work necessitated by contractor's failure to maintain and store their own software backups until the end of the warranty period.

M. Attribute sources for all software templates shall be "copy," not "inherit."

1.11 AS-BUILT DOCUMENTATION

A. The BAS contractor shall provide as-built drawings and written sequences of operation that reflect final University assigned room numbers.

B. A copy of all as-built drawings shall be provided to the University as part of the final project record drawings.

C. The BAS contractor shall submit to the University copies of all graphic files and a text export file of the complete software code on a read-only CD.

D. The as built documentation shall include points list, I/O wiring diagrams, manufacturers' maintenance and troubleshooting data sheets for all BAS field devices, floor plans with all sensor and controller locations, BAS communications bus wiring diagrams showing location of the bus runs within the building, floor plan showing all electrical power panels and circuit numbers serving BAS equipment with locations of junction boxes.

E. BAS contractor shall install the following documentation in a plastic sleeved holder at each BAS controller location: written sequence of operation, controller I/O wiring diagram, controller locations, and floor plan showing sensor and controlled-equipment locations.

F. At each BAS controller, the BAS contractor shall mount an output override switch chart with complete descriptive names and software point names for each override switch. The chart shall clearly indicate what equipment is controlled by each numbered override switch. This override switch chart shall be mounted separately from the documentation required above.

1.12 EQUIPMENT LIST REQUIREMENTS

A.

1.13 TRAINING

A. The BAS contractor shall provide 16 hours of on-site training on all projects exceeding 10,000 square feet. The BAS contractor shall provide an additional 40 hours of training for one person at the manufacturer's facility on all projects exceeding 50,000 square feet in size, and 80 hours at the manufacturer's facility on projects over 100,000 square feet.

1.14 TESTING AND VERIFICATION

A. The BAS contractor shall be familiar with all commissioning specifications and be responsible for providing commissioning assistance with all divisions as required and outlined in the Construction Documents.

B. All tests required by this Section shall be scheduled in advance with the University and conducted in the presence of a University representative. BAS contractor shall obtain sign-off from the University observer and Commissioning Agent if applicable after successful completion of each test.

C. Inputs and Outputs

1. For all inputs and outputs, BAS contractor shall prepare a point-to-point verification spreadsheet with columns for point name, date of verification test, test results, and University observer sign-off.
2. BAS contractor shall verify all input points by altering conditions at the input device and observing that an appropriate change in value for that point occurs on a locally connected computer terminal. Shorting or opening wires at the input device shall be an acceptable method of altering input conditions.
3. Results of each input test shall be recorded on the verification spreadsheet.
4. BAS contractor shall verify all output points by disabling and modifying the output point value via a locally connected computer terminal and observing that an appropriate change occurs at the controlled device. Results of each output test shall be recorded on the verification spreadsheet.
5. Any points failing the initial verification test shall be re-tested and recorded on the verification spreadsheet until the point passes the verification test.
6. BAS contractor shall provide the University with the completed verification spreadsheet prior to project acceptance.

D. Local Hand-Off-Auto (HOA) switches on motor starters for BAS-controlled equipment are not acceptable if the associated BAS controller has built-in override switches. The integral, status reporting, override switches built into the BAS controllers shall be used for the HOA function. Coordinate

E. Lead-lag-standby equipment sets:

1. All lead-lag-standby equipment sets shall be tested for proper sequence of operation by causing a failure of each piece of equipment in the equipment set and observing that the appropriate back-up unit operates. Simulating equipment failure via software is not an acceptable test.

F. Dispatch Alarms

1. All Dispatch alarm software shall be of the same format as the existing Dispatch alarm software and shall be installed by UNH Facilities Operations Zone 3 Building Controls Technicians. BAS contractor shall not designate any alarms as “Level 8.”, but shall work with UNH staff to configure Level 8 Dispatch alarms.
2. All alarms designated by the University as “Dispatch” alarms shall be tested by causing an alarm condition. Simulation of alarm conditions via software is not an acceptable test.

3. BAS Contractor shall demonstrate that an alarm signal is received at the UNH/Durham Dispatch Center alarm console when the alarm condition occurs.
4. The condition shall be left in the alarm state and the BAS contractor shall demonstrate that the alarm signal at the Dispatch Center alarm console clears when the alarm is acknowledged at a University Cyberstation workstation.
5. The alarm condition shall then be returned to normal and the BAS contractor shall demonstrate that the active alarm display indicates a return to normal condition at a University Cyberstation workstation.

G. Trend Logs

1. BAS Contractor shall set up Cyberstation trend log groups and log configurations on designated inputs, outputs, and numerics.
2. Generally, each system, control zone, or HVAC unit shall have a separate trend group. BAS contractor shall meet with the University to identify group names, point log types and intervals, and group member lists.
3. In order to provide historical trend logs covering an entire weekend period, most trended points will require logs with 128 entries at 30 minute intervals. BAS contractor shall provide extended logs if the field controller memory cannot accommodate the required number of log entries.
4. The BAS contractor shall review trend logs with the UNH to confirm proper operation of control sequences and shall perform all required software/hardware modifications to obtain proper operation.

H. Modulating Control Loops

1. Each modulating control loop shall be inspected by the BAS contractor for stability and response time.
2. Inspections shall take place at a University Cyberstation workstation with a UNH Facilities Operations Zone 3 representative and the University Project Manager present.
3. Each modulating control loop shall be tested by creating a significant change in the setpoint numeric and, after five minutes, returning the setpoint to its normal value. Response time to return to the normal setpoint shall be a maximum of 5 minutes. Certain types of outputs, as determined by the University, will require faster response time.
4. Oscillations during the response time period shall not exceed 10 percent of the setpoint value.
5. At the end of the response time, control loops shall maintain setpoint within the following tolerances:

Air Pressure	+/- 0.5” w.g. range 0-6” w.g.
	+/- 0.01” w.g. range –0.1 to 0.1” w.g.
Airflow	+/- 2 percent of setpoint in cfm
Temperature	+/- 1.0 degrees F
Humidity	+/- 5% RH
Fluid Pressure	+/- 2.0 psi range 1-150 psi
	+/- 2.0” w.g. range 0-50” differential pressure

6. BAS Contractor shall tune modulating control loops as needed to meet the requirements of this Section.

END OF SECTION 25 0000