23 09 23
BUILDING AUTOMATION AND TEMPERATURE CONTROL SYSTEM (BAS)

1. **GENERAL**
   A. Related sections:
      i. 00 73 01 – Sole Source / Sole Brand
      ii. 01 91 13 – Commissioning Requirements
      iii. 23 00 00 – General Mechanical Requirements (HVAC)
      iv. 23 05 93 – Testing, Adjusting, and Balancing for HVAC
      v. 27 00 00 – Communications
      vi. 27 15 00 – Communications Horizontal Cabling
      vii. 23 05 19 – Meters and Gages for HVAC Piping
   B. The BAS shall utilize direct digital control (DDC) technology to maintain the space conditions and provide automatic control of the associated mechanical equipment.
   C. For the UGA Athens campus, the building automation controls system main software and hardware reside at server racks located at the Boyd Graduate Research Center. The Design Professional shall coordinate with the Project Manager and FMD to determine if any front-end computing hardware upgrade/replacements are required as part of the Project. The Contractor and controls Subcontractor are additionally responsible for including any required software or hardware upgrades specific to the selected controls system in the Cost of the Work or Bid.
   D. The University of Georgia Standard Controls shall be reviewed by the design team and incorporated into designs for both renovations and new construction. The document is available at the following location: https://www.architects.uga.edu/standards.
   E. The Design Professional is responsible for coordinating the connection locations of the direct digital controls system to the UGA network.
      i. Refer to Section 27 15 00 Communications Horizontal Cabling for data cabling requirements.
      ii. The Design Professional shall locate all required ethernet points / drops to the Project Manager and the Project Manager shall request IP address assignments from EITS. The Contractor shall provide the Project Manager with the date that the data connection points utilized by the DDC are required to be active. The DDC system shall be actively connected to the UGA network prior to the start of TAB to allow TAB Subcontractor, CxP and Design Professional to check the Work before completion and handover.
      iii. All information technology related issues shall be communicated promptly to Project Manager.
      iv. BAS contractor is to provide a temporary network and server setup to allow BAS startup and Commissioning activities to occur if the permanent IT connection provided by EITS is not in place in sufficient time to use during construction. The setup will allow multiple users.
   F. The Contractor shall coordinate with the controls Subcontractor during preparation of shop drawings to ensure that tappings for sensors are provided and are located to ensure accurate sensing and control.
   G. Provide instrumentation across all heat exchangers plus P/T plugs. P/T plugs and wells for pressure gauges and thermometers shall be provided across all heating and cooling

coils, control valves and strainers. Provide differential pressure sensors across all filter banks on AHUs and elsewhere, where indicated. These shall have an analog output connected to the BAS. Filter status shall be displayed on AHU graphic. Display shall indicate 'as tabbed' filter 'clean' DP and filter clean-out, as specified – shown as 'dirty' DP and actual DP in inches WG. Display shall change to "CLEAN FILTER" when 'filter dirty' set=point is reached. Transmitter shall be equal to Dwyer Photohelic gauge if there is no BAS and, with Owner's prior approval, equal to Magnahelic if no power is available.

H. Utilities to building shall be independently metered and trended via the BAS. Rolling, Daily, Monthly, and Annual Consumption and peak demand data shall be stored in historical trend database for a period of 2 years for all main utility meters and sub-meters.

I. Control drawings shall show schematic control diagrams for all systems; show, as minimum, symbols for sensors, controllers, and actuator; sequences referencing these sensors, controllers, actuator symbols; I/O summaries; system architecture / riser. Input and output numbering shall be descriptive to indicate the function (use SAT1, OAD1, etc., in lieu of AI1, DI1, etc.); every actuator shall, unless specified otherwise, have a dedicated output and independently adjustable control range. Designers shall refer to campus standard control sequences of operation and schematics. Campus standard sequences, modified as required for project-specific considerations, shall be incorporated into each project, all variations from the standard sequences shall be discussed with the UGA project manager.

J. Controls graphics shall be submitted as a standalone submittal unless a live/online graphics review is conducted with necessary personnel (UGA, Cx, and DP).

K. Status of sump and steam condensate pumps shall be monitored by ALC.

L. Control system devices and panels shall have suppressors to protect against lightning damage; power supply surges; induced voltage from other equipment such as transformers or electric motor operations; and electronic transmission / relay such as may be caused by radio / TV broadcasting towers, radars and high-voltage transmission lines.

M. Provide leaving air temp sensor on all AHUs, FCUs, and VAV terminals.

N. Humidity sensors for HVAC applications shall be equal to Vaisala, model HMD60/70 (or HMD50 with INTERCAP replaceable sensors), HMW82/83 or HMT120/130 to suit the application, and output required. Sensor to be interchangeable in the field and calibration-free. Accuracy is +/- 3% RH from 0 and 90% RH. Sensor to have a stability of a +/- 2% RH over a two-year period. Transmitter shall operate over a humidity range of 0 – 100%. Sensors shall be warranted for 2 years from date of installation and shall be NIST-certified / traceable calibration. Wall-mounted devices shall have replaceable sensor kits. Where dewpoint sensing is called for, the transmitters shall be equal to Vaisala HMW110B1VA1NN for wall-mounted and HMD 102B1VA1NN for duct-mounted; 2% accuracy, 3-point NIST-certified / traceable calibration; on-site calibration using HM70 hand-held meter or PC connection. Output parameters to be selectable with a PC connection. Sensors shall be warranted for two (2) years from date of installation and shall be NIST-certified / traceable calibration.

O. The controls Contractor shall verify the specified sizes of control devices, (valves, dampers, etc.) to ensure the devices have the correct system authority for proper, stable, control.
P. HVAC systems shall be zoned for a maximum of 3 thermally similar spaces per zone. All non-common areas shall have separate adjustable sensors.
Q. The controls Contractor shall provide the applicable version of the Building Automated Systems (BAS) software required by the TAB Subcontractor to do the Test and Balance work specified at no extra cost to the Contract or the TAB Subcontractor.
R. Upon completion of the Project, the controls Contractor shall provide, to the Owner, all software and design tools required for system design, programming, graphics, etc.
S. For critical applications, in lieu of a "power trunk", provide a minimum 40va, 24vac control transformer from the factory for each terminal unit, to be wired by Division 26 subcontractor in the field with a toggle switch disconnect.
T. Control devices shall be provided with disconnects and shall be wired such that any device can be removed from the circuit without causing other devices on the same circuit to be de-energized.
U. Graphic User Interface: (shall be available through the web browser).
    i. If an MDF/IDF room is served by a mini-split AC unit, a sensor shall be added to the space that connects to the BAS for temperature monitoring only. If an MDF/IDF room is served by a mini-split AC unit, a sensor shall be added to the space that connects to the BAS for temperature monitoring only."
    ii. Building Graphics
        a. General
        b. GRAPHICS specific to this Project as follows:
        LEVEL ONE: Shall identify location of building on the site.
        LEVEL TWO: Shall show each floor plan such as basement, first, second, and roof showing terminal devices with link to its schematic diagram.
        LEVEL THREE: Shall show mechanical rooms linked to level four devices.
        LEVEL FOUR: Shall show each individual system, chiller, air-handling units, terminal units, fans, etc.
        c. On all screens, the entire graphics screen should be visible in full screen mode, i.e. no scroll bar required to view entire screen and should be printable with a white back ground.
        d. A legend should be provided on all screens where graphical colors are used. Provide an active link to a comprehensive project specific legend that explains all abbreviations used.
        e. Floor plan graphics should be uniform design for all projects: simple, easy to read, intuitive, uncluttered and organized. Floor plans should be 2 dimensional only. (No 3D floor plans).
        f. Graphic displays shall show all I/O points including set points, dynamic, real time values of temperature, pressure, status, etc., alarm settings and any current alarm / alert conditions; shall show air flows in CFM and temperature, actual and set-point, for outdoor air, return air and supply on AHUs and primary air on VAV terminals. Fan amp and Kw shall be shown at each device. Graphics for VAV terminals shall so maximum, minimum, dual minimum, etc., as applicable and the actual real-time

CFM.

g. Graphic screens shall include a complete system schematic layout showing real-time values and set-points for all points. For VAV systems, the airside shall show AHU serving the system, air terminals, duct static-pressure sensor location(s) with an active link to floor plan(s) showing actual installed locations, etc. For water side, the graphic shall show control valves and pump status. The graphic screen shall show design goal for monitored points and set-point and the real-time current temperature, humidity, static pressure, flow rate, etc., as well as status of all fans associated with the system; to include, real-time air flow rate, with maximum and minimum cfm sert-points (as specified). All air flows shall be shown in an air balance schedule on the graphic screen, as well as the space static pressure for the system or, depending on the amount of information on the graphic screen, accessible via an active link. The air balance schedule shall show the actual net positive or negative air flow in the summary. The graphic shall show all control air flow damper positions and re-heat, hot water valves, or electric heat control, as a percentage open or closed.
h. All outputs should be able to be overridden from the graphical interface. Clear intuitive means of indicating when any point is overridden to a manual position shall be provided on the graphic. This could be done by text changing color from a normal state or a hand icon appearing next to the over-ridden point.
i. Piping schematics shall be two-dimensional to clearly identify service (CHW Supply, CHW Return, CW Supply, CW Return, MP Stream, Pumped Condensate, Make-up, etc.). Display shall use bold colors (rather than shades).
j. Graphics shall show water flow in real-time and set-point for GPM, temperature and pressure drop and pump amps draw and Kw.
k. All points shall be trended and provided historical trending with enough memory for up to 1 year of data.
l. Point names shall be process specific, unique and intuitive on control drawings with the same on graphic screen and in the program (do not use AI1, DO1, T1, P1, but LAT1, SDSP1, etc.). Special attention shall be given to pump point naming; names shall consistent across graphics, control drawings and in programming.
m. A point naming legend shall be provided on the control drawings and graphic screens. Link the legend to pump graphic icons.
n. Graphics shall clearly differentiate between normal operating mode, manual over-ride, alarm, etc.
o. Economizer control shall be dry-bulb unless the application requires control of space humidity levels in which case enthalpy control shall be used.
p. Graphic screens showing floor plans and zones shall be color coded based on temperature setpoints (not actual temperature). Zone, area, and building information shall be displayed using colors to indicate

conditions. Relative temperature conditions, based on setpoint, are displayed in a series of colors indicating the zone performance to represent comfort within a given zone.

q. Graphics shall be viewable, over the web, on mobile devices such as phones and tablets without need for installing "Apps."
r. Control drawings shall be linked to the graphics, allowing the user to verify intended sequence of operations for all controlled equipment.
s. As-built mechanical drawings shall be linked to the graphics.

iii. Building Level Graphics
   a. This level should include an overall building plan, illustrating all floors (if possible). The overall floor plans will indicate comfort status displayed via color codes. The intent is to allow the building engineer to quickly see problem areas within the facility.
   b. Main building screen should indicate major building systems that are in alarm and those elements that have lost connectivity with the server.
   c. Main building screen should provide active links to as-built control drawings, basis of design documentation, sequence of operations, and MEP as-builts.
   d. Outside air temperature and relative humidity should be displayed.
   e. "Global" Building heating and cooling set-points shall be indicated at this level and shall be able to be modified for all associated building systems.

iv. Floor Plan Level
   a. Floor plan level graphics should display the comfort status of all rooms on that floor via color codes incorporated into the actual floor layout. Comfort status should include actual status of all controlled variables: temperature, humidity, indoor air quality (CO2 level), etc. Active links to change the set points of these variables should be incorporated.
   b. Zone boundaries should be able to be determined by means of color-coded floor plans at this level.
   c. Web page should identify the building, i.e. "Pharmacy 2nd Floor", clear at the top of the page, centered, just above the floor plan(s).
   d. Active links to other floors in the building should be provided.
   e. Layout and location of system components: duct, boxes, etc. should be provided with color code according to use (supply, return).
   f. Identify AHU(s) and central exhaust fan(s) with name and location serving the floor with active link to its graphic.

v. Zone Level
   a. All "%" indicators of valves or dampers should indicate "open" or "closed."
   b. Should indicate air handler supplying the zone on the page and provide a dynamic link to that page.
   c. Occupancy status and temperature should be graphically represented via a color bar chart.
   d. Entering and Exiting temperatures should be shown at the device.
   e. Indication of air flow through box should be shown graphically.

f. Actual components of box should be shown graphically.
g. All points should have process specific, intuitive, names on every graphic screen (not T1, P1, but LAT1, SDSP1, etc. (see 'project specific legend') – to be used consistently across all graphics and for all projects, (ex. don't use 'discharge air temp' and 'leaving air temp').
h. Provide zone level environmental index and building performance dashboard.
i. The system shall provide equipment fault diagnostics, with analysis, and detection alarms.

vi. System Schematics
a. Graphics should include a system schematics page showing all major components of any given monitored system (chilled water system, hot water system, AHU and all associated terminal units, etc.) and all measured variables as required to give the building engineer an overall perspective of any given system.

V. Trending / Reporting
i. General
a. System should allow user to create new trends / reports from the browser mode without the need for any programming.
b. All points, software, hardware, calculated / virtual, shall be trended continuously. System shall be delivered to owner in this way without need for any additional programming.
c. Trends and reports should be pre-formatted, requiring minimal user effort to establish a quick trend or report for system troubleshooting.
d. System should allow user to copy, using simple operating system menu commands, trend / report data to a spreadsheet that management can use for trouble shooting, energy reporting, etc.

ii. Programmed Trends / Reports
a. System should provide a drop-down menu, by page, of all equipment where programmed trends / reports are available and link directly to these for viewing.

iii. Configured Trends / Reports
a. Within browser mode, user should be able to select any controlled point for trending and reporting.
b. New graphical trends should be able to show up to 5 user selectable points concurrently.
c. User should have the ability to save new trends and reports and view at later time showing all data since trend / report was created.

iv. Standard and Custom Reports
a. Standard reports shall include, but not be limited to, locked points report, commissioning reports, network points, hardware points.
b. Commissioning reports shall at a minimum identify date, technician name and action.
c. Custom reports shall be configurable by the use / operator.
d. An audit log report identifying system changes by action, date, password, etc. shall be included in the BAS.

W. Programming
    i. General
        a. Programming pages for the whole campus shall be accessible through the web browser from the graphics display window, without requiring additional logon or opening new windows.
        b. Active links to programming should be available from all levels of graphics screens, i.e. floor plan, zone, etc. Link should access pertinent areas of programming for that screen.
        c. Programming function should accept multiple concurrent users, without 'bumping' a current user offline when an additional user logs on. Further, only one user can have access to a specific system at a time for programming purposes.
        d. Graphical programming shall be with live graphic function blocks in a continuous program without opening multiple screens.
    ii. Editing
        a. Edit capabilities should be available on programming pages.
        b. Programming pages should be graphical representations of live programming, i.e. pages should show actual data values as they change.
        c. Over-ride capabilities should be directly accessible from programming pages.
        d. Troubleshooting capabilities for each component should be confined to a single page.
    iii. Scheduling
        a. Scheduling should be available for each individual device.
        b. Group scheduling should be provided whereby multiple device schedules can be modified concurrently without having to modify each schedule individually. Individual devices shall be assignable to multiple groups.
        c. Scheduling shall be hierarchical allowing all devices below a given device to follow the same schedule. All devices shall have override capability to allow deviation from the hierarchical schedule.
    iv. Energy Saving Strategies
        a. The BAS software shall include energy saving strategies such as, but not limited to the following:
            1) Demand Limit Control
                i) Demand control settings should be provided whereby individual and group set points are relaxed in response to energy pricing signals.
                ii) Three demand levels should be provided by device.
                iii) Source temperature optimization. Zone conditions and actual load demand will reset and optimize air side and water side equipment.
    v. User Help Files
        a. Video training modules and context sensitive help shall be provided with the BAS system software through a 'help' function.
X. Information Technology

i. General
   a. Server control software shall be platform independent and shall reside on UGA's Linux (open source) operating system.
   b. Web client should be accessible via multiple browser systems other than Internet Explorer. System shall support unlimited simultaneous users at no additional cost to the Owner.
   c. All future versions of the control system software should be compliant with older versions.
   d. Server software will be virtualized using enterprise platforms such as VMware ESX or Microsoft HyperV.
   e. All trend data, including historical trend data shall utilize an Oracle database. Trend data whether current or historical shall be readily available to user through the web browser.

ii. Architecture
   a. System should be able to operate as an intranet without connectivity to campus backbone for setup and testing.
   b. System should operate via a single Internet Protocol (IP) address for each building, not multiple IPs.
   c. Any data within the system must be available either through database or flat-file exports.

iii. Alarms
   a. System should be configured with a single alarm screen where alarms from multiple buildings are displayed.
   b. Active links should be provided from the alarm screen to the device in alarm for troubleshooting purposes.
   c. Remote alarm notification via e-mail, mobile devices, text messaging shall be included in the software and setup as required by users at no extra cost. Users shall also be able to set up alarms and alarm notifications without additional programming.

iv. Configurable User Access
   a. The Owner shall have the ability to assign access privileges (such as programming, view only, specific buildings, etc.) to various operators and users.

2. **PRODUCTS**

A. This is a sole source of equipment by Automated Logic Corporation: 770-429-3000 and procured through Automated Logic – Georgia: 770-421-3280. For renovation projects that utilize a different brand, the decision to change to Automated Logic Corporation or modify the existing system will be made on a case by case basis.
   i. The Construction Manager shall contract with Automated Logic Georgia as a direct Subcontractor.
   ii. Automated Logic Georgia shall not, for example, be in a sub-subcontract relationship with the mechanical Subcontractor.

B. DDC Control Modules
   i. All modules shall be native BACnet, fully programmable, including zone modules (down to lowest control level).
   ii. Non-customizable routines are not acceptable.

iii. Air handling unit and plant control modules require manual override switches on all outputs.
iv. All modules shall have stand-alone capability including trending.
v. All outputs shall be isolated. TRIAC outputs are not acceptable.

C. All equipment interfacing with the BAS shall have BACnet communication interfaces.
D. Control valves on AHU cooling and heating water coils and steam coils shall have 300:1 rangeability / turn-down. Valves on terminal reheat coils may be 100:1 minimum turndown. All valves and associated actuation shall be selected to operate and close tight at a valve differential pressure of 1.5 times the pump design head or the pump shut-off head. Basis of design control valves for AHUs shall be Valve Solutions – Vee Ball. Valve actuators shall be direct coupled.
E. High occupancy spaces shall have demand control ventilation (DCV). Basis of design CO_2 sensors shall be Telaire model 8002.
F. CTs shall be adjustable equal to Veris H608. Wet media differential pressure transducers shall be equal to Veris PW Series (or PW2 Series depending power supply availability). The Design Professional shall identify the correct locations of differential pressure sensors based on pipe calculation and shall, if necessary, require the Contractor to re-locate the sensors to a better location based on TAB results.
G. Measuring station shall be capable of continuously monitoring the airflow volume of the duct served and electronically transmitting a signal linear to the airflow volume. Airflow measuring devices shall be of the insertion type, or built into ductwork to suit the system configuration and shall be capable of measuring velocity over the range 375 to 7000 FPM with +/- 2% accuracy. Devices shall be selected by the manufacturer or authorized representative, and installed in accordance with the manufacturer's installation instructions and recommendations. Standard materials shall be aluminum bars with aluminum and ABS or aluminum sensors. Support bars over one foot in length shall be supported on both ends; in corrosive air streams, sensors and support bars, shall be of corrosion resistant materials. Velocity sensors shall not be affected by dust, lint, temperature, pressure, or humidity. The sensors shall be passive in nature, with no active parts within the air stream. The output from individual sensors shall be linear with respect to airflow velocity and shall be capable of sensing airflow in one direction only. The velocity sensors shall not require calibration. The transmitter shall provide a scale-able output over the full range of control of the unit, via on-board adjustments. The output signal of the transmitter shall be industry standard electronic signals, selectable on-board via jumpers or switches, for 4-20ma, 1-5vdc or 2-10vdc. Power requirement for the transmitter shall be 24VAC or DC. The device and associated controls shall be native Bacnet-compatible. Measurement system accuracy shall be +/- 2% of volumetric airflow rate. Turndown capability shall be at least 15:1.
H. Wet Differential Pressure: Water system differential pressure use the Veris PW2 series or approved equal. Select the appropriate PW2 range for the given application Select operational range according to maximum gauge pressure, NOT differential pressure. Differential Pressure tubing shall be constructed of ¼" hard copper. Blowdown piping shall be run to the closest floor drain.
I. Air Differential Pressure / Dry Media Measurement: For dry media differential pressure monitoring (static, building pressure, etc.), use the Veris Industries series PXULX05S or approved equal. For static pressure use the included static tip. For room pressure use

the KELE RPS along with the SD-030 Surge Dampener or approved equal. When you need to reference OA pressure, use the KELE A-306 OA static pressure sensor kit or approved equal.

J. The airflow measuring device shall be Vortek VT series (IAQ 2000 for outdoor sensor) manufactured by Tek-Air Systems or approved equal.
K. Basis of design for actuators shall be Belimo.
L. All water-cooled chillers shall be provided with a dedicated DDC control panel. The control panel shall have a hand / off / auto (HOA) switch and an alarm light indicator. In the manual position, the chiller and all associated auxiliary equipment will be commanded "on" and will modulate normally to maintain chilled water set-point temperature. The rest of the loop chillers will modulate normally.
M. Domestic water flow meter used in sub-metering applications shall be shown on the plumbing drawings to be installed under that division. The meter shall be furnished under Section 23 09 23 Building Automation and Temperature Control System BAS, and shall be Badger Recordall Meter, or approved equal, for meters 2 inches or less and Recordall Turbo Meter, or approved equal, for meters greater than 2 inches. Meters to be furnished with a pulsed output for interface to BAS.
N. Building main electric meter shall be shown on the electrical drawings but shall be furnished under Section 23 09 23 Building Automation and Temperature Control System BAS and shall be Veris E50H or approved equal. Meter to be installed by electrical contractor. Refer to Section 26 24 13 Switchboards.
O. The use of a UPS for controls systems should only be used in critical applications. If it is deemed necessary, one utilizing a hot swappable battery and audible alarm for low battery indication is required

3. **EXECUTION**

A. For all equipment with which the controls Contractor will be interfacing, the controls Contractor shall be responsible for reviewing the equipment submittals to ensure that the equipment is being supplied with appropriate accommodations to interface with the BAS as specified.
B. Work required under paragraphs 1.E, 1. F, 1.J, and 2.C shall be provided by the mechanical Contractor in coordination with the controls Contractor.
C. Locate instrumentation, sensor wells, to allow removal and replacement without having to cause damage to or having to remove insulation, etc. show, to scale, on piping shop drawings. Well and sensor shall be matched to ensure accurate measurement of the medium.
D. Label all control elements to clearly indicate function; labels to match control wiring diagrams, schematics and BAS and graphics. Provide legend for each symbol used on both control drawings and graphics.
E. Control sequences shall be written clearly and stated in a logical progression of events and/or actions for all modes of. Sequences shall be provided for both DDC controlled equipment and "packaged equipment". The graphic screen for each item of equipment and system shall have a link to the associated 'as-built' sequence of operation. Package equipment suppliers shall provide sequences of operation specific for the equipment provided. (Although the packaged equipment may not be internally controlled by the BAS, UGA needs to understand the internal operation of the equipment and how it relates to the external system).

F. Electrical supply serving controls shall be permanently energized; one circuit will be provided per floor, all wiring and electrical work, including surge protection, from electrical termination point will be by the controls provider. Control panels associated with the HVAC BAS, the wiring in the panels, and the connections to the panels and all control elements shall be executed by the controls Subcontractor. Subcontracted electrical work associated with the HVAC BAS shall be confined to conduits and wiring between panels and controls devices. Control wiring shall be run in conduit. For exceptions permitted in the specification, wiring shall be independently supported, run continuously tight to and fixed to structure, J-hooks at approved spacing will be accepted. New wireways shall be installed in walls or chases. Surface mounted conduit and wire molding shall not be used without written approval.

G. The controls Contractor shall submit an as-built electronic copy of all programming done, including point-to-point wiring, VAV terminal coefficients as set and calibrated by the TAB Subcontractor. This shall be updated to as-built at the end of the warranty period. An electronic zip file after all TAB and Cx with all final programming loaded shall be provided to UGA to allow reloading of the complete program in the event of a 'crash'.

H. Controls drawings shall be laminated and bound and placed within a pocket inside each control panel.

I. Service:
    i. Two year warranty on parts and labor required.
    ii. Maximum of 5 working days response time to warranty items required.

J. Smoke Damper and Fire Smoke Damper Power / Control: All smoke dampers shall be powered and wired by Division 26 00 00 Electrical. Smoke damper power circuits shall be designated on the electrical panels on the electrical drawings. Control of these dampers shall be by the fire alarm contractor and designated as such on the electrical drawings.

MINIMUM REQUIREMENTS CHECKLIST TO BE USED BY CONSULTANTS AND CONTRACTORS FOR SEQUENCE OF OPERATIONS ON HVAC PROJECTS

Address these questions during 10% or 35% design stage (helps with coordination, cost estimates, etc.)

SEQUENCES OF OPERATION

Start/Stop:

1. How is the equipment energized?
2. Is other equipment interlocked?
3. Auxiliary contacts needed?
4. Coordinated with electrical?

Safeties:

1. Are smoke detectors required?
2. Are safety t'stats required?
3. Miscellaneous safety interlock?
4. Emergency stop switch?
5. Fail safe position

Temperature Control:

1. Proper fail safe position of controlled devices.
2. On a rise or fall of control setpoint?
3. Mixed air limiting controller?
4. Economizer control?

Humidity Control:

1. Fail safe position?
2. Control point?
3. Control high limit?

Pressure Control:

1. Fail safe position?
2. Control point?

Miscellaneous or Special Control:

1. Emergency Power Supply
2. Output indication
3. Remote communications
4. Relief air"