

Design Guidelines for Facilities Construction:

DESIGN GUIDELINE DG15-9 Building Automation System & Controls

1. GENERAL.....1

2. EQUIPMENT.....2

3. INSTALLATION.....3

4. NETWORK INFRASTRUCTURE AND ADDRESSING.....3

5. PROGRAMMING.....4

6. GLOBAL COMMAND AND CONTROL.....5

7. GRAPHICAL INTERFACE.....6

8. SOFTWARE AND DOCUMENTATION.....8

9. SEQUENCES.....9

10. SYSTEM SECURITY.....15

11. ALARMS.....16

12. TRAINING.....16

13. TRENDING.....17

1. GENERAL

- A. Electronic direct digital controls (DDC) are the preferred method of controlling building systems at WMU. Systems controlled and/or monitored include, but are not limited to, HVAC, exhaust, heating, chiller, DX cooling, lighting, roof heat tape, snow melt, and lawn irrigation.

- B. A campus Ethernet data jack must be installed early in the life of a project (if one does not already exist) for each building supervisory controller (BSC) that is to be installed. One additional Ethernet data jack must also be installed in each mechanical room for laptop PC access. These Ethernet connections will facilitate programming of the Building Automation System (BAS), remote access to the system, and communications between each BSC.

- C. All new building automation systems and components shall interface with the existing BAS at WMU, using a pre-approved open protocol, or Network 8000 proprietary protocols. "Interface" means that all monitoring and control points can be accessed from, and/or transferred to or from the existing BAS.
- D. All monitoring and control points in a controller shall have the ability to be monitored from the web using a standard web browser. Set points and schedules shall have monitor and change access from the web as well.

2. EQUIPMENT

A. Acceptable Manufacturers

1. Building Supervisory Controller (BSC)

t.a.c

2. Field or Stand-Alone Unitary Controllers

t.a.c

t.a.c MNL-800 and MNB-1000 Controllers are NOT to be used.

Third party controllers are allowed for specific special applications. They must meet 2-B-2 and must have prior written WMU approval.

B. DDC Controllers & Connection

- 1. Every new building or project shall have an internet/web-based building supervisory controller (BSC) installed for the purpose of coordinating control of field controllers, serving up graphics, and connecting to the existing Building Automation System (BAS) on campus. This BSC will also perform scheduling, trending, and alarming functions. The only exception to the requirement for this BSC will be in buildings where a BSC already exists, has sufficient memory available, and can be used to connect to new unit controllers using its current communications bus protocols. This BSC shall be capable of communications using TCP-IP, BACnet IP, and LonTalk. It shall also be capable of serving up web-based graphics that can be viewed by any standard web browser.
- 2. DDC unit controllers shall interface with the BCS using BACnet IP, LonTalk, Modbus, or Invensys Network 8000 bus protocols. Modbus installations must have prior written WMU approval.
- 3. Gateways and/or routers are not permitted for the purpose of converting communication protocols without prior written WMU approval.

- C. Thermometer ranges shall be scaled so that normal operating temperatures are in the middle of the thermometer's range, and so that minimum and maximum operating temperatures are not outside of the thermometer's range.

- D. Pressure gauge ranges shall be scaled so that normal operating pressures are in the middle of the gauge's range, and so that minimum and maximum operating pressures are not outside of the gauge's range.
- E. WMU prefers not to use pilot positioners on pneumatic actuators unless they are required to change response ranges or to provide adequate response time. It shall not take more than 60 seconds for a pneumatic actuator to fully stroke in either direction. If this stroke time exceeds 60 seconds without a pilot positioner then a positioner is required.

3. INSTALLATION

- A. All wiring in mechanical spaces or areas with exposed ceilings shall be installed in conduit or electrical trays.
- B. A duplex receptacle must be located within 6 feet of any control cabinet that contains a programmable device.
- C. All sensor and bus wiring shall be labeled at each end to identify what device and/or contact point is at the other end of the wire.
- D. All DDC wall mounted thermostats/sensors shall have LAN access from the thermostat/sensor.
- E. A thermometer shall be installed adjacent to any control sensor installed in a fluid pipe.
- F. A pressure gauge shall be installed adjacent to any pressure control sensor installed in a fluid or gas pipe.
- G. A pressure gauge shall be installed on the branch output of all pneumatic control devices.
- H. A supply temperature sensor shall be installed down stream of any reheat coil.
- I. A temperature sensor shall be installed in the cooling tower sump for any chiller plant (See 9-C-2-b).

4. NETWORK INFRASTRUCTURE AND ADDRESSING

- A. WMU's Energy System Specialist shall assign IP addresses for all Ethernet connected controllers associated with the BAS.
- B. The router IP address and subnet mask settings shall be provided by WMU's Energy System Specialist.

- C. BACnet network numbers shall be assigned by WMU's Energy Systems Specialist.
- D. A BACnet IP device's BACnet device address (or instance number) shall be the same as the last octet of its IP address.
- E. LonWorks installations shall be installed so that different subsystems (HVAC, fire, access, elevator, etc.) are each installed on separate segments of the LON network. Routers can connect these segments to each other if control schemes or user interface require it. All Lonworks cabling shall comply with industry standards.

5. PROGRAMMING

- A. Control programs shall use WMU as-built room numbers to refer to all spaces. Construction room numbers are not to be used if they differ from the as-built room numbers.
- B. Spaces that use VAV boxes shall be programmed such that all VAV boxes supplied by a particular AHU can be driven to maximum flow with a single command. Additionally this single command shall be activated if the variable frequency drive (VFD) on the supply fan is placed in "hand" or "bypass".
- C. Control programs shall be configured such that automatic control will still function if equipment such as fans and pumps are put in hand. Control enable signals shall not rely on schedules or start commands, but shall instead rely on equipment status. For example, the discharge air temperature control of an air-handling unit shall be enabled based on supply fan status, not the BAS start signal to the unit.
- D. Return fans shall be interlocked with supply fans so that the return fan will not run in automatic if the supply fan is not running.
- F. Maintenance Time Reminders (MTR) shall not be specified unless the design professionals provide the control contractor with specific time intervals for each piece of equipment that is to have an MTR. These time intervals shall be in accordance with the equipment O&M recommendations.
- G. Invensys IA sequenced loops are not to be used for air handler discharge air temperature control.
- H. In those buildings with VAV boxes, the actual VAV air flows shall be totaled up. There shall be total air flows for each air handling unit, each floor, and a total for the building.

- I. Niagara stations shall be named according to the building name and shall not include WMU in the name. Each name shall begin with a capital letter; this includes buildings which use more than one word. Underscores shall not be used between words but are allowed before numbers. For example, the station name for Waldo Stadium would be “WaldoStadium” and the station name for Valley 1 would be “Valley_1”.
- J. If data must be passed from one LonWorks device to another, then the data shall be linked (bound) directly from Lon shadow object to Lon shadow object without being passed through other control objects in the BSC so that data will continue to flow if the BSC is off-line.

6. GLOBAL COMMAND AND CONTROL

- A. The control contractor is responsible for making all of the links required to pass the global signals listed in this section and for programming the proper local defaults for those signals.
- B. Local building outside air temps (OAT) are sent to the BAS server and averaged. The average is sent back to all local building controllers to be used for control purposes. The BAS average OAT at the building level shall read -75° F upon a communications loss. The local building supervisory controller (BSC) shall default to the local sensor (local average if there is more than one building OAT sensor) if it sees a BAS average of less than -50° F. Outside air humidity works in a like manner.
- C. Occupied heating, occupied cooling, standby heating, standby cooling, unoccupied heating, unoccupied cooling, heating offset, and AHU space temp setpoints are all sent from the BAS server to the local control devices. Proper defaults must be used in local control devices. Current values for these setpoints can be viewed at the WMU BAS website.
- D. Equipment is rotated every Monday morning at 7:00am. A master schedule for this event is located in the BAS server. If building equipment must rotate, a slave schedule shall be placed in the building’s supervisory controller, receiving its schedule command from the master schedule.
- E. Master time of day schedules shall reside on the BAS server to allow off-site editing of the schedule. Slave schedules shall be located in the building supervisory controller acting as defaults, receiving signals from their respective master schedules.
- F. Time of day schedules shall be organized according to room use to facilitate holiday scheduling for different types of spaces. Master holiday schedules are located in the BAS server and are divided into three types, OFFICE, CLASSROOM, and LIBRARY holidays.

- G. A roof heat-tape (or ice melt) enable signal is sent globally from the BAS server and shall be used on those projects that include heat-tape. It originates from two moisture sensors located on campus. Outside temperatures must be below 35°F and both moisture sensors must indicate ON before the global heat-tape (or ice melt) signal is enabled. An off delay is programmed in at the building level to allow different off delay times for each building. Overrides for any DO (digital output), and the amount of time delay for the building, shall both be accessible from the BAS ice melt graphic screen. If there is a communications loss between the server and the local heat-tape controller the program shall default to a local outside temperature thermostat and the heat-tape shall be ON if the outside temperature is below 32°F.
- H. A chiller alarm disable command is sent to all devices controlling chillers for the purpose of disabling chiller alarms during the winter season.
- I. Each building shall have a master manual cooling enable control signal from the BAS. Non-critical cooling valves and DX units shall not be allowed to operate unless this master signal is enabled. This master enable signal shall be toggled from the master cooling enable graphics screen in the BAS. Any no-freeze program shall override this signal.

7. GRAPHICAL INTERFACE

- A. Graphics shall be accessible from a standard web browser.
- B. The following graphics shall be accessible from off campus: Composite campus screens that pull data from multiple sites (such as all chillers, all steam pressures, etc.), building home pages, building floor plans, AHU summary screens and VAV summary screens.
- C. The following graphics shall not be accessible from off campus and shall be loaded on the building supervisory controller (BSC): AHU detail screens, VAV detail screens, VFD screens, chiller screens, heating water system screens, irrigation screens.
- D. Graphics of floor plans shall include WMU as-built room numbers for all spaces. Construction room numbers are not to be used if they differ from the as-built room numbers.
- E. Graphics of floor plans shall be colored to indicate which spaces are supplied by specific air-handlers. Colors shall be standardized according to the following chart:

<u>Floor Color</u>	<u>AHU #</u>	<u>(RGB) ></u>	<u>Red</u>	<u>Green</u>	<u>Blue</u>
Gray	no AHU		191	191	191
Light blue	AHU-1		139	230	255
Pale Yellow	AHU-2		255	255	153
Dark Green	AHU-3		0	255	150
White	AHU-4		255	255	255
Orange	AHU-5		255	151	102
Dark Blue	AHU-6		20	111	194
Violet	AHU-7		116	76	190
Red	AHU-8		255	48	0
Bright Yellow	AHU-9		255	237	18
Light Green	AHU-10		109	182	0

If a project contains more than 10 air handlers the controls contractor shall seek guidance from WMU personnel to establish additional colors.

- F. Space temperatures on floor plans shall be displayed in a white box with a black border and black text. If this space temperature is associated with a VAV box or other terminal unit, the display box shall also be a link to the terminal unit graphic.
- G. Fan status shall be displayed using a Boolean graphic that displays a spinning fan wheel when the status is ON and a stationary fan wheel when the status is OFF. Pump status graphics shall be displayed in a like manner using a pump impeller in a pump. If a fan or pump have no DI (digital input) to display the status a NS (no status) shall be placed on the fan or pump icon on the graphics screen to indicate there is no motion ON/OFF status.
- H. DO (digital outputs) shall be displayed using a Boolean graphic that displays a switch ON when the status is ON and a switch OFF when the status is OFF. These switch graphics shall not be used for anything other than digital outputs.
- J. Heating and cooling coils shall be displayed using a Boolean graphic that displays a color change when the status is ON and an off-white coil when the status is OFF. Text status shall accompany this color change. See the WMU BAS Control Center for more details.
- K. All graphics should have a similar look and feel as those graphics already in use on the WMU BAS.
- L. All equipment controlled or monitored by the BAS shall be graphically represented.
- M. Temperatures and fluid pressures shall be displayed to one decimal place. Relative humidity, control signal output percentages, and air flows shall be

displayed to zero decimal places. Static pressures shall be displayed to two decimal places.

- N. The air flow totals listed in section 5-G shall be displayed in the graphics system.
- O. The BAS Network Diagram and Device Totals graphics pages shall be updated whenever new control devices are added to the BAS network.
- P. Every building shall have a graphic screen that lists all of the BAS alarms for that building and the status of each alarm. VAV alarms will not be listed on this primary alarm screen, but on a separate VAV alarm screen. These alarm graphic screens shall be configured such that when a point is in alarm the text on the graphic for that point shall flash red with the current point value. These alarm screens shall be arranged in a table format with the alarm points clearly labeled as to what they are. The text point identifying the equipment shall also be a link to the graphic page for that equipment.

8. SOFTWARE AND DOCUMENTATION

- A. The control contractor shall provide WMU with all software and cabling required to access and/or program any and all programmable devices installed on a job. Software provided must be the latest version available. The contractor is not required to supply this software if WMU already has it. However, updated revisions shall be provided to WMU if they are more recent than those owned by WMU.
- B. The control contractor shall provide WMU with at least 3 hard copies and one electronic copy of all programming manuals relevant to any and all programmable devices installed on a job. These manuals shall be complete and provide instruction on how to program said devices.
- C. As-built control drawings shall indicate the location of all control system components.
- D. As-built control drawings shall indicate the proper device layout sequence of all control devices on a daisy chain communications bus.
- E. VAV box control program file names shall start with the AHU number supplying the box followed by a dash and the room number where the thermostat is located. Next will be another dash and the VAV box number assigned on the mechanical drawings, if applicable (skip this if no number was assigned). This number shall be followed by a dash and additional characters to indicate connection or control of special equipment if applicable. For example a file name might be "1-1204-TU3-sp" where the box is supplied by AHU-1, with a thermostat located in room 1204, VAV box TU-3, and a static pressure sensor (sp) wired to the controller for AHU-1.

9. SEQUENCES

The sequences listed in this document are typical of how WMU prefers to control its HVAC equipment. These sequences were developed primarily for energy management but also for occupant comfort. The control system shall be capable of implementing these sequences if it is to be accepted. These sequences should be strictly adhered to wherever possible. Exceptions can only be made in those cases where special design considerations prevent the use of one or more of these sequences. WMU must be consulted before a deviation is made.

A. TERMINAL UNITS CONTROL SEQUENCES

1. Variable Air Volume Box Control With Occupancy Sensor(s):
 - a. **Unoccupied mode (building occupancy schedule off, occupancy sensor off):** The VAV damper and heating valve(s) (if applicable) will be closed and the airflow set point shall be 0 CFM. If the space temperature rises to the unoccupied cooling set point the VAV controller shall call for airflow (which will command the AHU on, see 9-B-4-a) and modulate the VAV CFM, up to maximum airflow, to maintain space temperature at set point. When space temperature falls sufficiently below the unoccupied cooling set point the VAV controller shall call for 0 CFM airflow. If the space temperature falls to the unoccupied heating set point the VAV controller shall call for airflow (which will command the AHU on, see 9-B-4-a) and modulate the VAV damper to maintain airflow at the minimum/reheat minimum CFM set point. The heating valve(s) shall modulate to maintain the space temperature at set point. When space temperature rises sufficiently above the unoccupied heating set point the VAV controller shall call for 0 CFM airflow and the heating valve(s) shall close. When a person enters the space the occupancy sensor shall place the VAV in the occupied mode. An override push button shall be located on the thermostat, and shall provide a one hour occupied override.
 1. **Standby mode (building occupancy schedule on, occupancy sensor off):** The VAV damper and heating valve(s) (if applicable) will be closed and the airflow set point shall be 0 CFM. If the space temperature rises to the standby cooling set point the VAV controller shall call for airflow (which will command the AHU on, see 9-B-4-a) and modulate the VAV CFM, up to maximum airflow, to maintain space temperature at set point. When space temperature falls sufficiently below the standby cooling set point the VAV controller shall call for 0 CFM airflow. If the space

temperature falls to the standby heating set point the VAV controller shall call for airflow (which will command the AHU on, see 9-B-4-a) and modulate the VAV damper to maintain airflow at the minimum/reheat minimum CFM set point. The heating valve(s) shall modulate to maintain space temperature at set point. When space temperature rises sufficiently above the standby heating set point the VAV controller shall call for 0 CFM airflow and the heating valve(s) shall close. When a person enters the space the occupancy sensor shall place the VAV in the occupied mode.

2. **Occupied mode (building occupancy schedule on, occupancy sensor on):** The VAV damper shall modulate to maintain airflow at the minimum CFM set point and heating valve(s) (if applicable) will be closed. The AHU shall be running, see 9-B-4-a. If the space temperature rises to the occupied cooling set point the VAV controller shall call for additional airflow, up to maximum airflow, and modulate the VAV CFM to maintain space temperature at set point. When space temperature falls sufficiently below the occupied cooling set point the VAV controller shall return to minimum airflow. If the space temperature falls to the occupied heating set point the VAV controller shall modulate the VAV damper to maintain airflow at the reheat minimum CFM set point. The heating valve(s) shall modulate to maintain space temperature at set point. When space temperature rises sufficiently above the occupied heating set point the VAV controller shall return to minimum airflow and the heating valve(s) shall close.

2. Variable Air Volume Box Control Without Occupancy Sensors:

- a. **Unoccupied mode (space occupancy schedule off):** The VAV damper and heating valve(s) (if applicable) will be closed and the airflow set point shall be 0 CFM. If the space temperature rises to the unoccupied cooling set point the VAV controller shall call for airflow (which will command the AHU on, see 9-B-4-a) and modulate the VAV CFM, up to maximum airflow, to maintain space temperature at set point. When space temperature falls sufficiently below the unoccupied cooling set point the VAV controller shall call for 0 CFM airflow. If the space temperature falls to the unoccupied heating set point the VAV controller shall call for airflow (which will command the AHU on, see 9-B-4-a) and modulate the VAV damper to maintain airflow at the minimum/reheat minimum CFM set point. The heating valve(s) shall modulate to maintain space temperature at set point. When space temperature rises sufficiently above the unoccupied heating set point the VAV controller shall call for 0 CFM airflow and the heating valve(s) shall close. An override push button shall be located on the thermostat, and shall provide a **one** hour occupied override.

space temperature at set point. When space temperature falls sufficiently below the standby cooling set point the fan shall stop and the cooling valve shall close. If the space temperature falls to the standby heating set point the fan shall start and heating valve shall modulate to maintain space temperature at set point. When space temperature rises sufficiently above the standby heating set point the fan shall stop and the heating valve shall close. When a person enters the space the occupancy sensor shall place the FCU in the occupied mode.

- c. **Occupied mode (building occupancy schedule on, occupancy sensor on):** The fan-coil unit shall be off and the heating and cooling valves shall be closed. If the space temperature rises to the occupied cooling set point the fan shall start and the cooling valve shall modulate to maintain space temperature at set point. When space temperature falls sufficiently below the occupied cooling set point the fan shall stop and the cooling valve shall close. If the space temperature falls to the occupied heating set point the fan shall start and the heating valve shall modulate to maintain space temperature at set point. When space temperature rises sufficiently above the occupied heating set point the fan shall stop and the heating valve shall close.

5. Fan Coil Unit Control Without Occupancy Sensor(s):

- a. **Unoccupied mode (building occupancy schedule off):** The fan-coil unit heating and cooling valve(s) will be closed and the fan shall be off. If the space temperature rises to the unoccupied cooling set point the fan shall start and the cooling valve shall modulate to maintain space temperature at set point. When space temperature falls sufficiently below the unoccupied cooling set point the fan shall stop and the cooling valve shall close. If the space temperature falls to the unoccupied heating set point the fan shall start and heating valve shall modulate to maintain space temperature at set point. When space temperature rises sufficiently above the unoccupied heating set point the fan shall stop and the heating valve shall close. An override push button shall be located on the thermostat, and shall provide a one hour occupied override.
- b. **Occupied mode (building occupancy schedule on):** The fan-coil unit shall be off and the heating and cooling valves shall be closed. If the space temperature rises to the occupied cooling set point the fan shall start and the cooling valve shall modulate to maintain space temperature at set point. When space temperature falls sufficiently below the occupied cooling set point the fan shall stop and the cooling valve shall close. If the space temperature falls to the occupied heating set point the fan shall start and the heating valve shall modulate to maintain space temperature at set point. When space temperature rises sufficiently above the occupied heating set point the fan shall stop and the heating valve shall close.

B. AIR HANDLING UNIT (AHU) CONTROL SEQUENCES

1. Air Handling Unit Control - All Air Handlers:
 - a. When the supply fan is off, the outside air dampers, cooling valve(s) and heating valve(s) shall all be closed, unless the outside air temperature is below 32 degrees, in which case the heating valve(s) shall modulate to prevent the lowest temperature in the AHU from going below 50°F.
 - b. If an AHU has a chilled water coil, and the chiller status (the chiller that supplies that particular AHU) is off for more than three hours, the outside dampers shall not go to minimum position, but instead shall open to provide outside ventilation.
 - c. If there is a diagnostic error on any of the sensors that affect control of an air handler, the supply fan (and return fan if applicable) will shut down and a BAS alarm shall be generated.
 - d. If an AHU has any pneumatically controlled, normally open heat, a loss of main control air pressure (pressure below 15 psig) will shut the AHU down to prevent overheating of the space. A heating night setback call shall override this function and run the fan(s).
2. Air Handling Unit Control - Single Discharge Units:
 - a. An air handling unit with a heating coil, mixed air dampers, and cooling coil (or any combination) shall modulate them in sequence such that the heating coil and cooling coil never open together unless it is for a dehumidification sequence. The mixing dampers shall modulate in sequence between the heating and cooling coils so that on a call for mechanical heat, the outside dampers shall be at minimum position. At outside temperatures below 60 degrees (adjustable), and on a call for cooling, the outside dampers shall modulate 100% open before the mechanical cooling modulates open (chilled water), or is sequenced on (DX). At outside temperatures above 60 degrees the outside dampers shall be at minimum position.
3. Air Handling Unit Control - Single Zone Units:
 - a. If an AHU supplies only one temperature zone, with only one space temperature sensor, an economizer space temperature set point shall also be part of the control program. At outside temperatures below 60 degrees (adjustable) the outside dampers shall modulate as needed to maintain the space temperature at 73°F (adjustable). At outside temperatures above 60 degrees the outside dampers shall be at minimum position.

4. Variable Speed Air Handlers for Variable Volume Systems:

- a. An AHU shall start if there is airflow demand from any one VAV box supplied by that air handler.
- b. All VAVs supplied by a particular AHU shall be defined as a zone for the purposes of this sequence. All zone space temperatures shall be averaged. A reverse acting PI (proportional, integral) loop shall be configured such that its input shall be the average zone space temperature and its set point shall be the AHU space temp set point listed in 6-C. The loop output shall be used as the AHU discharge temperature set point and shall be limited between 55 and 70 degrees F (adjustable). This sequence is designed to use the AHU temperature control to maintain most spaces in the zone at or close to the AHU space temp set point. This would, ideally, position most VAVs at minimum CFM with no heat running.
- c. Occupancy schedules shall enable the VAV box controller (no occupancy sensors), not the air handler. See section 9-B-4-a for air handler start sequence. When occupancy sensors are used the occupancy schedule is used to change set points from unoccupied to standby.
- d. The AHU supply static pressure setpoint shall be reset dynamically based on the actual demand of the VAV system. The goal is to use the lowest possible static pressure in the system that will still allow the VAV boxes to meet their current airflow demand.

C. CHILLER CONTROL SEQUENCES

1. All Chillers:

- a. If the outside temperature is above 55 degrees (adjustable), and at least one AHU supplied by a chiller plant is running, the chiller system shall be enabled. If any one of these is not true the chiller system shall be disabled.
- b. If there is a diagnostic error in any of the sensors that affect control of a chiller plant (in other words, the loss of this sensor would be harmful to chiller operations), the chiller system will shut down and a BAS alarm shall be generated.
- c. Once the control system senses that a chilled water primary pump is running, the chilled water secondary pump(s) shall start. In addition, if there are multiple chilled water zones, at least one AHU fed by any given zone pump must be running before that zone pump is allowed to run. If there are parallel pumps, the lead pump shall start.

2. Water Cooled Chillers:

- a. Once the control system senses that a condenser water pump is running, the control system will modulate the cooling tower valve and cooling tower fans (VFD) in sequence to maintain the condenser water supply temperature at set point. The cooling tower valve shall fail open to the cooling tower, and closed to the bypass.
- b. In addition to the condenser water supply and return sensors, a cooling tower sump temperature sensor shall be provided. The cooling tower sump temperature shall reset the condenser water supply temperature control loop throttling range. The initial reset schedule shall be as follows: 60 degree F sump temp = 80 degree TR, 85 degree sump = 20 degree TR. This schedule shall be fine-tuned after chiller startup.

D. MISCELLANEOUS CONTROL SEQUENCES

1. “No-Freeze” Program: If the outside temperature is below 32 degrees and any particular air handler that has a chilled water coil has a mixed air temperature below 40 degrees, the chilled water pumps that feed that AHU will start and the chilled water valve on the affected air handler will open to move water through the chilled water coil to prevent freezing. A BAS alarm shall also be generated for that AHU. This control program does not negate the need for hard-wired low-limit thermostats for freeze protection.
2. Parallel Pumps: If the lead pump fails, the lag pump should start in its place. The lead-lag alternates every Monday at 7:00 AM and the command is sent from the BAS File Server (see 5-A-3-E).
3. Variable Speed Pumps: The control system will control the speed of the frequency drive pump(s) to maintain differential pressure on the system at set point. If the pressure cannot be maintained with one pump, a second pump shall start (if applicable), and then a third pump if necessary, etc. If the lead pump fails, the lag pump should start in its place.

10. SYSTEM SECURITY

- A. Strong passwords shall be used if available.
- B. SSL security shall be used if available.
- C. A guest access account shall be entered in every device to enable guest access to view graphics screens and control programs. Users of this account shall not have

- authority to make any changes. The user name shall be “WMUguest1” and the password “WMUbronco1” and both shall be case sensitive.
- D. Schedules, set points, and override objects shall be enabled with “HVAC” security access.
 - E. Each Invensys Universal Network Controller (UNC) shall have its own user name and password for the purpose of communicating with the BAS file server. The user name and password of each UNC shall be entered into the user list of the server as well as any other UNC which requires direct communication with the subject UNC. The server user name and password shall be entered into the user list of each UNC. These user names and passwords follow a standard format and shall be assigned by WMU’s Energy Systems Specialist. They shall be assigned to all “Operator” and “Command” functions under the “General” Security Mask. This security information must also be properly entered into the UNC and server address books to allow proper communications between devices.

11. ALARMS

- A. Alarms shall be routed to the WMU BAS server. Alarms are divided into priorities from 1 to 255, 1 being the highest priority. Design professionals and others should be aware that Maintenance Services is not a 24 hour operation and only a portion of the BAS alarms are sent to a 24 hour pager. The design professionals need to coordinate with Maintenance Services staff to identify those critical alarms that need 24/7 response. A list of priorities currently defined by WMU can be obtained from the WMU BAS Control Center.
- B. All fans and pumps, which have both digital input and digital output points, shall be alarmed. The alarm shall be generated whenever the input and output values do not match. The time delay on these alarms shall be 20 minutes unless there is reason for a shorter delay.
- C. Alarm text messages shall be descriptive and contain the building name and equipment type and number from which the alarm was generated. The alarm message shall also contain the room number where the equipment is located.
- D. Those heating systems that use parallel pumps shall have a non-paged status alarm on each pump as well as a paged alarm if both pumps fail.

12. TRAINING

- A. The controls contractor shall provide one week of factory training for every \$250,000 exceeded in a job contract. The class(es) shall be selected by WMU and the training provided shall include transportation to and from the factory school and also include lodging at a local hotel for the duration of the training.

- B. On-site control training shall be held for every building system that is connected to the BAS. This training shall be broken down by system, such as air-handling system, heating water system, cooling system, etc. Very small systems can be covered as a group in one training session. The control contractor shall cover all aspects of the control system for each system, describing the type and location of each controller, and covering the entire control program for each system in detail. If the control contractor requires a formal space at WMU with special needs such as projection equipment they must arrange this with the project manager prior to training. Training sessions shall not exceed 2 hours in length. If more than 2 hours is required to cover the entire building or project then multiple training sessions are required.

13. TRENDING

- A. A trend shall be created for every networked variable frequency drive (VFD) on the “drive energy” point. This trend shall be located on the BAS server, shall take a sample every 60 minutes and store 11520 samples.