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PART 1 - GENERAL

1.1 OVERVIEW

- A. Provide a building temperature control/building automation system (BAS) for the space temperature control and monitoring of defined environmental conditions. General system operation is described within this Design Guideline Element.
- B. The temperature control/building automation system will be accomplished utilizing a direct digital control system per Owner's Building Automation Specifications. Owner has two different versions of building automation specifications. The Owner will direct the A/E in writing on which specification version applies to the Project upon authorization to proceed with the Design Development Phase.
- C. Edit MD Anderson Specialty Equipment Control Standard Drawing Templates for systems as appropriate for the Project. Create control drawings as necessary using the same format provided in the templates. For additional information visit the following Internet URL:

http://www2.mdanderson.org/depts/cpm/standards/bas.html

D. Written sequences of operation are described within Element D3060 subsections that supplement this Design Guideline. Refer to the Control Standard Drawing Templates for systems that are not described within these Element D3060 subsections.

PART 2 - DESIGN CRITERIA

2.1 GENERAL

- A. Actuation of dampers, control valves, and air terminals will be accomplished utilizing electronic actuation. For devices where speed of response or shut-off pressures are critical, these devices will utilize pneumatic actuation. Actuation of valves, dampers, etc. exposed to an outside environment will be accomplished utilizing electric actuators. Confirm with Owner for specific applications where more discussion may be required to make a recommendation about the type of actuator.
- B. A duplex type control air compressor will be provided with refrigerated air dryers, PRV's, and associated appurtenances for pneumatic devices.
- C. Air handling unit (AHU) fail safe operation shall fail to cool unless the there is a potential for a freeze condition to damage equipment. Only AHU exposed to a freeze hazard shall fail to heat. Air terminals and valves less than one (1) inch in size may fail in place where applicable.
- D. The BAS and its associated equipment (i.e. air compressor) will be connected to emergency power, with a plug-in uninterruptible power supply (UPS) device provided for the computer equipment. This shall be shown and coordinated on the contract documents. Refer also to Section D3000 for additional emergency power requirements.

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- E. Components of the BAS that should be connected to emergency power and UPS are the multiplexers, the unit direct digital control (DDC) controllers controlling/monitoring critical systems (air handling and associated terminal units, steam and chilled water), and the communication panels.
- F. All primary controllers and control panels shall be protected from any memory loss due to a loss of power by one or a combination of the following:
 - 1. Volatile RAM shall have a battery backup using a lithium battery with a rated service life of fifty (50) hours, and a rated shelf life of at least fifty years.
 - 2. EEPROM, EPROM or NOVROM non-volatilememory.
- G. Coordinate BAS network and telecommunications requirements with telecommunications design.
- H. The BAS shall be capable of reporting to the Owner's 24-hour Monitoring Services Control Center located at 1515 Holcombe Boulevard, Room B2.4481.
- I. The BAS shall be capable of monitoring digital inputs and analog inputs not related to HVAC control. The A/E shall confirm the quantity and the location of these additional inputs into the BAS with the Owner. These additional DDC inputs shall be referred to as Client Critical Alarms and shall report to the Owner's 24-hour Monitoring Services Control Center.
- J. All primary controllers shall have the capability of direct connection to the Ethernet Network.
- K. Wireless sensors may be used for wall mounted sensors located in office and administrative areas, where approved in advance by the Owner.

2.2 GENERAL SYSTEM OPERATION

- A. The chilled and hot water pumps supplying water to the building loop will operate in a lead/lag/standby mode of operation to equalize run time on each pump. When a pump is signaled to start, the lead pump will be started. On an increase in the system flow requirement beyond the capacity of the lead pump, the lag pump will be started. Both pumps will run at the same speed. When both pumps slow to 40 percent on falling system flow requirements, one pump will shut down and stay off 5 minutes. The designation of the lead/lag/standby pump will be adjustable. Variable frequency drives will be utilized to modulate the speed of all pumps to meet the variable flow requirements of the system.
- B. The chilled or hot water flow to the majority of the coils in the air handling units, computer room air-conditioning units and fan-coil units will be controlled utilizing two-way control valves. The chilled or hot water flow to the coils in last air handling unit or fan coil unit on a distribution piping circuit will be controlled utilizing three-way control valves to maintain a minimum flow in the system when A/E and owner determine it is required. A differential pressure transmitter between the chilled water supply and return mains will be utilized to vary the speed of the pumps, via the variable frequency drives, to maintain a constant pressure (adjustable) differential between piping mains. Similar control sequence is also applied to the hot water system.

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- C. Constant volume and variable volume terminal units will utilize internal multi-point flow sensor to acquire airflow measurement at each inlet along with separate, pressure independent velocity control loops.
- D. AHU fail safe operation shall fail to "cool" unless there is potential for a freeze condition to damage equipment. Only AHU's exposed to a freeze hazard shall fail to heat. Air terminals and valves less than 1 inch in size may fail in place where applicable.
- E. During occupied periods all variable volume air terminal units will be at normal or maximum airflow setting. During unoccupied periods, the variable volume air terminal units will be either at normal airflow position or setback mode and the two position air terminal units will be at the minimum airflow position. During power outages, all air terminal devices will be at the fail position airflow setting.
- F. Offices/Administration Spaces:
 - 1. Air handling units will operate in the occupied mode from 7 a.m. to 6 p.m., Monday through Friday. The air handling unit will operate in a night setback mode from 7 p.m. to 6 a.m., Monday through Friday, Saturday, and Sunday.
 - 2. Each HVAC zone with a supply air terminal unit controller:
 - a. Shall be provided with a space temperature sensor with an occupant pushbutton override to override the system into occupied mode.
 - b. During occupied hours:
 - i. Occupancy shall be sensed to switch between HVAC modes of unoccupied (day)/pre-comfort to occupied/comfort.
 - ii. Shall be configured to provide a temperature range or dead band of at least 5°F between heating and cooling during occupied hours when occupancy is sensed.
 - iii. Shall be configured to change temperature set points (minimum -2°F heating; minimum +2°F cooling) from normal occupied temperature set points after occupancy is not sensed for 15 minutes.
 - c. During unoccupied hours:
 - i. Setback Controls: Heating systems shall be equipped with controls capable of and configured to automatically restart and temporarily operate the system as required to maintain zone temperatures above an adjustable heating set point at least 10°F below the occupied heating set point.
 - ii. Cooling systems shall be equipped with controls capable of and configured to automatically restart and temporarily operate the mechanical cooling system as required to maintain zone temperatures below an adjustable cooling set point at least 5°F above the occupied cooling set point or to prevent high space humidity levels.
 - 3. Variable frequency drives will be utilized to modulate the fan speed to vary the supply air quantity based on system airflow requirements and to compensate for filter loading.
 - 4. Refer to other Design Guideline Element D Sections for operating hours of other types of occupied space.

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- 5. Variable air volume and fan powered terminal units will modulate to maintain space temperature set point. During power outages, all air terminal devices will be at the fail position airflow setting.
- G. Lab spaces: Space temperature sensors will be equipped with an occupant pushbutton override to override the system into occupied mode.
- H. General exhaust systems will operate 24 hours/day, 365 days per year. Pressure dependent, manual-balancing dampers will be provided at each general exhaust branch connection for balancing purposes. Exhaust fans will be constant volume with all controls required for VAV operation. Fans may only vary flow upon approval from owner and wind tunnel study.

PART 3 - SPECIAL CONTRACT DOCUMENT REQUIREMENTS

3.1 GENERAL

- A. Edits to each BAS Master Construction Specification Section shall be performed in Microsoft Word software. All editing shall be performed using the "Track Changes" option with all changes not accepted. This allows the Owner to review all changes proposed to the Master Specifications.
- B. Decision-making guidance to the A/E is provided throughout the Master Specifications in the form of "Editor's Notes" so that the A/E may make prudent decisions and specify the most effective requirements for the system being installed and for those that have to use them.
- C. Only those items listed in Blue Italic Text are to be modified. All other items in the Master Specifications are to remain unchanged unless prior, explicit permission has been obtained by Owner.

PART 4 - PRODUCTS

4.1 GENERAL

- A. Refer to Owner's BAS Master Construction Specifications for requirements of BAS systems and components. These are available on the Owner's Design Guidelines website: <u>http://www2.mdanderson.org/depts/cpm/standards/specs.html</u>
- B. The Owner's BAS Master Construction Specifications set forth guidelines to assist the A/E in specifying and procuring controls for building systems. The intent of the Specifications is not to require a "one-size-fits-all" solution because that is simply not in the best interest of the Owner. It is ultimately the A/E's responsibility to assess systems to be controlled and the environments in which they will be installed, commissioned, and operated.
- C. The BAS Master Construction Specifications apply the following principles to the control systems in the order they are presented:
 - 1. Principle 1:

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- a. The control system must first and foremost provide effective and reliable control, commensurate with the systems it is controlling. Obviously the types, complexities and the criticalities of the systems being controlled will dictate the quality/power of the control system that should be applied to them.
- b. The ultimate quality of the control system is primarily dictated by the components that sense, execute logic for, actuate, and document the systems they are controlling.
- c. These components are generally specified in Master Specification Section BAS Basic Materials, Interface Devices, and Sensors and BAS Field Panels. These Specifications apply the concept of an "Application Category: for controllers whereby the performance requirements of the controllers are grouped into categories. The Master Specifications must remain unchanged.
- 2. Principle 2:
 - a. The manufacturer and installer must be highly qualified with extensive experience and must be committed and bound to thorough Commissioning (Cx). While the control system power/quality is very important, equally or more important is the expertise and commitment of the installing Contractor and their collaboration with the overall commissioning team.
 - b. Qualifications should ensure that a quality Contractor with an extensive proven track record is specified and that effective, thorough commissioning of the control systems by that Contractor whether or not a formal commissioning process is employed is essential. Given this, there lies a challenge to the A/E to fairly restrict installers to those that can deliver effectively within the context of both the construction and the service/support arenas.
 - c. To address this, Master Specification Section BAS General provides for qualifications of both the installer and manufacturers of the systems. Master Specification Section BAS Commissioning dictates a high standard for commissioning of the system by the installer.
- 3. Principle 3:
 - a. The control installation must be fully documented as consistently as practical with nothing required to fully operate and maintain the system withheld from the Owner. The system must always be put in the context of the enterprise (Owner's WAN) and implemented and documented using standard approaches wherever possible.
 - b. Point naming conventions, programming logic, network configuration requirements, security information, etc. must be strictly adhered to and totally documented. No element for the continued operation and maintenance of the control system may be withheld in any way.
 - c. No part of the installation may be considered confidential or proprietary information. This Master Specification requires applicable documentation throughout. These requirements are not optional; however, certain documents are only applicable for certain approaches.

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- 4. Principle 4: Specify Sequence of Operations Logic.
 - a. The A/E must specify all DDC point types and counts (point summary) for all equipment sequences of operation on the Drawings to precisely define the BAS and the A/E must specify the logic of equipment sequences of operations.
 - b. Often sequence of operation is specified only in general, and often ambiguous, terms, with much of the sequence left to the Contractor's programmer. The programmers should not be put in the position of having to complete the A/E's sequence, which often resort to sequences, which are not optimal for the Project.
- 5. Principle 5: Require SufficientInstrumentation.
 - a. The A/E must require instrumentation to support both the sequence of operations, and the data acquisition capability to support equipment performance monitoring and building diagnostics analysis. A listing generally establishing minimum instrumentation requirements is included with the Master Specifications. This identifies minimum instrumentation for common types of systems.
 - b. The A/E is responsible for requiring additional instrumentation as necessary to support the sequence of operations, or to supplement data acquisition capabilities when the nature of the equipment or systems to be installed makes this feasible.
 - c. Additional higher end devices shall be specified for control of critical systems or areas in the facility. It is the responsibility of the A/E in consultation with Owner to specify the appropriate products for the application.
- D. Application of these Principles to a given project requires the A/E to research and consider the project-specific environment and requirements and to edit the BAS Master Construction Specifications appropriately. The specific decision depends on a number of other important variables, including the specific HVAC control applications being served, the critical nature of the area or facility being served, the quality and capabilities of the local installer, and operator capabilities.
- E. All instrument wiring conduit must be sealed at the device box, wall, or ceiling penetration.
- F. All HVAC controls specified on the Drawings shall comply with MD Anderson Cancer Center standards. Each piece of mechanical equipment which requires building automation shall have the following five (5) pieces of information specified in a single Drawing sheet for each piece or system of mechanical equipment:
 - 1. Sequence of Operation. Detailed specific directions on how this equipment or system was designed to operate.
 - 2. Schematic drawing of the mechanical equipment or system of mechanical equipment. Schematic drawing shall display the exact mechanical hardware in the correct physical orientation to the equipment that is specified to be installed. All building automation control sensors and apparatus shall be represented in this schematic drawing in the correct physical orientation and tagged with a logical acronym and a unique number identification.

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- 3. Material list of building automation sensors and apparatus spreadsheet. Five columns shall be divided with the following information specified in the rows:
 - a. Control Device: Corresponding logical acronym and a unique number identification used in the schematic drawing.
 - b. QTY: The quantity of the apparatus specified.
 - c. Product Number: Space is left blank unless a specific model number is required to meet the design intent.
 - d. Manufacturer: Space is left blank unless a specific manufacturer's product is required to meet the design intent.
 - e. Description: Phrase which accurately describes the apparatus.
- 4. Building Automation points summary spreadsheet. Four columns shall be divided with the following information specified in the rows:
 - a. BAS Acronym: To be left blank to be populated by Owner.
 - b. Point Descriptor: Short description of the building automation point required.
 - c. Point type:
 - 1) DI (digital input).
 - 2) AI (analog input).
 - 3) DO (digital output).
 - 4) AO (analog output).
 - 5) Virtual
 - d. Remarks such as temperature setpoint values.
- 5. Installation Notes. Any additional directions necessary to ensure that the functional and design intent is achieved shall be listed and tagged.
- G. The A/E shall organize the above five (5) categories of information into a single Drawing sheet outlined as follows:

Top Right:	Building automation points summaryspreadsheet.		
Bottom Right:	Material list of building automation.		
Top Center:	Sequence of operation.		
Top Left:	Installation notes.		
Bottom Left:	Schematic drawing of the mechanical equipment.		

H. Examples of this sheet format layout are available upon request.

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PART 5 - DOCUMENT REVISION HISTORY

Issue	Date	Revision Description	Reviser
	20190301	Original Issuance	
Rev. 1			

END OF ELEMENT D3060