DESIGN GUIDELINE 230900
MECHANICAL SYSTEMS CONTROLS

Related Sections

U-M Design Guideline Sections:
SBA 5.11 - Fire Command Center
DG230030 - Laboratory Ventilation Design
DG230930 - Refrigerant Monitoring Systems

U-M Master Specification Sections:
MS230900 - Mechanical Systems Controls
MS230910 - Lab Air Flow Controls-DDC
MS230920 - Lab Terminal Air Flow Units & Controls

U-M Standard Details:
15635001 - Refrigerant Monitor Control Diagram
15975001 - Differential Pressure Transmitter Installation Detail (Liquid)
15975002 - Typical DDC Panel Assembly

General

This Design Guideline does not apply to laboratory and fume hood air flow controls; see Design Guideline 230030 for these systems.

Direct digital controls (DDC) are the standard for control at U-M. Pneumatic or other non-DDC controls are limited to very small systems and shall only be specified with the Design Manager's permission.

U-M Master Specification Section 230900 Mechanical Systems Controls shall be used as the controls specification on all projects. The A/E shall edit U-M Master Specification 230900 to make it project specific. Turn on hidden text and read all spec. editor's notes when editing the specification.

> Note that generally the U-M controls specification should only have items *added to it* to make it project specific (e.g. a meter which is peculiar to the project and not already covered in the spec.), otherwise it is recommended that the A/E *not* delete materials or devices from the specification.
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> Exception: If the typical work scope split described below under "U-M vs Contractor Work Scope" is *not* to occur, the A/E will need to edit Part 1 and 3 of the specification to make the work scope split specific to the project. While rare, such editing may be required for certain non General Fund auxiliary unit projects such as for Athletics. Consult the U-M Design Manager.

U-M has an extensive Building Automation System (BAS) that networks to localized DDC controls. This system utilizes propriety Siemens components as well as non proprietary generic controls. UM has negotiated pricing for the proprietary components and purchases these direct from Siemens for projects. U-M also self performs a portion of the DDC control work. Project budgets must (also) include the cost of the proprietary components and U-M's self performed work. During budget planning, the U-M Design Manager will provide information regarding how these costs are to be accounted for in the budget.

U-M vs Contractor Work Scope

The A/E should consult the first few pages of U-M Master Specification 230900 for detailed information regarding the split of control work, university versus contractor. By utilizing U-M's control specification, proper work scope split occurs automatically and is essentially transparent to the A/E design effort. Note that non General Fund auxiliary units may handle controls differently; always consult the Design Manager. In general, the split is as follows:

University of Michigan: Provides proprietary DDC panels, terminates inside these panels, and programs and starts-up the DDC panels. Provides application specific terminal equipment controllers (TECs) for contractor installation (e.g. DDC VAV box controllers) and room sensors for TECs.

Contractor: Supplies and installs: all field devices (transmitters, actuators, control valves, control dampers, transducers, etc.), all control wiring and tubing, all auxiliary control panels, and prepares a complete controls submittal. Mounts U-M supplied DDC panels. Installs TECs and TEC room sensors.

The detail "Typical DDC Panel Assembly" provides a graphical representation of the work split.

Using U-M Master Specification 230900

The A/E shall use U-M Master Specification 230900 as the basis for the control specification and edit it to make it project specific.

When editing this spec, assure hidden text is tuned "on" and carefully review all spec editor's notes.

Special attention should be paid to the following articles:

- Article 1.3: Edit the list of acceptable controls contractors in consultation with and as approved by the Design Manager.
- Article 2.2: Obtain approval for the type of steam condensate meter to be used, and then edit the spec accordingly.
- Article 2.3: U-M supplies application specific TECs for DDC terminal (VAV, CAV, etc.) boxes. The controls contractor is responsible for mounting these TECs on the boxes. The A/E must edit his specification for such boxes to assure the box manufacturer only supplies the components listed in article 2.3 (e.g. pneumatic damper operator and air flow arrays), NOT DDC controllers. *On the rare occasion pneumatic*

VAV box controllers are used, specify that the box manufacturer provide a Krueter model CSC-3011 controller, a normally open damper, and a damper operator.

- Article 2.6: 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.

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 requiring factory provided control dampers, e.g. air handler specifications, shall reference Master Specification 230900 for the control damper spec.

Control Drawings

The required scope of a project's controls shall be indicated by the use of control drawings. Each control drawing shall include a detailed sequence of operation.

Control drawings and sequences shall appear on the mechanical drawings; they shall not appear in project specifications.

Control drawings shall utilized U-M's standard controls symbology. Normally, U-M will provide sample control drawings in electronic format for A/E use, which will include sequences of operation. 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 setpoints and alarm values. Provide similar control drawings for systems not available from U-M's samples.

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.

"Point Lists" are not required and shall not be used.

DDC Panel Locations, Clearances, and Communication Wiring

The control drawings shall include system architecture diagrams specific to the project. These diagrams indicate the location and quantity of DDC and auxiliary panels. U-M will normally provide this information to the A/E, for inclusion on the project drawings.

The controls contractor will run all communication wiring between DDC panels and TECs. Communication wiring is to be indicated on the system architecture diagram, including wiring back to a telephone closet.

Each DDC panel will have one or more auxiliary panels. See "Typical DDC Panel Assembly". 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, consult with U-M.

Locate panels to provide a minimum of 36" clearance in front of each panel, and designate this clearance on the drawings.

Power for Controls

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.

TEC Power (DDC VAV box controllers, etc.): Designate circuits in receptacle panels on each floor for TEC transformers. Provide one 20 amp circuit for every (50) Terminal Equipment Controllers.

Actuator Power: See Master Specification 230900, Article 2.6.

Power for meters and other control accessories that are provided by the controls contractor: This is provided through a fused disconnect located in the DDC auxiliary panel and is part of the controls contractor's scope of work per U-M Master Specification 230900. Therefore the A/E does not need to typically indicate power for such items on the design drawings. See U-M Master Specification 230900, article 2.5.

Life Safety Control

U-M's DDC system is not listed for life safety use and therefore shall not be used for initiating or alarming life safety applications. Two 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.
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> 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.

However, 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.

Manufacturer Provided (Packaged) Controls

Chillers and boilers shall be equipped with manufacturer provided controls. Manufacturer provided controls shall typically be limited to control of the chiller (boiler) itself. Control of the chiller (boiler) plant (chiller (boiler) sequencing, etc.) shall be by U-M's DDC system.

Packaged controls should also be specified for equipment normally equipped that way, such as storm/sanitary pumps, RO/DI systems, vacuum pumps, air compressors, pollution control (air and water treatment) systems, refrigerant leak detection, fuel oil systems, DX systems, condensate pumps, etc. See the respective design guideline for these systems for any specific requirements for the packaged controls.

Packaged controls shall not be specified for air handlers, unless specific permission is given by the U-M Design Manager.

Control Air

For central campus projects, 90 PSIG compressed air is available from the campus steam tunnel system at minus (-) 50 ºF dewpoint. This air shall be utilized for control air use, dryers for control air are not required.

For other campus locations, a control air compressor will normally be required. U-M Master Specification 230900 specifies control air compressors and accessories (PRV stations, refrigerated air dryers, etc.).

In either case, A/E drawings shall indicate the source of control air.

Electric vs. Pneumatic Actuators

Damper actuators and large control valves shall be pneumatically actuated, except for special conditions as approved by the U-M Design Manager. Small dampers and valves controlled by TECs shall utilize electric actuators, as indicated in U-M Master Specification 230900.

Smoke and combination fire/smoke dampers shall be pneumatically actuated.

Typical Alarms to be Monitored by DDC

In addition to the typical status alarms associated with DDC control, the DDC shall be indicated as monitoring the following equipment. Equipment should be specified with a common alarm contact for DDC monitoring, not separate alarm contacts for each alarm condition, except as noted:

- Sanitary and Storm Pumps (common alarm: high level, seal failure, etc)
- Cold/Warm/Environmental Rooms
- Walk-in Freezers
- Heat Trace
- Emergency Generator (generator running, generator trouble)

- Automatic Transfer Switch Transferred to Generator Power (Connect in series each "on generator power" auxiliary contact in each ATS to a single point in a DDC panel to notify BAS if any ATS transfers to generator power.)
- Critical Unitary A/C units (for example, computer rooms)
- RO/DI Systems
- Pollution Control Systems
- Fuel Oil Systems
- Refrigerant Leak Detection Systems
- Chiller Relief Valve Status
- Domestic Water Booster Pump Systems
- Glycol Make-up Systems (separate low pressure and low level alarms)
- Substation Room Temperature

The above list is not exhaustive. The design team shall carefully consider and include alarm monitoring appropriate for the project. *The A/E shall indicate any special alarm setpoints on the control drawings* (e.g. critical humidity limits in a clean room or museum).

Miscellaneous

DDC controlled heating hot water heat exchangers shall include back-up pneumatic control.

DDC controlled cooling towers shall include a pneumatic controller to provide back-up control of the tower condenser water bypass valve arrangement .

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 contactor for exterior lighting control by DDC.

U-M utilizes a central weather station that transmits outside temperature and humidity conditions across the BAS network. Therefore local outside temperature and humidity transmitters should normally not be indicated.

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 AE 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.

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

For reheat coils in zones serving animal rooms, reheat coil control valves shall be **normally closed** type. This avoids a wild coil condition from severely over-heating the animal room.

Include U-M's "Differential Pressure Transmitter Installation Detail (Liquid)" on any project utilizing liquid DP transmitters.

For all air and liquid flow measuring devices, the AE 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.

For information regarding controls related to refrigerant leakage monitoring, see DG230930 Refrigerant Monitoring Systems and the standard detail 15635001 Refrigerant Monitor Control Diagram.