SECTION 25 90 00 INTEGRATED AUTOMATION CONTROLS SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. The Contractor’s attention is specifically directed, but not limited, to the following documents for additional requirements:
   2. The University of Houston’s Supplemental General Conditions and Special Conditions for Construction.

1.2 SUMMARY

A. Section includes administrative and procedural requirements, including, but not limited to, the following:
   1. Successful creation of sequences of operation
   2. Sequence of operation as carried forward through commissioning and into the long-term operation of the building
   3. Points list
   4. Monitoring capability and alarms
   5. System storage capability

B. Related Requirements:
   1. Section 01 91 13 – “General Commissioning Requirements”
   2. Section 23 05 93 – “Testing, Adjustment and Balancing”

1.3 WORK INCLUDED

A. Conduct a BAS Mockup session to prove sequence of operations, graphics and overall acceptance prior to construction. The owner, MEP consultant and General Contractor shall be present and the mockup session shall be conducted at the controls vendor’s facility. Controls vendor shall provide BMS with records of testing results demonstrating 100% functionality. The Mockup session shall take no longer than one week. At completion, all parties present shall sign off that the mockup was completed and proven to meet the design intent.

B. If Commissioning agent must make return trips, a fee will apply. Commissioning may be done in phases with the Cx agent’s approval.

1.4 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. The Authority Having Jurisdiction (AHJ) for building automation systems (BAS) shall be the Building Management Systems shop. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASHRAE 90.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Submit a flow diagram identifying the components that must be controlled to achieve the desired operational results. The sequence can generally be written with a subsection for each of the major air handling unit components. Fan control may be addressed in one section, temperature control in another, and various safety devices and accessories detailed separately

1. Identify the airflow pathway and piping connections. Airflow and water flow rates do not need to be included as this information should be included on equipment schedules. The flow rates could be included if desired, or diagrams can be left more generic. The latter permits use of the same diagram for multiple units with similar configurations. Include all inputs and variables that must be controlled. Components that are not inputs or controlled variables should be left out to maintain a simple diagram that is easy to read.

2. Categorize the purpose of the equipment: for example, comfort heating or cooling for human occupants. maintaining acceptable temperatures for a data center or specific pressure relationships. Include any other equipment that is affected by the sequence, for example, a makeup air unit must interlock with the exhaust fan(s) that create the need for the makeup air unit. A system with multiple purposes should have all purposes noted.

3. Identify the required inputs and output, e.g. space sensors, air temperature sensors, static or differential pressure sensors, etc. Note what inputs are already available for use in the control system and whether the required input devices are already included as a part of the equipment or specified for other purposes. Confirm that additional devices are indicated in the construction documents and specified at this time.

4. List any code required functions of the system (such as ASHRAE 90.1).

5. Incorporate Owner’s operational requirements and expectations. Identify any desired system features which may conflict with overall successful operation or code requirements. Review the system design for additional components necessary to suit the owner’s desired operation.

C. Develop a matrix of points (see Table 1 for sample matrix). The points can be classified as digital or analog. Using the information gathered in the previous steps, create a points list designating all the inputs and outputs that are controlled or monitored by the BMS.

1. The system should be designed to permit expansion and be capable of handling at least 125% of the number of points currently specified. Allowances should also be made for virtual points. These are points that are calculated or passed through the controls system as opposed to hardwired physical points. Virtual (“pseudo”) points must be approved by Owner/Commissioning Agent.

2. Eliminate unnecessary points, such as those at fans, CO2 monitors, and humidity sensors.
3. Sequences should always be as simple as possible while still meeting the performance requirements. Unnecessarily complex control sequences can overwhelm even the most experienced operator because they are more difficult to operate and maintain.

<table>
<thead>
<tr>
<th>Table 1: AHU points</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENABLE / DISABLE</td>
</tr>
<tr>
<td>SUPPLY FAN VFD SPEED COMMAND</td>
</tr>
<tr>
<td>SUPPLY FAN VFD SPEED STATUS</td>
</tr>
<tr>
<td>EXHAUST FAN VFD SPEED COMMAND</td>
</tr>
<tr>
<td>EXHAUST FAN VFD SPEED STATUS</td>
</tr>
<tr>
<td>OUTDOOR AIR DRY BULB TEMPERATURE</td>
</tr>
<tr>
<td>OUTDOOR AIR WET BULB TEMPERATURE</td>
</tr>
<tr>
<td>RETURN AIR DRY BULB TEMPERATURE</td>
</tr>
<tr>
<td>RETURN AIR WET BULB TEMPERATURE</td>
</tr>
<tr>
<td>MIXED AIR TEMPERATURE</td>
</tr>
<tr>
<td>SUPPLY AIR TEMPERATURE</td>
</tr>
<tr>
<td>SPACE TEMPERATURE SENSOR</td>
</tr>
<tr>
<td>SPACE RELATIVE HUMIDITY SENSOR</td>
</tr>
<tr>
<td>RELIEF AIR DAMPER COMMAND</td>
</tr>
<tr>
<td>RELIEF AIR DAMPER POSITION</td>
</tr>
<tr>
<td>OUTDOOR AIR DAMPER COMMAND</td>
</tr>
<tr>
<td>RETURN AIR DAMPER COMMAND</td>
</tr>
<tr>
<td>CARBON DIOXIDE SENSOR</td>
</tr>
<tr>
<td>SUPPLY DUCT SMOKE DETECTOR</td>
</tr>
<tr>
<td>RETURN DUCT SMOKE DETECTOR</td>
</tr>
<tr>
<td>CHILLED WATER VALVE COMMAND</td>
</tr>
<tr>
<td>HEATING HOT WATER VALVE COMMAND</td>
</tr>
<tr>
<td>OUTDOOR AIRFLOW MEASURING STATION</td>
</tr>
<tr>
<td>FILTER DIFFERENTIAL PRESSURE SWITCH</td>
</tr>
<tr>
<td>SUPPLY AIR STATIC PRESSURE SENSOR</td>
</tr>
</tbody>
</table>

D. Review monitoring capability and alarms. Alarms may be generally categorized as Critical (main equipment failure), intermediate (high humidity or excessive CO2 events), or nuisance alarms. All alarms shall be delayed 15 seconds.

E. Specify the storage capability of the system. Data should be retained for [30, 60, or 90] days. Readings shall be sampled and recorded every 15 minutes. BMS device storage is backed up daily.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 Sequences of Operation (Design engineer shall submit SOO for BMS --and EHLS as needed -- review and approval.

A. Wortham House—Overview:
Two chillers with dual chill water pump control system - ambient control economizer mode; multiple air handlers with humidity control; seasonally sensitive; single chiller is not adequate; failure alarm on chillers and pump, chilled water temperature, room temperature sensor shall have nuisance alarm.

B. IDF Rooms/MDF rooms—Overview:
Different building air; monitor room temperature: e.g. communicating BacNet thermometer; humidity monitoring desirable

C. Computing center—Overview:
Multiple chiller sequence of operation; add BacNet communication cards as retrofit, rotation between 2 primary chillers shall be automated; third chiller is only brought on to supplement primary as needed

D. Classrooms—Overview:
Requires temperature, humidity, and CO2 monitors

E. Retail— Overview: Not available

F. Laboratories—Overview:
VAV may feature 5-6 physical points: damper, reheat, temperature sensor discharge temperatures and humidity.

1. AHU- if the exhaust fails:
   If the AHUs receive a signal noting that the exhaust manifold is down (all fans are in alarm and off), all but the AHU with the least run time shall shut down and the remaining operational AHU shall reduce to the minimum allowable speed of the VSD to maintain a Static pressure of the building to a positive nature. The labs shall keep the Exhaust valves open and the Supply valves to reduce in the labs to maintain a static pressure in the labs to neutral/or negative. Upon the exhaust manifold returning to operation, the AHU system shall return to normal operation. Chill water pump must be on emergency or standby power to maintain some tepid temperature to the building in high ambient conditions. Low ambient conditions- 58Degrees F - the Hot water pump must stay operational on standby power and the preheat coil will operate a conditions to provide tepid conditions to the building at low ambient conditions. **A customized evacuation message shall be issued via the addressable fire alarm system; coordinate with Fire Marshal/EHLS.** Requirements (10-15 points) 3 different temp sensor (pre-heat, chilled, discharge) fans status, start stop, isolation damper (2) VFD speed VFD alarm, CFM release

2. Exhaust- if the AHU fails:
   If the Exhausts receive a signal noting that the AHU manifold is down (all fans are in alarm and off), all but the Exhaust with the least run time shall shut down and the remaining operational Exhaust shall reduce to the minimum allowable speed of the VSD to maintain a Static pressure of the building to a positive nature/or static. The labs shall keep the Air Handling valves open and the Exhaust valves to reduce in the labs to maintain a static pressure for the labs to neutral/or negative. Upon the AHU manifold returning to operation, the Exhaust system shall return to normal operation. Chill water pump shall stay operational and the exhaust shall pull
the air from the AHU to maintain some temperature relief to the buildings. If the Temperature is at low ambient conditions, 58 degrees F the Hot water pump shall stay running to allow for the building to operate a tepid temperature during low ambient conditions.

G. Wet Labs—Overview: Not available

H. High Hazard Lab —Overview:
   Controls must be located outside the laboratory space

I. Biological Safety Labs- Levels 1&2—Overview: Not available

J. Instructional Labs —Overview: Not available

K. General office spaces — Overview: Not available

L. Auditoriums —Overview: Not available

M. Kitchens —Overview: Consider systems that use infrared or temperature to turn on the exhaust fan. Hilton hoods exhaust fan are triggered by heat and smoke; sensor will shut off gas.

N. Central Plant — Overview:
   Freeze protection is required for any system with more than 30% outside make up air: Engineering drawings are required on any system with pre-heat. Systems are typically maintained at 55 deg. F; sensor shall trip at 34 degrees and close outside air damper, open all valves on coils.

END OF SECTION 25 31 00