2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

# 230905-H: MECHANICAL SYSTEMS CONTROLS

## Scope

Mechanical system control requirements, including direct digital controls (DDC) and other types. Also applies to laboratory controls in labs that do not include VAV or combination sash hoods.

## Related Sections

Basis Guideline: N/A
230030-H – "Supplemental Laboratory Ventilation Design"
230930 – "Refrigerant Monitoring System"
260913-H - "Electrical Power Monitoring"
5.11 – "Fire Command Center"
5.13 – "MM - Healthcare Procedure Room Infection Control Types and Requirements"
5.14 – "MM - Patient Care and Support Spaces Room Type Requirements"
5.16- "MM Requirements for Critical Pressure Sensitive Rooms"
5.17- "MM Pharmaceutical Compounding Room Requirements"
For an explanation of the use of these guidelines, see "Design Guidelines for UMHHC Facilities"

Included as part of this UMH guideline section are the details described within the following UM Master Specification sections:
MS230905 – "Mechanical Systems Controls (Hospital Projects)"
MS230910 – "Lab Air Flow Controls-DDC"
MS230920 – "Lab Terminal Air Flow Units & Controls"
MS230924- "Systems Integration (Hospital Projects)"

The UM Master Specifications may be used as a reference and/or basis, but the A/E is completely responsible for contract specifications (meeting the intent of the UMH Guidelines and Preferred Manufacturers List) that are used in UMH projects.

UMH Standard Details:
D230905H-2 – "Typical VAV Unit W/ Reheat Coil & Tracking Return Control Diagram - UH"
D230905H-3 – "Typical VAV Unit W/ Reheat Coil Control Diagram - UH"
D230905H-4 – "Typical VAV Unit W/ Reheat Coil Control Diagram - THC & MCHC"
D230905H-5 – "Typical VAV Unit W/ Reheat Coil & Tracking Return Control Diagram - Cancer Center"
D230905H-6 – "Typical Dual Duct CAV Unit Control Diagram - Mott"
D230905H-7 – "Typical DDC VAV Unit W/ Reheat Coil Control Diagram – Retrofit in Existing UMH Facility"
D230905H-8 – "Typical VAV Unit W/ Reheat Coil & Tracking Return Control Diagram - Retrofit in Existing UH Facility"
D230905H-9 – "Typical VAV Unit W/ Reheat Coil & Tracking Return Control Diagram - Retrofit in Existing C&W Facility"
D230905H-10 – "Fan Coil Unit Control Diagram"
D230905H-11 – "Typical DDC Panel Assembly"
D230905H-12a – "Building Management System Network Architecture"
D230905H-12b – "Building Management System Network Architecture for Bldg #5173 Only"
D230905H-13a – "Table 1- Monitoring Points, Alarm & Trend Requirements (Mechanical Equipment)"
D230905H-13b – "Table 2- Monitoring Points, Alarm & Trend Requirements (Applications)"
MD 230900 001 - Differential Pressure Transmitter Liquid
MD 230900 003 - Mechanical Controls Symbols
MD 230900 004 - Mechanical Controls Blocks
MD 230930 001 - Refrigerant Monitor Control

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

D 15635 001 – "Refrigerant Monitor Control Diagram"
D 15975 001 – "DP Sensor Detail"

## General

UMH (University of Michigan Health) maintains significant differences in the specification and installation of mechanical system controls, compared to projects in UM Campus buildings. UMH does not maintain a dedicated mechanical controls shop and hence does not participate in the installation of mechanical control system hardware via in-house trades.

UMH owns and maintains a unified Building Management System (BMS) frontend called Siemens Desigo CC. This frontend is the single and only frontend used to monitor, control, alarm and trend DDC points reporting from a variety of mechanical and electrical equipment/ systems used in UMH facilities. These DDC systems include Johnson Controls, Siemens, Honeywell & ASI.

- The design A/E shall utilize UMH's master spec MS230905 "Mechanical Systems Controls (Hospital Projects)" for all work on hospital funded projects that are to be maintained and monitored by the UMH BMS. AE shall be responsible for editing this master spec so that it is job specific.
- The design A/E shall utilize UMH's master spec MS230924- "Systems Integration (Hospital Projects)" for all work on hospital funded projects that are to be maintained by UMH and/ or monitored by the UMH BMS. AE shall be responsible for editing this master spec so that it is job specific.
- All UMH DDC systems, regardless of manufacturer or type, shall report all points back to the Desigo CC frontend. Proprietary, or vendor specific frontends, are not allowed.
- The complete control system work shall be split between the Mechanical Systems Controls Contractor (MSCC), the Systems Integrator (SI), UMH's Systems Monitoring, UMH's Facilities Applications and Health Information Technology & Services (HITS) departments. See master spec 230905 Mechanical Systems Controls (Hospital Projects), Part 1 section for a detailed description on the division of work.
- The MSCC shall provide a fully integrated BACnet BMS incorporating electric, pneumatic, and direct digital control (DDC) components for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment, electrical equipment and other related systems. Controllers shall natively use the most current ANSI/ASHRAE Standard 135 for communications and shall be BTL certified with BTL published PIC statements.
- UMH's Desigo CC frontend is installed on virtual servers in HITS datacenter. All communication/ integration to the Desigo CC frontend shall be via BACnet IP over the HITS layer 3 network. UMH's HITS department shall be responsible for the design and installation of this primary network. The AE shall coordinate and clearly show on the contract documents all HITS data drops to all IP based DDC controllers.
- UMH wishes to maximize the use of its HITS network for a) communication to the Desigo CC frontend and b) communication between DDC building controllers. AE shall review the use of IP vs MS/TP communication. New facility designs should consider the use of all IP communication.
- The SI shall be responsible for BACnet device and object discovery, point instantiation, alarm & trend definitions and creating of all front end graphics.
- The AE shall discuss with the FPD mechanical engineer the approved control manufacturers to list in the project specifications. The desire is to competitively bid all control projects to the approved control manufacturers listed in specification 230905. In general, all terminal unit controls (VAV/ CAV boxes, mixing boxes, FCU's, etc.) as well as all brand new stand-alone facility installations shall be competitively bid. However, UMH wishes to standardize controller manufacturers (and programming, sequence of operation, set points, alarming, etc.) on critical equipment within a given facility. Examples of equipment that UMH may wish to sole source include modifications to chiller plants, heating plants, AHU plants and Operating Room/ Procedure Room terminal controls.

UMH utilizes this same Desigo CC frontend to monitor, alarm & trend electrical equipment, including generators, substations, UPS, meters, etc. The work required for this is detailed under electrical design guideline 260913-H "Electrical Power Monitoring".

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

See Design Guideline 230030-H and master spec 230910 - LABORATORY AIRFLOW CONTROLS-DDC for variable volume laboratory and fume hood air flow controls. For labs with VAV or combination sash hoods, venturi style terminal units must be used on all the terminal units serving the lab. Refer to DG230030 - Laboratory Ventilation Design for more information. Constant volume laboratory designs shall utilize standard VAV terminal boxes for airflow control and hence are covered under master spec 230905 MECHANICAL SYSTEMS CONTROLS. In general, UMH prefers all DDC controls, including controllers used for lab airflow/ temperature control, to be provided by the MSCC. Furthermore, UMH requires that the integration of these lab systems be native BACnet at the individual field controller level (not via LON or utilize macro/ micro servers). Edit master spec 230910 accordingly. All lab & fume hood controls should be integrated into the Desigo CC frontend.

Direct digital controls (DDC) are the standard for control in new facilities and new renovation work at UMH. Renovation work within many existing UMH facilities is a mix of pneumatic and DDC controls. In general, all renovation work should look to utilize DDC controls, regardless if the existing control strategy is pneumatic. In special, rare instances, where renovation work does not look to significantly modify the existing VAV box pneumatic controllers, the A/E shall provide a control system that matches existing (i.e. pneumatic controls within the University Hospital). See standard terminal box control details available on the UMH FPD website for these instances. The A/E shall discuss the continued use of pneumatic controls with the UMH Mechanical Engineer.

## Using U-M Master Specification 230905

The A/E shall use U-M Master Specification 230905 as the basis for the control specification and edit it to make it project specific.

When editing this spec, ensure hidden text is turned “on” and carefully review all spec editor’s notes.

Special attention should be paid to the following articles:

- Article 1.6: Edit the list of acceptable controls contractors in consultation with and as approved by the UMH Mechanical Engineer.

- Article 2.6 : (Flow Meters): U-M normally uses magnetic flow meters for hydronic and steam condensate applications. For steam, multiple types are specified; obtain direction from the U-M Design Manager regarding the type to be used. In all cases meter type shall be indicated on the control drawings. For steam condensate meters used for utility billing, obtain approval for the type of steam condensate meter to be used with UM Plant, and then edit the spec accordingly.

- Article 2.9: If electrical actuators are used, power for these actuators must be accounted for on drawings. Read the spec editor’s note in this article for further direction.

- Article 3.9: MSCC is responsible for data connection raceways between all DDC panels and the HITS network. HITS is responsible for data cabling & activation. In order to coordinate HITS’ scope, the AE shall clearly show all required DDC data connections on the design drawings.

- Article 3.9.B: Section provides requirements for an all IP network architecture, but is shown in hidden text. AE shall exercise caution on applying all IP solutions, especially in existing facilities, which require discussions with the hospital’s HITS department to validate sufficient network connections can be provided. If applicable, AE shall review network topology requirements and quantity of controllers that can be supported on each trunk with FPD Engineer.

The U-M master specification includes specifications for most types of control components. In some cases, the A/E will need to add supplemental specifications for atypical components.

Control or automatic dampers (actuated dampers) are specified in Master Specification 230900. The A/E’s specification should include no other control damper specifications, and specification sections

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

requiring factory provided control dampers, e.g. air handler specifications, shall reference Master Specification 230905 for the control damper spec.

## Control Drawings

The required scope of a project's controls shall be indicated by the use of control drawings. All equipment/ systems provided or modified by the project that are to be controlled, monitored or alarmed by the BMS shall be identified with the following:

- Control Diagram: Depicting the required system components and all respective DDC points and point type (ie AI, DO, etc)
- Sequence Of Operation:
    - Each paragraph in a sequence shall be numbered.
    - The control device tag numbers shall be included when describing the sequence of operation, e.g. "The leaving air temperature set point shall be maintained at 55°F +/- 2°F, as measured at TTR-12"
    - Where specific tuning requirements are required, e.g. for high precision temperature control, they shall be described in the sequence of operation. Note that 230905 includes default tuning requirements in Part 3.

- Alarm & Trend Requirements: AE shall utilize standard detail D230905H-13a – "Table 1- Monitoring Points, Alarm & Trend Requirements (Mechanical Equipment)" and D230905H-13b – "Table 2- Monitoring Points, Alarm & Trend Requirements (Applications)" and edit to be project specific to the equipment/ system being depicted. Detail is meant to reflect the MM's alarm & trend requirements for typical equipment and critical room applications. Table shall be used to reflect the project specific setpoint (including allowable variation from setpoint), alarm & trend requirements and where that alarm & trend is managed (ie local DDC panel vs Desigo front-end).

The control drawings shall include system architecture diagrams specific to the project. These diagrams shall indicate the location and quantity of DDC and auxiliary panels and the communication (ie IP vs MS/TP) amongst panels as well as to the BMS frontend.

The A/E shall show all required HITS data drops at all IP DDC controllers, UPS's, HMI's, IP Routers and Utility Meters on the contract documents thru the use of standard "triangle" data drop symbology.

Each control diagram shall be labeled with a unique identification number, similar to how multiple details are typically numbered on a drawing. This unique number shall be used to identify the control drawing that applies to a particular piece of equipment or system, e.g. in a terminal equipment schedule.

Control drawings, control sequences and alarm & trend requirements shall appear on the mechanical drawings; they shall not appear in project specifications. Include all project specific set points and alarm values.

Control drawings shall utilize U-M's standard control symbology and acronyms, refer to MD 230900 003 Mechanical Controls Symbols and be sure to include these symbols on a key sheet as part of the mechanical drawings. Each control device on the drawing shall be tagged and labeled with a unique identification number, as indicated by the # symbol on MD 230900 003.

Sample control drawings in electronic format for A/E use are available on the U-M AEC website; refer MD 230900 004 Mechanical Control Blocks. Revise these drawings to make them project specific. Revise sequences of operation to include strategies specific to the project (example: change-over to free cooling). Include all project specific set points and alarm values. Provide similar control drawings for systems not available from U-M's samples.

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

Wiring diagrams shall be provided on the control drawings that indicate the method of starting fans, pumps, and other equipment, safety interlocks, interface to manufacturer's provided controls, etc. These diagrams may be schematic in nature but shall indicate fundamentally how electrical control is accomplished.

All DDC systems shall outline all means of energy conservation including start/ stop optimization, electric demand limiting and day/ night set back, where applicable. For systems with occupied/ unoccupied control, drawings should indicate anticipated operation time schedules of relevant HVAC equipment.

"Point Lists" are not required and shall not be used, however all necessary points for monitoring and control shall be represented on the control drawings.

## Typical UMH DDC Monitoring/ Alarm Points

**General**
See UMH standard detail D230905H-13a – "Table 1- Monitoring Points, Alarm & Trend Requirements (Mechanical Equipment)" and D230905H-13b – "Table 2- Monitoring Points, Alarm & Trend Requirements (Applications)" for DDC points and point types off typical equipment and applications used in UMH facilities. Details are meant to reflect the minimum and typical point and point type requirements for typical equipment and critical room applications. AE shall edit this detail to reflect project specific requirements and include on the contract documents. See Control Drawings section of this guideline.

Provide an automatic restart for all equipment on power failure. Provide a manual override switch for each piece of equipment.

All set points and alarm thresholds shall be made adjustable for UMH Systems Monitoring from the BMS front end graphical interface.

Packaged Equipment controllers should be specified with a common alarm contact for DDC monitoring, not separate alarm contacts for each alarm condition, except as noted.

## Factory Manufacturer Provided (Packaged) Controls

UMH requires that all controls be provided by a single temperature controls contractor rather than with factory packaged controls. This includes HVAC systems (chiller & heating plants) as well as frontend equipment (air handling units, large rooftop units, etc) and terminal equipment (VAV's, FCU's, CUH's, etc).

Packaged controls are discouraged as they are more problematic to integrate into the hospital's BMS frontend, exhibit operational problems, and the means to integrate and manage data varies widely amongst manufacturers.

Packaged controls are acceptable on equipment where installing third party controls is not feasible or would compromise system performance/safety, such as chillers, boilers, storm/sanitary pumps, booster pumps, RO/DI systems, vacuum pumps, air compressors, pollution control (air and water treatment) systems, refrigerant leak detection, fuel oil systems, computer A/C units and non-critical DX systems. For all other equipment, packaged controls are NOT acceptable. Contact UMH FPD Engineer for use of packaged controls on any equipment not listed. See the respective design guideline for these systems on any specific requirements for packaged controls.

Packaged controls on rooftop units are acceptable when the function served is non-critical and is not subject to regulatory compliance, ie RTU's serving outpatient clinics, medical offices and other business use areas. Packaged rooftop unit controls should NOT be provided on units serving Group A or B rooms in Inpatient, Ambulatory Surgery Centers or Outpatient facilities (see DG 5.16- MM Requirements for Pressure Sensitive Rooms)

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

Chillers and boilers shall be equipped with manufacturer provided controls, which shall serve to provide complete control, monitoring and alarming of that respective piece of equipment. Control of the chiller or boiler plant (chiller/ boiler sequencing, etc.) shall be by UMH's DDC system. Boiler sequencing panels should not normally be specified.

Packaged controls shall not be specified for air handlers, unless specific permission is given by the UMH FPD Engineer.

Where packaged controls are specified to be BMS integrated, they shall be specified with an open protocol communication interface. UMH's preference is for BTL tested BACnet interfaces, but other protocols could be utilized where appropriate. The A/E shall coordinate with the UMH FPD Engineer.

Where an open protocol communication interface is available on packaged equipment, the A/E shall specify that the BMS integrate with the packaged equipment controls to provide enhanced monitoring and control capabilities. The A/E shall discuss the benefits of this with the UMH FPD Engineer. This package equipment integration is in addition to the discrete DDC points indicated under standard detail D230905H-13a – "Table 1- Monitoring Points, Alarm & Trend Requirements (Mechanical Equipment)"
.

## Control Air

For facilities on the main hospital campus, 90 PSIG (at the tunnel entrance) compressed air is available from the campus steam tunnel system. This air shall be utilized for temperature control air use; however a desiccant dryer must be indicated if any control air line or pneumatic component (e.g. actuators) will be exposed to outside air conditions. Otherwise, the tunnel air is dry enough for indoor control air use and dryers for control air are not required.

In addition to campus compressed air, the A/E shall specify a control air compressor(s) and dryers as a redundant source of compressed air for each facility. Critical facilities NOT connected to the campus compressed air system (ie offsite Ambulatory Surgery Centers, Data Centers, etc.) shall utilize (2) fully redundant air compressors & dryers with an automatic alternating means- see specification.

Pneumatic control air work within existing facilities shall utilize existing pneumatic air sources where feasible. The A/E shall be responsible for analyzing the existing pneumatic control air system in its applicable use in renovation work. U-M Master Specification 230900 specifies control air compressors and accessories (PRV stations, refrigerated air dryers, etc.). The A/E drawings shall indicate the source of control air.

## Electric vs. Pneumatic Actuators

Historically UMH has required that large damper actuators and large control valves shall be pneumatically actuated. Small dampers and valves used outside of infrastructure spaces in the distribution of piping & ductwork (i.e. smoke dampers, FCU valves and VAV reheat valves) have utilized electric actuators, as indicated in UM Master Specification 230905.

Improvements in the reliability and functionality of modern electric actuators have resulted in them becoming the standard in the industry. For these reasons, the AE shall specify and coordinate the exclusive use of electric actuators in all new facilities, on all valves and dampers, large or small. The exception would be small changes to larger, comprehensive control systems (i.e. replacing a single control damper on a large AHU header that utilizes pneumatic damper operators). Power to electronic actuators shall be closely coordinated to ensure proper operation in all modes (ie emergency power). In all cases, the priority of power (ie generator power- equipment branch vs critical branch vs normal power) shall match the power source of the equipment being served.

For existing facilities, the AE shall discuss the use of pneumatics vs electric actuators.

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

## Terminal Boxes

Room thermostats/ sensors shall be DDC type for all new construction and pneumatic where interfacing with existing pneumatic controls.

Typically, all thermostats shall be occupant adjustable (limited range, set thru BMS) and shall utilize a visible digital LED temperature readout. Systems that operate with an occupied/ unoccupied mode should utilize thermostats with an integrated override button.

Transient, public areas (i.e. waiting rooms, corridors, cafeteria, etc.) shall control space temperature via a wall mounted temperature sensor that does not include local temperature set point adjustment. These sensors and connected temperature control devices shall be set thru the BMS to maintain a 70°F to 74°F temperature range with dead band.

Larger staff or clinical areas which require multiple VAV boxes serving a common area shall be controlled to prevent simultaneous heating & cooling. Typical applications include:

- Where user set point adjustment is not required (i.e. public spaces), provide each VAV zone with a space temperature sensor set to control to the same temperature set point range (common 4°F range).
- Where user set point adjustment is required, provide a thermostat in one of the VAV zones and temperature sensors in the remainder. Program to have the thermostat set the temperature control point of all the VAVs in that space.

All thermostats mounted on cold surfaces (i.e. uninsulated walls) shall be provided with an insulated base plate.

Thermostats/sensors shall be installed in the most frequently occupied area of the zone, best representing the load seen in the respective HVAC zone.

The Architect/Engineer shall coordinate their work with project Interior Designer for coordination with equipment, shelving, PC locations, etc. within the space. A/E shall utilize notes on the drawings or in the specifications, as necessary, to prevent the placement of thermostats in non-functional areas of the occupied spaces, such as in or behind bookcases, casework, file cabinets, binder bins, coat hooks, etc. The preferred location for thermostats is adjacent to a door, next to the room's light switch.

Each room provided with radiant heat (baseboard/ ceiling panel) shall be individually controlled to prevent simultaneous heating & cooling. UMH's preference is to interlock the radiant heat control valve with the room's respective terminal box. Alternately, large open public spaces on a common exposure can be controlled via a DDC temperature space sensor.

Location of all thermostats shall be shown on the contract documents and on the as-built drawings.

The design of terminal equipment (i.e. VAV boxes) serving pressurized rooms as indicated under design guideline 5.16: UMHS - REQUIREMENTS FOR PRESSURE SENSITIVE ROOMS shall ensure that the daily calibration cycle does not disrupt the required room pressurization. Typically, this requires the use of an "auto-zero" module that calibrates airflow without closing the box damper. See Master spec 230905.

## Valves

In general, UMH prefers the use of two-way modulating control valves in conjunction with variable flow pumping systems. In addition, each floor shall utilize a small branch with a balancing valve between supply & return piping at the end of the loop to maintain water circulation.

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

## Fume Hood Controls

A/E to specify a fume hood control system that maintains a constant average face velocity over the entire hood opening area regardless of sash position. Multiple hoods on a common exhaust system shall utilize quick-response Air Control Valves (ACV). See guideline 230030-H for more detailed information on fume hood and laboratory airflow control.

## Outside Air Control

All air handling units, rooftop units, etc. including recirculated return air shall include a mixed air economizer. The economizer shall be overridden, with mixed air dampers commanded to minimum outside air positions if the outside air enthalpy is greater than the return air enthalpy.

In cases where high outside air volumes are required by code for densely occupied areas, consider the use of carbon dioxide sensors and associated controls to automatically reduce ventilation during low occupancy periods. The system shall control to maintain a maximum hi-limit carbon dioxide level (PPM) set point.

At a minimum, air handling systems serving I-2 areas shall include airflow measuring stations that monitor the active quantity (CFM) of outside air in the system. This may be accomplished by directly measuring the outside airflow into the air handling system, or by measuring the total supply airflow and the return airflow being recirculated back into the supply airstream (i.e. after any relief air discharge) and subtracting the two (just measuring the total airflow returned from the space is not acceptable for this calculation). Please be aware of any other LEED project requirements or other applicable codes which may require direct measurement of the outside airstream into the air handling system. Mixed air damper controls shall be set to automatically maintain the design minimum outside air quantity (CFM) or greater at all times.

## Occupied/Unoccupied Control

During design, every effort should be made to group spaces with common anticipated occupancy periods into common central HVAC system zones in order to allow central air handling units and HVAC systems to be scheduled off during typical unoccupied periods. Design drawings should indicate anticipated operation time schedules of relevant HVAC equipment.

Additionally, regardless of location in a scheduled HVAC zone or not, occupancy sensors should be installed and tied into the local VAV or other terminal equipment controller, in order to automatically enable unoccupied mode operation and reduce HVAC system requirements during unoccupied periods in feasible spaces. It is common to use a ceiling or wall mounted (not light switch mounted) occupancy sensor with auxiliary contacts to control both lighting and HVAC in a space. Coordinate with electrical lighting design as applicable. If a terminal HVAC control device serves multiple areas, occupancy sensors in all served areas must simultaneously detect unoccupied conditions prior to enabling unoccupied mode operation. During unoccupied mode, the controller shall reduce minimum airflow set point to 0 CFM, but shall maintain an unoccupied space temperature range (typically 68°F to 76°F) and shall increase airflow if necessary to maintain this range. This method of control shall be applied to most space types such as, offices, meeting rooms, exam rooms, waiting rooms, lounges, classrooms, etc. This method of control shall not be applied to corridors, rooms with continuous exhaust airflow requirements, and rooms with air pressure relationship requirements that do not include supply and return airflow control equipment, or areas that are otherwise prohibited by code requirements.

Occupancy control of ventilation shall be included in operating rooms, procedure rooms, or other areas with air pressure control requirements if those spaces include both terminal supply and return airflow control devices. Systems shall reduce airflow but shall maintain required room pressurization set points at all times. See SBA-5.13 for further details on occupancy control in various procedure rooms.

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

## DDC Panel Locations and Clearances

Each DDC panel will have one or more auxiliary panels. See D230905H-11 – "Typical DDC Panel Assembly" detail. The A/E shall indicate the location of these panels on the plan views. For a typical assembly allow 7' of wall space; note that some panel assemblies require more space. Locate panels to provide a minimum of 36" clearance in front of each panel, and designate this clearance on the drawings.

## Power for Controls

Power to controllers and associated controlled devices shall be 24 VAC, provided by the MSCC. Power source (i.e. normal vs. emergency power & emergency power priority) shall match that of the equipment being controlled.

- UPS power should be provided for all DDC controllers, to protect against damage due to power quality and to minimize disruption. The exceptions are controllers serving non-critical infrastructure in offsite/ outpatient facilities. When local UPS is required, provide with an integral automatic bypass feature (in case of UPS failure) and network integration to the Building Management System (BMS). See Master spec 230905 for UPS specification.
- **DDC Panel Assemblies:** Each assembly (not each panel in an assembly) shall be provided with (2) 20 amp dedicated circuits (separate circuit breakers). Indicate these circuits on the electrical drawings, home-runned to the panel assembly location.
- **Terminal Equipment Controllers (TEC) Power (DDC VAV box controllers, etc.):** Designate circuits in receptacle panels on each floor for TEC transformers. In general, provide one 20-amp circuit for every (50) VAV DDC controllers- confirm with temperature control manufacturer requirements.
- **Actuator Power:** See UM AEC Master Specification 230905, article 2.9.
- **Power for meters and other control accessories that are provided by the controls contractor:** Provided through a fused disconnect located in the DDC auxiliary panel and is part of the controls contractor's scope of work. The A/E does not need to typically indicate power for such items on the design drawings. See UM Master Specification 230905, article 2.6.

## Status Indication Methods

Pump, fume hood, biosafety cabinets, etc., status indicator should provide a positive indication of proper operation - i.e. status for a fume hood should be connected to a differential pressure switch, NOT an auxiliary starter contact; proof of flow for chillers shall be via a local differential pressure transducer, not via an auxiliary pump starter contact. Status for fans/ pumps should be via a current sensing relay (adjustable to detect belt loss) on the motor.

UMH's preference is that the fume hood/ biosafety cabinet be provided with the required local proof/ alarm of central exhaust airflow. Coordinate with Medical Equipment Planner/ Architect.

## Life Safety Control

The BMS shall not be used for initiating or alarming life safety applications; however, all life safety systems shall report general alarms and status to the BMS front-end (i.e. fans and dampers commanded by the fire alarm system shall be monitored for status by the BMS). Three common examples are as follows:

- **Stair Pressurization Control:** The building fire alarm system will initiate operation of the stair pressurization fans. Any controls required for stair pressurization shall be stand-alone from (and independent of) the DDC system.
- **Atrium Smoke Purge:** The building fire alarm system will initiate atrium smoke purge. Any controls required for smoke purge shall be stand-alone from (and independent of) the DDC system.

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

- **Smoke Control:** The building fire alarm system will initiate the smoke control system. Any controls required for smoke control shall be stand-alone from (and independent of) the DDC system.

The controls contractor will provide the stand alone components (dampers, end-switches, pressure transmitters, etc.) and therefore these components shall be indicated on the control drawings and include complete sequences of operation.

## Fire Command Centers

The building code requires status indicators and controls for air distribution systems in Fire Command Centers (FCC). These devices shall be provided as a separate DDC control panel in the FCC. The DDC system (as opposed to the fire alarm control system) shall output status to the panel and provide air distribution system control from the panel. Refer to Design Guideline SBA 5.11 Fire Command Center for additional information

## Miscellaneous

For air handlers that are shut down by smoke detectors, a detail must be included with the control diagrams that describes the interface wiring between the air handler controls and the fire alarm system. U-M coins this the “red/blue box detail”. Use the detail that is appropriate for the project specific fire alarm system from the electrical standard details on the U-M AEC website. Consult with the U-M Design Manager to determine which detail is appropriate. Typically, an addressable fire alarm system is used, in which case U-M standard electrical detail 28310006 is appropriate.

A UM Utilities Data Acquisition Panel is required whenever steam, steam condensate, or chilled water will be billed to a building. Consult with the U-M Design Manager regarding when required. When required, show and label the panel on a control drawing with the appropriate control points connected to the panel:

- Steam: steam flow meter output
- Steam Condensate: Condensate flow meter output
- Chilled Water: BTU meter output.

The DDC points associated with the data acquisition panel must also be shown looped to the DDC system.

Exterior lighting associated with new buildings shall be controlled by DDC. DDC shall turn the lights on and off, and status the lighting contactor (via a current sensing relay). The contract drawings shall indicate a contractor for exterior lighting control by DDC. Consider utilizing the BMS for lighting control in lieu of dedicated lighting control systems.

Existing UMH facilities with DDC controls typically utilize numerous weather stations that transmit outside temperature and humidity conditions across the BMS network. Local outside temperature and humidity transmitters should normally not be needed, except on off-site facilities. The A/E shall coordinate this requirement with the UMH Mechanical Engineer.

Fan systems capable of developing static pressures in excess of the duct system’s (air handler casing, plenums, ducts) static pressure rating (positive or negative) shall be equipped with static pressure safeties to turn off the fans prior to damage occurring from excessive pressure. The A/E should not indiscriminately specify these devices but shall include them based on an evaluation of the maximum pressure the fan can develop, the pressure class of the duct system, damper pressure ratings, and the degree of risk. Static pressure safeties utilized on air handling systems with downstream smoke dampers shall act to reduce fan discharge pressure upon a rise in pressure above normal levels, prior to reaching the static pressure high limit. This function helps maintain continuous AHU service during regular smoke damper testing.

2101 Commonwealth Blvd, Suite B
Ann Arbor, MI 48105-5759
www.med.umich.edu/facilities/plan/

In general, for air handlers, heating coil control valves shall be designated as fail open, and cooling coil control valves shall be designated as fail closed.

Include U-M's MD 230900 001 Differential Pressure Transmitter Liquid on any project utilizing liquid DP transmitters.

For all air and liquid flow measuring devices, the A/E shall indicate their location on the plan views as well as on the control drawings. Design the duct or piping at the meter location to provide the manufacturer's required up and downstream straight and unobstructed lengths and indicate these requirements on the drawings. When in doubt as to specific manufacturer's requirements, provide 10 straight diameters upstream and 5 straight diameters downstream. Where flow varies, A/E shall ensure that the turndown ratio for the transmitter will allow accurate measurement at low flow conditions.

All installed devices and sensors shall be calibrated, either factory or in the field. Coordinate field calibration of air and fluid flow sensors with the Test and Balance contractor.

The A/E shall specify that all existing control panels, devices, wiring, and tubing that are to be abandoned as part of new work shall be demolished completely by the TCC. All demolished controllers that are still in working condition shall be handed over to UMH's Maintenance group. The A/E shall also specify that all existing control points and system graphics that are no longer going to be utilized as the result of new work shall be demolished or deleted from the BMS software.

For information regarding controls related to refrigerant leakage monitoring, see DG230930 Refrigerant Monitoring Systems and the standard details MD 230930 001 Refrigerant Monitor Control and MD 15635 001 Refrigerant Monitor Control Diagram.