AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT AT QUANDER ROAD CENTER

6400 Quander Rd
Alexandria, VA 22307
(FAIRFAX COUNTY PUBLIC SCHOOLS)

CONTRACT # MMB-064-24

DRAWING INDEX

FAIRFAX COUNTY PUBLIC SCHOOLS

OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
TEL.: 703-764-2423

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

QUANDER ROAD CENTER

6400 Quander Rd
Alexandria, VA 22307

DRAWN SM

CHECKED

DATE 3/19/2024

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REVISIONS

NO.	DATE	DESCRIPTION

DRAWING TITLE

COVER SHEET

DRAWING NUMBER

CS

SCOPE OF WORK

GENERAL: THE CONTRACTOR SHALL COMPLETELY REPLACE EXISTING HVAC AUTOMATIC TEMPERATURE CONTROL (ATC) SYSTEM WITH A NEW HVAC AUTOMATIC TEMPERATURE CONTROL SYTEM WITH DDC CONTROLS. THE NEW BUILDING AUTOMATION SYSTEM (BAS) SHALL INCLUDE OPERATING SEQUENCES THAT ARE SPECIFICALLY DESIGNED FOR THIS SITE TO PROVIDE MAXIMUM ENERGY EFFICIENCY AS WELL AS OPTIMUM OCCUPANT COMFORT IN THE MANAGEMENT OF THE BUILDING'S HVAC SYSTEMS. THE BAS WILL ALSO INCLUDE A HIGH QUALITY, USER FRIENDLY GRAPHICAL INTERFACE. THE CONTRACTOR SHALL PROVIDE THE FOLLOWING:

1 - REMOVE ALL PNEUMATIC CONTROL DEVICES, INCLUDING ACTUATORS. REMOVE ALL EXPOSED PNEUMATIC TUBING IN THE MECHANICAL ROOMS AND ELSEWHERE. FOR PHASING PURPOSES, ALL REMAINING UNEXPOSED PNEUMATIC LINES SHALL BE CAPPED WHILE THE AIR COMPRESSOR REMAINS IN SERVICE. AT THE END OF THE PROJECT, THE AIR COMPRESSOR SHALL BE REMOVED AND DISPOSED OF BY THE CONTRACTOR. CONTRACTOR SHALL REMOVE EXISTING DISCONNECT, CONDUIT AND POWER WIRES FROM BREAKER PANEL TO COMPRESSOR.

2 - REPLACE EXISTING THREE WAY MAIN HOT WATER MIXING VALVE WITH NEW. REPLACE PNEUMATIC ACTUATOR WITH NEW SPRING RETURN ELECTRONIC ACTUATOR. PROVIDE AND INSTALL NEW VARIABLE FREQUENCY DRIVES FOR SPECIFIED HOT WATER PUMPS AND DIFFERENTIAL PRESSURE TRANSMITTER(S) AT THE LOCATION SPECIFIED ON DRAWING M-2.

3 - REPLACE OUTSIDE AIR TEMPERATURE AND HUMIDITY SENSORS WITH NEW. PROVIDE AND INSTALL NEW BAS WATER TEMPERATURE SENSORS FOR CENTRAL PLANT HOT WATER AND CHILLED WATER SYSTEMS AS SHOWN ON THESE DRAWINGS. WELD NEW SENSOR WELL THREAD-O-LETS ON PIPES. EXISTING SENSOR WELLS MAY BE REUSED IF COMPATIBLE AND CLEANED WITH NEW SENSORS. PROVIDE NEW THERMAL GREASE IN EACH WELL.

4 - REPLACE ALL HVAC EQUIPMENT (AHUS, RTUS, MAUS, UVS, FCUS, FTRS) HW & CHW COIL VALVES AND ACTUATORS WITH NEW VALVES AND ELECTRONIC ACTUATORS.

5 - REPLACE ALL HVAC EQUIPMENT (INCLUDING EXHAUST FANS) PNEUMATIC DAMPER ACTUATORS WITH NEW ELECTRONIC ACTUATORS. CLEAN & LUBRICATE ALL UNIT DAMPER LINKAGES INCLUDING BAROMETRIC DAMPERS AND VERIFY PROPER DAMPER OPERATION.

6 - REMOVE ALL EXISTING BAS CONTROLLERS AND RETURN TO FCPS. REMOVE ALL EXISTING CONTROL DEVICES SUCH AS RELAYS, SENSORS, POWER SUPPLIES, TERMINALS, TRANSDUCERS, ETC. AND REPLACE WITH NEW WHERE APPLICABLE. RE-USE OR RETURN TO FCPS UNINTERRUPTIBLE POWER SUPPLIES (UPS).

7 - PROVIDE AND INSTALL A NEW STAND ALONE DDC PROGRAMABLE CONTROLLER FOR EACH OF THE FOLLOWING HVAC SYSTEMS AND EQUIPMENT: CENTRAL HEATING SYSTEM (BOILERS & HW PUMPS), CHILLED WATER SYSTEMS (CHILLERS & CHW PUMPS), EACH AHU, RTU, MAU, UV AND FCU. BAS CONTROLLERS FOR MAJOR EQUIPMENT (BOILERS, CHILLERS, PUMPS, AHUS, RTUS & MAUS) MUST HAVE CONTROL POINT (OUTPUT) OVERRIDE CAPABILITIES. THE BAS SHALL CONTROL ALL EXHAUST FANS, FTRS, CUHS AND UHS SHOWN ON THESE FLOOR PLANS THAT ARE NOT CONTROLLED BY ELECTRONIC THERMOSTATS OR WALL SWITCH. PROVIDE AND INSTALL NEW LINE VOLTAGE THERMOSTATS WITH CONCEALED SETPOINT ADJUST WHERE SHOWN ON FLOOR PLANS.

8 - PROVIDE AND INSTALL MOTOR CURRENT SENSORS AND STATUS RELAYS FOR ALL EF, HW & CHW PUMP MOTORS AND AHU, RTU & MAU AND FC FAN MOTORS FOR THE PURPOSE OF MONITORING AND TRENDING THE RUN STATUS OF THIS EQUIPMENT AS WELL AS ACCUMULATING RUN TIME. THE BAS WILL ALSO MONITOR & TREND THE ALARM AND RUN STATUS POINTS OF THE BOILERS AND CHILLERS.

9 - PROVIDE AND INSTALL NEW RETURN AND SUPPLY AIR TEMPERATURE DUCT SENSORS IN ALL AHUS, RTUS & MAUS. PROVIDE & INSTALL NEW AVERAGING TYPE SENSORS TO MONITOR MIXED AIR FOR ALL AHUS & RTUS. PROVIDE & INSTALL RETURN AIR HUMIDITY DUCT SENSORS WHERE SHOWN ON THESE DRAWINGS. PROVIDE NEW SENSORS TO MONITOR DISCHARGE AIR FOR ALL UVS & FCUS AND MOUNT IN CENTER OF UNIT.

10 - INSTALL NEW 2 POLE FREEZESTATS IN ALL UNITS WITH OUTSIDE AIR INTAKE AND HW OR CHW COILS. ONE POLE FOR THE HARDWIRED SAFETY INTERLOCK SEQUENCE, THE OTHER FOR THE BAS CONTROLLER ALARM INPUT.

11 - REPLACE EXISTING SPACE SENSORS WITH NEW SETPOINT ADJUST TYPE SENSORS. SURFACE MOUNT ON WALL WITHIN A VENTILATED COVER (EXCEPT IN HALLWAYS, BATHROOMS & SHOWERS - USE FLAT WALL PLATE TYPE WITHOUT ADJUSTER) AND INSULATE BEHIND SENSOR. NEW WIRING SHALL BE RUN FROM SENSOR TO CONTROLLER AND BE CONCEALED IN WALLS AND CEILING. PROVIDE CAGE TYPE PROTECTIVE COVERS FOR SENSORS IN GYMS & CAFETERIA, AND KITCHEN. REMOVE ALL EXISTING NIGHT SETBACK SENSORS ASSOCIATED WITH EXISTING BAS.

12 - PROVIDE AND INSTALL NEW OCCUPANCY (MOTION) SENSORS IN SPACES SHOWN ON THESE FLOOR PLANS AND WIRE TO LOCAL BAS CONTROLLERS AS SHOWN ON THESE DRAWINGS. PROVIDE & INSTALL CARBON DIOXIDE (CO2) SENSORS IN SPACES SHOWN ON FLOOR PLAN(S). PROVIDE CAGE TYPE PROTECTIVE COVERS FOR CO2 SENSORS IN GYMS & CAFETERIA. PROGRAM OCCUPANCY SEQUENCE FOR THESE DEVICES AS SPECIFIED HEREIN.

13 - HVAC UNIT NAMES IN PROGRAMS AND ROOM NUMBERS ON GRAPHIC SHALL MATCH UNIT NAMES & ROOM NUMBERS AS SHOWN ON THESE DRAWINGS. ALL SPACE SENSORS SHALL BE LABELED WITH THE HVAC ID NAME OF THE UNIT SERVING THAT AREA. CONTRACTOR SHALL FIELD VERIFY ROOM NUMBERS AND NAMES.

14 - PROVIDE NEW CONTROL CABINETS WITH LATCHING DOOR PANEL (WITHOUT KEY LOCK) FOR NEW BAS CONTROLLERS AND REMOVE ALL UNUSED CONTROL CABINETS. EXPOSED MOUNTING HOLES IN WALL FROM REMOVED CABINETS SHALL BE REFILLED AND NEWLY EXPOSED AREAS SHALL BE PAINTED TO MATCH EXISTING WALL COLOR.

15 - EXISTING CONDUIT TO SENSORS AT AIR HANDLERS AND CENTRAL PLANT MAY BE RE-USED IF IN GOOD CONDITION AND IF SIZED PER NATIONAL ELECTRIC CODE. CONTRACTOR SHALL REPAIR ALL CONDUIT USED FOR CONTROLS INCLUDING CONNECTORS AND COVER PLATES AS NEEDED. ALL NEW CONDUIT FOR POWER WIRING SHALL BE INTERMEDIATE METAL CONDUIT IF LARGER THAN 1" OR ELECTRIC METALIC TUBING IF 1" OR SMALLER. NEW CONDUIT SHALL BE SIZED PER NATIONAL ELECTRIC CODE. FOR POWER WIRING IN THE CENTRAL PLANT, LIQUID-TIGHT GALVANIZED SINGLE STRIP FLEXIBLE METAL CONDUIT MAY BE USED FOR POWER WIRING IN LENGTHS UP TO 24" AND A SEPARATE GREEN GROUND WIRE SHALL BE INSTALLED THROUGH THE FLEXIBLE CONDUIT BACK TO THE SOURCE. FOR NEW CONDUIT TO END DEVICES SUCH AS SENSOR AND ACTUATORS, METAL CLAD (MC) FLEXIBLE CONDUIT IN LENGHTS UP TO 24" MAY BE USED. ALL CONTROL WIRING SHALL BE NEW. WIRING SHALL BE CONTINUOUS FROM CONTROLLER TO INPUT SENSORS AND OUTPUT DEVICES WITHOUT SPLICING OR WIRE NUTS. WIRING TO CONTROL END DEVICES ON MOVING OR VIBRATING EQUIPMENT SHALL BE RUN IN FLEXIBLE METALIC CONDUIT IN LENGTHS UP TO 24".

16 - ALL THE EXPOSED CONTROL WIRING AND POWER WIRING IN OCCUPIED SPACES INCLUDING BUT NOT LIMITED TO CLASSROOMS AND OFFICES SHALL BE RUN IN 700 SERIES WIREMOLD METAL RACEWAYS. THE COLOR OF THE RACEWAY SHALL MATCH THE COLOR OF THE WALL.

17 - ALL NEW VALVES AND PIPING INSULATION DISTURBED DURING THE COURSE OF THIS WORK SHALL BE RE-INSULATED. THE NEW INSULATION SHALL CONFORM TO SECTION 15250.

18 - THE CONTRACTOR SHALL BE RESPONSIBLE FOR DRAINING, REFILLING THE HOT WATER AND CHILLED WATER SYSTEMS, AND BLEEDING AIR OUT OF THE SYSTEMS AFTER REFILL TO PERFORM THIS WORK. CONTRACTOR SHALL BE RESPONSIBLE TO CYCLE HVAC EQUIPMENT FOR THIS PURPOSE.

19 - THE CONTRACTOR SHALL HIRE A CERTIFIED TESTING, ADJUSTING, AND BALANCING (TAB) AGENCY TO PERFORM AIR AND WATER BALANCING OF THE SYSTEMS PER SECTION 01660 OF SPECIFICATIONS. CONTRACTOR SHALL BE RESPONSIBLE FOR DISASSEMBLING AND ASSEMBLING UNITS AS NEEDED TO PERFORM BALANCING. CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIRING PIPE AND AIR DUCT INSULATION DISTURBED DURING THE COURSE OF BALANCING.

20 - CONTRACTOR SHALL INCLUDE AND BEAR THE COST OF ALL THE APPLICABLE SERVER UPGRADES NECESSARY FOR THE ADDITION OF THE SYSTEM INSTALLED PER THIS CONTRACT TO THE SERVER AND FURTHER THE CONTRACTOR SHALL MAKE CERTAIN THAT THE ADDITION OF THE NEW SYSTEM AND ANY ASSOCIATED UPGRADES PROVIDE NO NOTICEABLE DISRUPTION TO SERVICE OR OTHER NEGATIVE IMPACTS ON REMAINING FCPS FACILITIES HOSTED ON THE SERVER

MECHANICAL EQUIPMENT DATA

ROOFTOP UNIT SCHEDULE

			Total	OA	Cooling		Heating		Outside Air Damper		
Unit #	Rm/Area Served	Zone	CFM	CFM	MBH	ST	MBH	ST	Control	Min Pos	Other
RTU-1A	Gymansium	3	3750	862	113.1	2	250.0	2	Min OA	23%	
RTU-1B	Gymansium	3	3750	862	113.1	2	250.0	2	Min OA	23%	
RTU-1C	Gymansium	3	3750	862	113.1	2	250.0	2	Min OA	23%	
RTU-1D	Gymansium	3	3750	862	113.1	2	250.0	2	Min OA	23%	
RTU-2	Shop 108	8	1500	300	48.4	1	150.0	1	Min OA	20%	
RTU-3A	Stage	4	1450	450	48.4	1	150.0	1	Min OA	31%	
RTU-3B	Work room 156	6	1450	450	48.4	1	150.0	1	Min OA	31%	
RTU-4	Weight room	5	1500	300	38.4	1	115.0	1	Min OA	20%	
RTU-5	Multipurpose room	7	3200	1215	101.9	2	250.0	2	Min OA	38%	
RTU-6	Various	9	1800	475	54.7	1	111.8	N/A	Economizer	26%	Hydronic heat

DEDICATED OUTDOOR AIR SYSTEM SCHEDULE

			Total	OA	Cooling	Heating	Outside Air Damper		
Unit #	Rm/Area Served	Zone	CFM	CFM	MBH	MBH	Control	Min Pos	Other
DOAS-E	Classrooms	1	5500	5500	260	240	Min OA	100%	
DOAS-W	Classrooms	2	5500	5500	260	240	Min OA	100%	

UV/FC SCHEDULE

					CHW Coil			HW Coil		
Unit#	Room Served	Zone	CFM	OA CFM	MBH	GPM	Pipe** Runout Size	MBH	GPM	Pipe** Runout Size
FC-1	Lobby	2	800	N/A	16.0	3.2	3/4"	22.0	2.20	3/4"
FC-2	Office	2	300	N/A	10.2	2	3/4"	10.5	1.10	3/4"
FC-3	Office	2	1000	N/A	24.0	4.8	1"	35.5	3.55	3/4"
FC-4	Office	2	1000	N/A	24.0	4.8	1"	35.5	3.55	3/4"
FC-5	Office	2	300	N/A	10.2	2	3/4"	10.5	1.10	3/4"
FC-6	Storage room	2	300	N/A	10.2	2	3/4"	10.5	1.10	3/4"
FC-7	Office	1	440	N/A	16.2	3.2	3/4"	18.2	2.00	3/4"
FC-8	Storage room	1	300	115	10.2	2	3/4"	10.5	1.10	3/4"
FC-9	Lobby	1	800	N/A	15	3.2	3/4"	22.0	2.20	3/4"
FC-10	Lobby	1	800	N/A	15	3.2	3/4"	22.0	2.20	3/4"
FC-11	Office	1	600	N/A	19.2	3.8	3/4"	23.6	2.36	1"
FC-12	Office	1	600	N/A	20.5	4.1	3/4"	24.5	2.45	1"
FC-13	Hallway	1	600	N/A	20.5	4.1	3/4"	24.5	2.45	1"
FC-14	Hallway	2	600	N/A	19.2	3.8	3/4"	23.6	2.36	1"
FC-126	Work room 126	1	300	N/A	10.2	2	3/4"	10.5	1.10	3/4"
FC-131	Office 131	1	300	N/A	10.2	2	3/4"	10.5	1.10	3/4"
FC-133	Office 133	1	1000	N/A	27.5	5.5	3/4"	33.0	3.30	1"
FC-135	Office 135	1	1000	N/A	27.5	5.5	3/4"	33.0	3.30	1"
FC-141	Office 141	2	800	N/A	16.0	3.2	3/4"	22.0	2.20	3/4"
FC-146	Office 146	2	1000	N/A	27.5	5.5	1"	33.0	3.30	3/4"
FC-147	Office 147	2	800	N/A	16.0	3.2	3/4"	22.0	2.20	3/4"
FC-201	Office 201	1	600	N/A	20.5	4.1	3/4"	24.5	2.45	1"
FC-203	Work room 203	1	600	N/A	20.5	4.1	3/4"	24.5	2.45	1"
FC-204	Storage 204	1	300	115	10.2	2	3/4"	10.5	1.10	3/4"
FC-206	Storage 206	1	300	115	10.2	2	3/4"	10.5	1.10	3/4"
UV-1	Library	1	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-2	Library	1	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-105	Teachers Lounge 105	1	1000	450	33.0	5.8	1 1/4"	68.6	6.83	1"
UV-136	Instructional Room 136	2	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-137	Classroom 137	2	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-138	Instructional Room 138	2	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-139	Instructional Room 139	2	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-140	Instructional Room 140	2	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-144	Instructional Room 144	2	1250	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-149	Classroom 149	2	1250	450	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-209	Instructional Room 209	1	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-210	Instructional Room 210	1	1250	N/A	50.2	12.0	1 1/4"	68.3	6.83	1"
UV-211	Instructional Room 211	1	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-212	Instructional Room 212	1	1250	N/A	50.2	12.0	1 1/4"	68.3	6.83	1"
UV-213	Instructional Room 213	2	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-214	Classroom 214	2	1250	N/A	50.2	12.0	1 1/4"	68.3	6.83	1"
UV-215	Classroom 215	2	1500	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-216	Classroom 216	2	1250	N/A	50.2	12.0	1 1/4"	68.3	6.83	1"
UV-218	Classroom 218	2	1250	N/A	57.5	12.0	1 1/4"	68.3	6.83	1"
UV-219	Art Room 219	2	1250	N/A	50.2	12.0	1 1/4"	68.3	6.83	1"

*Contractor to field verify the data
**Control valves shall not be sized smaller that two sizes below the indicated pipe runout size

EF SCHEDULE

Exh Fan #	Control	Asc'd Unit	Zone
EF-1	BAS	N/A	1
EF-2	BAS	N/A	9
EF-3	LVT	N/A	N/A
EF-4	BAS	N/A	1
EF-5	BAS	N/A	7
EF-6	BAS	N/A	5
EF-7	BAS	N/A	1
EF-8	BAS	N/A	3
EF-9	LVT	N/A	N/A
EF-137	BAS	N/A	1
EF-139	BAS	N/A	1
EF-217	BAS	N/A	2

PUMP SCHEDULE

Pump#	Service	GPM	Head Ft.
P-1	Hot Water Pump	160	70
P-2	Hot Water Pump	160	70
P-3	Hot Water Pump	52	25
P-4	Hot Water Pump	17	25
P-5	Hot Water Pump	10	25
P-6	Chilled Water Pump	230	60
P-7	Chilled Water Pump	230	60

DHC SCHEDULE

Unit #	Capacity MBH	GPM	Pipe Runout Size
DHC-1	111.8	11.1	1 1/4"

FTR SCHEDULE

Unit #	Capacity MBH	GPM	Pipe Runout Size
FTR-1	4000	0.4	3/4"
FTR-2	3000	0.3	3/4"

STANDARD ABBREVIATIONS
AHU - Air Handling Unit
BAS - Building Automation System
CFM - Cubic Feet (of Air) Per Minute
CH - Cabinet Heater
CHW - Chilled Water
CU - Control or Cooling Unit (VAV)
CVT - Constant Volume Terminal (VAV)
DP - Differential Pressure (Static)
DHC - Duct Heating Coil
FCPS - Fairfax County Public Schools
FCU - Fan Coil Unit
FTR - Finned Tube Radiator
GPM - Gallons Per Minute
HW - Hot Water
LVT - Line Voltage Thermostat
MAU - Makeup Air Unit
MBH - Thousand BTU Per Hour
NIC - Not Included in Contract
RAHU - Rooftop Air Handling Unit
RTU - Rooftop Unit
UH - Unit Heater
UV - Unit Ventilator
VAV - Variable Air Volume
VFD - Variable Frequency Drive

GRAPHICS DISPLAY GUIDELINES

SCHEDULING, OCCUPANCY, ALARMS & TRENDS

General: The graphic selections shall include a Main Floor Plan which shall also serve as the 'Home' page, a Main Menu, Control Zone layouts, Central Plant layout, a Schedule Menu, Zone regular & overtime schedules and Mechanical Systems graphics. This should include an AHU/RTU Menu with links to individual unit graphics, Zone Equipment Data graphics and exhaust fan graphic.

All Zone & Equipment graphics as well as the Home Page shall display the outside air temperature, humidity and enthalpy. All graphics should have links to the Home Page, Main Menu and Central Plant.

The graphics shall be of professional quality and user friendly such that a service technician with basic computer skills can easily navigate the system and extract necessary equipment and environmental data. All data and text displayed shall contrast sharply with its background and be a standard font size for optimal visual clarity.

Every graphic shall display outdoor temperature, humidity, date and time

Trends of the points displayed on the graphic shall be accessible directly from the graphic

The graphics to be organized and displayed as follows:

Home Page: The opening (or Home) page will display the entire school layout outlining all control zones. Each zone will display its appropriate zone number and description (ref Dwg M-2). The Home page will provide links to all Zone Graphic pages, Schedule Menu, Central Plant and Main Menu.

Main Menu: Provide links to Main Floor Plan, Central Plant, Schedule Menu and Equipment Data Menus.

Central Plant: Provide an accurate graphical layout and mechanical flow of the boilers, chiller, cooling towers, pumps, sensors, etc. Graphic(s) will dynamically display all hardwired points and relevant virtual points such as set points, alarm flags, runtime hours, etc.

Equipment Data Menus: Provide menu with links to all AHU, RTU, UV, FCU, ETC. DATA pages.

Equipment Status Charts: Provide equipment status charts for AHU, RTU, UV, FC, EF etc grouped by type of equipment. The following sample information shall be indicated on the pages: Occupancy status, Supply fan status, Space temperature, Supply temperature, Return temperature, and links to Trends. The points displayed will vary depending on the type and configuration of the equipment.

Equipment Graphics: Provide detailed graphic of all AHUs, RTUs, UVs, FCUs etc. Show the proper flow sequence of dampers, coils, fans, sensors, etc. of each unit. Graphics will dynamically display all hardwired points and relevant virtual points such as set points, alarm flags, occupancy status, runtime hours, etc. Provide link back to Equipment Menus.

Schedule Menu: Provide links to Main Schedule and Control Zone Schedules, regular, overtime & holiday/vacation. See scheduling (above).

Zone Data Menu: Provide links to Zone Graphics, Zone Equipment Data Page and Zone Schedules.

Zone Graphics: Every zone # on the Home page shall be linked to a floor plan graphic that will display the various rooms, mechanical system layout and Occupancy status of that zone. This will include a heading at the top of the page stating the zone # and description of that zone. Names of areas (Gym, Admin, etc.) and room numbers will be displayed. Location of HVAC equipment & which areas and/or rooms they serve will be shown.

All space temperatures in that zone will be dynamically displayed. Either the space temps or the room/area background will be displayed as a thermograph with color variations based on temperature to set point comparison.

In addition to the standard links, each zone graphic will include links to its Zone Schedule, Zone Equipment Data Page and any AHUs or RTUs that may be associated with that zone.

Roof Plan: will indicate locations of rooftop equipment such as chillers, RTUs, and exhaust fans.

The graphics package should include a Navigation Tree with links to all graphics. The Navigation Tree should be organized into the Home Page, Main Menu, Schedule Menu, Central Plant and the various control zones. All other graphics will be organized accordingly as sub-folders. Ref. sample Navigation Tree below.

Sample Navigation Tree
- Main Floor Plan (Home)
- Zone 1 Floor Plan
  - (List of all equipment graphics in zone 1)
  - Zone x Floor Plan
  - (List of all equipment graphics in zone x)
- Main Menu (Links to all major graphics)
  - Equipment Status Charts
  - Roof Plan
- Schedule Menu (List all zone schedule links)
  - Main (Bldg) Scheduler
  - Zone 1 Scheduler
  - Zone x Scheduler
- HVAC Equipment Menu
  - Central Plant
  - Boiler System
  - Chiller System
- AHU/RTU Menu (Links to Various AHU/RTUs)
  - AHU-1 Graphic
  - AHU-x Graphic
- UV, FCU & VAV Data Pages
  - Zone 1 Unit Data
  - Zone x Unit Data

Scheduling:

General: There shall be a Regular & Overtime Occupancy schedule for each zone. There shall be a Holiday schedule that applies to the whole building.

Regular (Weekly) Occupancy schedules shall include an Optimal Start sequence for each zone (see below).

Overtime (Off Hour) Occupancy schedules are for one time events specific to that zone that include a date & time but not an Optimal Start sequence.

Holiday schedules shall override (Off) Zone Regular schedules. Zone Overtime scheduling and the on-site zone override panel will take priority over the Holiday schedule.

Vacation schedule shall override existing Regular Occupancy schedules (exept Admin zone).

A Snow Day button shall be provided on the main graphic to place the school in unoccupied setback in the event it needs to be shut down for one day only. This button should also be available in the system's main server graphic at Sideburn Support Center to override all connected schools. The Zone Override panel on site shall override the Snow Day if needed.

Morning warmup/cooldown: Each BAS control zone will use its own optimal start sequence. The sequence will reference the operator entered scheduled occupied start time, the zone space temperature (or average temps in a zone), the occupied setpoints and outside air conditions. Utilizing this data, the controller shall calculate a pre-occupied start time to activate the necessary HVAC system(s) so that it will bring the zone temp to within at least 1°F of the occupied setpoints prior to the scheduled occupied period. During the pre-occupied startup the associated outside air damper(s), shall be closed and remain so until the scheduled occupied time.
If the space temperature attains occupied setpoints prior to the scheduled start time, the equipment will be placed in the Standby mode until the scheduled Occupied time. This feature shall be programmed however, disabled by the contractor. The owner will enable it as needed via an Optimal start enable/disable accessible point.

Primary Freeze Protection Mode: If the outside air temperature falls below 38°F, the hot water system shall run continously 24/7 to ensure that hot water is constantly available at any time for HVAC systems to maintain night setback temperature setpoints or in case of a freeze protector trip.

Secondary Freeze Protection Mode: If the outside air temperature falls below 20°F, the building shall maintain occupied heating setpoints 24/7 regardless of the occupancy status.

Equipment control modes

Occupied mode: the HVAC equipment shall maintain occupied temperature setpoints. The unit's supply fan shall run continuously and the outside air damper shall be commanded on or opento a set position or position defined by the adjustable zone time schedule.

Unoccupied Mode: The HVAC equipment shall maintainnight setback or night setup temperature setpoints. The unit's supply fan shall be cycled on as needed to maintain these temperature setpoints, otherwise it shall remain off, heating valve shall be open and cooling valve closed. The outdoor air damper shall remain closed. The unoccupied mode shall occur outside the occupied zone time schedule.

Equipment Failure Notification (Alarms):

General: The BAS will be capable of generating alarms via email to a designated FCPS email address and to the central computer (server) monitoring station.

All alarms will be sent to FCPS central monitoring station, displayed in RED on the current screen showing the location (school), specific piece of equipment and nature of failure. This information will also be logged into the server database and time stamped. Any active alarms should also be displayed on their appropriate equipment screen.

Communication Failures: In the event a local controller loses communication (goes OffLine) with the main controller along with the scheduling info it provides, the controlled system shall remain in its current state (active or inactive). If still OffLine after 20 minutes and the controlled system is central heating or cooling, the system will activate. If A/C units, they will be placed in night setback (fan off & OA damper closed), but using occupied setpoints. If the main building controller were to fail, the system server will generate an alarm.

Trend Sampling as Follows: All Digital Points including alarm flags – Log Change Of State (On/Off) or every 10 Minutes if COS is unavailable

Outside Air, Space & Return Air Temperatures, Humidity & Enthalpy – Log Every 20 Minutes

Supply Air, Mixed Air Temps, All Water Sensors & Analog Outputs – Log every 5 Minutes

At least 48 samples for change of state (COS) logging and 96 samples for time stamp logging.

All points shall be continuously logged and capable of being automatically written to a standard computer database. All sample times & quantities shall be adjustable.

FAIRFAX COUNTY PUBLIC SCHOOLS
OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
TEL.: 703-764-2423

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

QUANDER ROAD CENTER

6400 Quander Rd
Alexandria, VA 22307

DRAWN SM
CHECKED
DATE 3/19/2024
PROJECT # MMB-064-24

REVISIONS

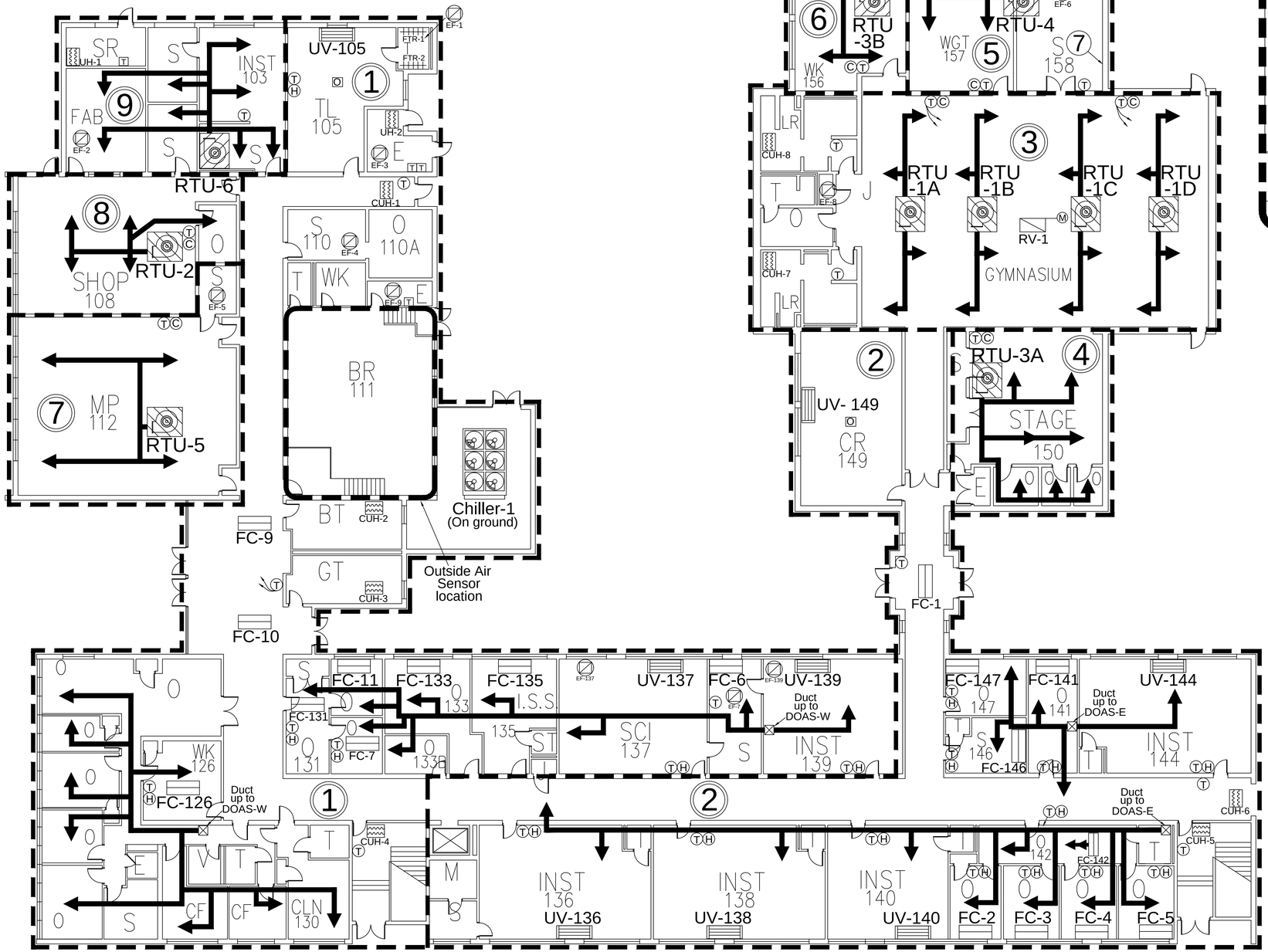
NO.	DATE	DESCRIPTION

DRAWING TITLE

CONTROL SYSTEM SCOPE, UNIT DATA & GUIDELINES

DRAWING NUMBER

M-1



FIRST FLOOR PLAN

FAIRFAX COUNTY PUBLIC SCHOOLS

OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
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DRAWING TITLE

ZONED FLOOR 1 PLAN AND HVAC LAYOUT

DRAWING NUMBER

M-2

SYMBOLS AND ABBREVIATIONS

RTU - ROOF TOP UNIT; DOAS - DEDICATED OUTDOOR AIR SYSTEM

UV - UNIT VENTILATOR

FC - FAN COIL UNIT

EF - EXHAUST FAN; CEF - CEILING EXHAUST FAN

CUH/UH - CABINET UNIT HEATER/UNIT HEATER

BAS - BUILDING AUTOMATION SYSTEM
T SPACE TEMPERATURE SENSOR (BAS)
T LINE VOLTAGE THERMOSTAT
C CO2 - CARBON DIOXIDE SENSOR
O OCCUPANCY SENSOR

1 ZONE - HVAC CONTROL ZONE NUMBER

DP - DIFFERENTIAL PRESSURE TRANSMITTER

H SPACE HUMIDITY SENSOR (BAS)

FTR - FINNED TUBE RADIATOR

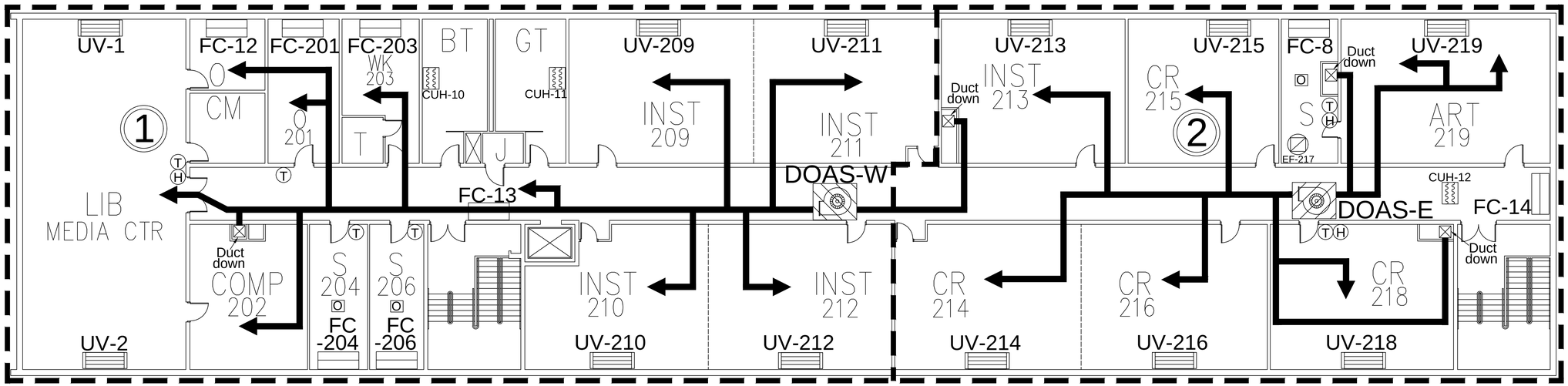
ZONES - AREA SERVED

1 - ADMIN OFFICES, CLASSROOMS
2 - CLASSROOMS
3- GYMNASIUM
4 - STAGE
5 - WEIGHT ROOM
6 - WORKROOM 156
7 - MULTI PURPOSE ROOM
8 - SHOP
9 - INSTRUCTIONAL ROOMS

EQUIPMENT CONTROLLED BY BAS

- DOAS - W; EF - 1, 4, 7, 137, 139; CUH - 1, 2, 3, 4
- DOAS - E; EF - 217; CUH - 5, 6
- RTU - 1A, B, C, D; EF - 8; CUH - 7, 8
- RTU - 3A
- RTU - 4; EF - 6
- RTU - 3B
- RTU - 5; EF - 5
- RTU - 2
- RTU - 6; EF - 2

MAIN HOT WATER SYSTEM SERVES ZONES 1, 2, 9
ACTIVATE CHILLER-1 FOR ZONES 1, 2



SECOND FLOOR PLAN

Project Notes:

1. For all equipment controlled by LVT and/or or wall switch only, remove existing BAS control relay and complete power circuit. Install new EMT conduit and power conductors from the power source to LVT and the unit as necessary to complete the installation.
2. Replace existing 3-way HW mixing valve with new. Replace existing actuator with new spring return electronic actuator.
3. Install VFD hot water pumps P-1 and P-2.
4. Install isolation ball valves for the Hot Water Pump P-1 and P-2 VFD DP transmitter tubes on top of 4" main HW supply HW return lines going to the building in boiler room. Install DP transmitter in boiler room at the indicated location.
5. For all EFs controlled by BAS: keep existing wall switch in place if applicable.
6. Install control panels for Chilled Water System, Hot Water System, RTUs - 2, 5, and 6 at the indicated location.
7. Install control panels for RTUs - 1A, 1B, 1C, 1D, 3A, 3B, and 4 at the indicated location.
8. Connect each RTU and Main Plant Ethernet network controller to a designated FCPS WAN Ethernet port on the drop provided and installed by FCPS adjacent to control panels at the locations indicated herein.
9. Contractor shall make information regarding MAC addresses pertinent to controllers installed within each control panel available within the panel.
10. Integrate Dedicated Outdoor Air Systems (DOAS) E and W into the new BAS via BACnet MS/TP. Provide all the points in the attached points' list within the new BAS. Points shall be named within the new BAS exactly as named by the manufacturer and indicated in Variables column of the list. Create graphics and points per FCPS drawing M-8.
11. All the work during the school year shall be performed after school hours. The start time for evening shifts will vary based on a particular school's release time. Contractor's and subcontractor's personnel shall work weekly 5-day 8-hour schedules. The approval of 4-day 10-hour workweek may be requested in writing to the FCPS project manager, but the approval is not guaranteed.

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PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

QUANDER ROAD CENTER

6400 Quander Rd
Alexandria, VA 22307

DRAWN SM

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DATE 3/19/2024

PROJECT # MMB-064-24

REVISIONS

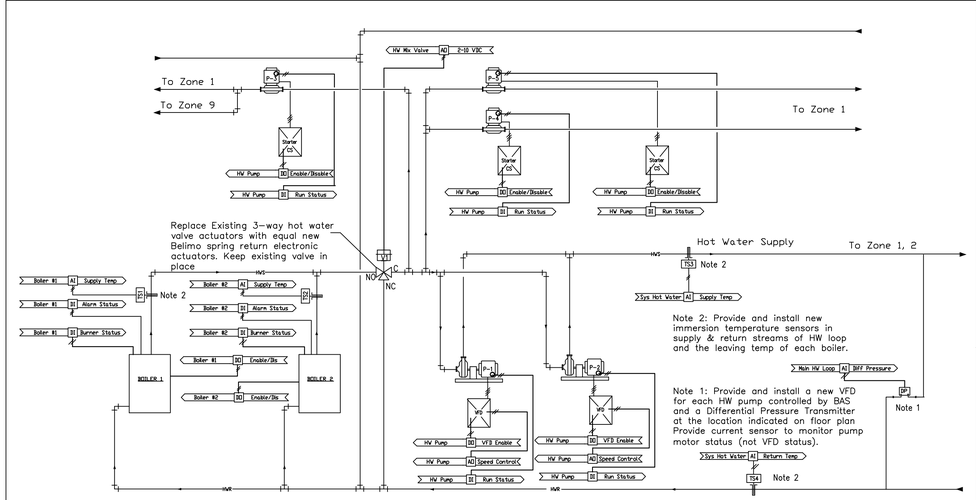
NO.	DATE	DESCRIPTION

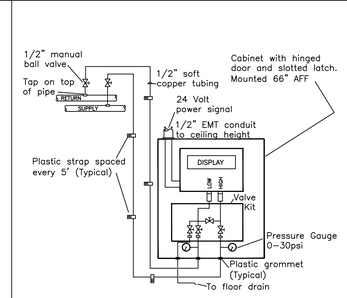
DRAWING TITLE

ZONED FLOOR 2 PLAN AND HVAC LAYOUT

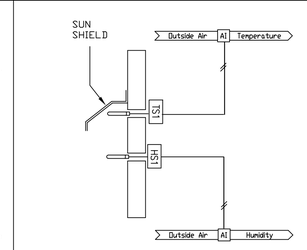
DRAWING NUMBER

M-3



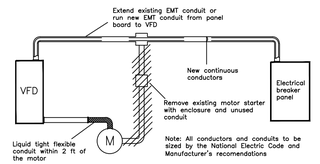


DIFFERENTIAL PRESSURE TRANSDUCER



Outside Air Temperature & Humidity Sensors

Mount sensing elements in a suitable location on north side of building where influences from solar radiation, exhaust or other heat or cool sources will not affect sensor readings.



HOT WATER PUMP VFD POWER WIRING

Central Hot Water Heating System Control Sequence

General: BAS shall control the Central Hot Water Heating System including both Boiler units & both hot water pumps and provide monitoring and diagnostic information for management purposes.

Heating Enable:

1) The Hot Water System shall be enabled when the outside air temperature is below the Heat Lockout setpoint of 56°F (adj.) AND when the average heating demand from the units served by the plant stays above 20% (adj.) continuously for 10 min (adj.).

2) OR anytime the outside air temperature is below the continuous 24/7 run setp of 38°F (adj),

3) OR whenever manually overridden locally on site or remotely from FCPS Energy Management central office by an operator with the appropriate password level.

4) The Hot Water System shall be Disabled when:
a) Average heating demand from the units served by the plant stays below 20% (adj.) continuously for 10 min (adj.) AND the outside air temperature rises above the continuous run OA setpoint plus 2°F.
b) OR the outside air temperature rises above the OA heat lockout setpoint plus 2°F.

HW Pump Control

1) For Pumps 1 and 2:Lead pump shall run continuously whenever heating is enabled. For Pumps 3, 4, and 5: The pump shall run continuously whenever heating is enabled.

2) BAS shall prove operation of the pump. If, after 30 seconds (adj.), the pump fails to start or fails at any time after, the BAS shall generate an alarm. For Pumps 1 and 2, it shall start the lag pump.

3) For Pumps 1 and 2 only: for start up, in order to prevent thermal shock to the boilers, program the VFD to slowly ramp up to full speed over a period of 5 minutes (adj.).

4) For pumps 1 and 2 only: the BAS shall modulate the HW pump VFD via a PID loop to maintain a differential pressure of 10psi (adj.). Adjust the PID loop for smooth modulation to prevent excessive variations in pump speed to maintain setpoint. A separate output start/stop and speed signal from the BAS shall be provided for each pump VFD. A minimum speed of 20Hz shall be programmed into each VFD.

5) The pumps shall continue to run for 3 min. (adj.) after the heating system has been disabled. The pumps shall remain off for at least three minutes before being allowed to restart.

6) The lead/lag pump sequence for Pumps 1 and 2 shall rotate weekly.

7) Log Total Runtime Hours for each pump by monitoring the pump's run status. The Runtime Hours variables shall be operator ressetable

Heating Water Temperature Control

a) BAS shall reset the leaving hot water supply of the 3-way mixing valve to maintain heating water supply as follows:
b) The heating water supply setpoint shall be reset with outdoor air temperature with all values being adjustable. The setpoint shall be reset from 120°F at or above 60°F to 180°F at or below 20°F
1) BAS shall modulate the 3-way mixing valve normally open to boilers. The mixing valve output shall be limited via a ramp restrictor to open and close within adjustable rate limits of 15 minutes for full stroke. N.O. mixing valve shall modulate based on the lower output of the following two loops.
1. Via a direct acting PID loop to maintain hot water temperature at setpoint.
2. Via a direct acting PID loop to maintain hot water minimum return temperature of 110°F (adj.)

Boiler Start Sequence

1) Whenever the Central Heating System is Enabled, the BAS shall Enable the boilers regardless of the status of the hot water pumps.

Boiler Stop Sequence

1) When boilers are no longer needed, the BAS shall Disable the boilers and allow them to stop under their own controls

Proof Of Boiler Operation

a) BAS shall prove the operation of the boilers via boiler alarm points. When a boiler is assessed as failed, an alarm shall be enunciated. The following conditions shall result in the assessment that the boiler has failed:
1) Closure of boiler failure input

Hardwired Points

Universal Inputs (Sensors):

1. Boiler #1 Burner Status
2. Boiler #2 Burner Status
3. Boiler #1 Alarm Status
4. Boiler #2 Alarm Status
5. HW Supply Temperature
6. HW Return Temperature
7. HW Pump P1 Run Status
8. HW Pump P2 Run Status
9. HW Pump P3 Run Status
10. HW Pump P4 Run Status
11. HW Pump P5 Run Status
12. Boiler #1 Supply Temp
13. Boiler #2 Supply Temp
14. Outside Air Temperature
15. Outside Air Humidity
16. Remote HW Diff Pressure Main HW Loop

Digital Outputs (Control):

1. Fail Safe
2. Boiler #1 Enable
3. Boiler #2 Enable
4. HW Pump P1 Start/Stop
5. HW Pump P2 Start/Stop
6. HW Pump P3 Start/Stop
7. HW Pump P4 Start/Stop
8. HW Pump P5 Start/Stop

Analog Outputs (Control):

1. HW Pump P1 VFD Speed Signal
2. HW Pump P2 VFD Speed Signal
3. Main HW 3-Way Valve

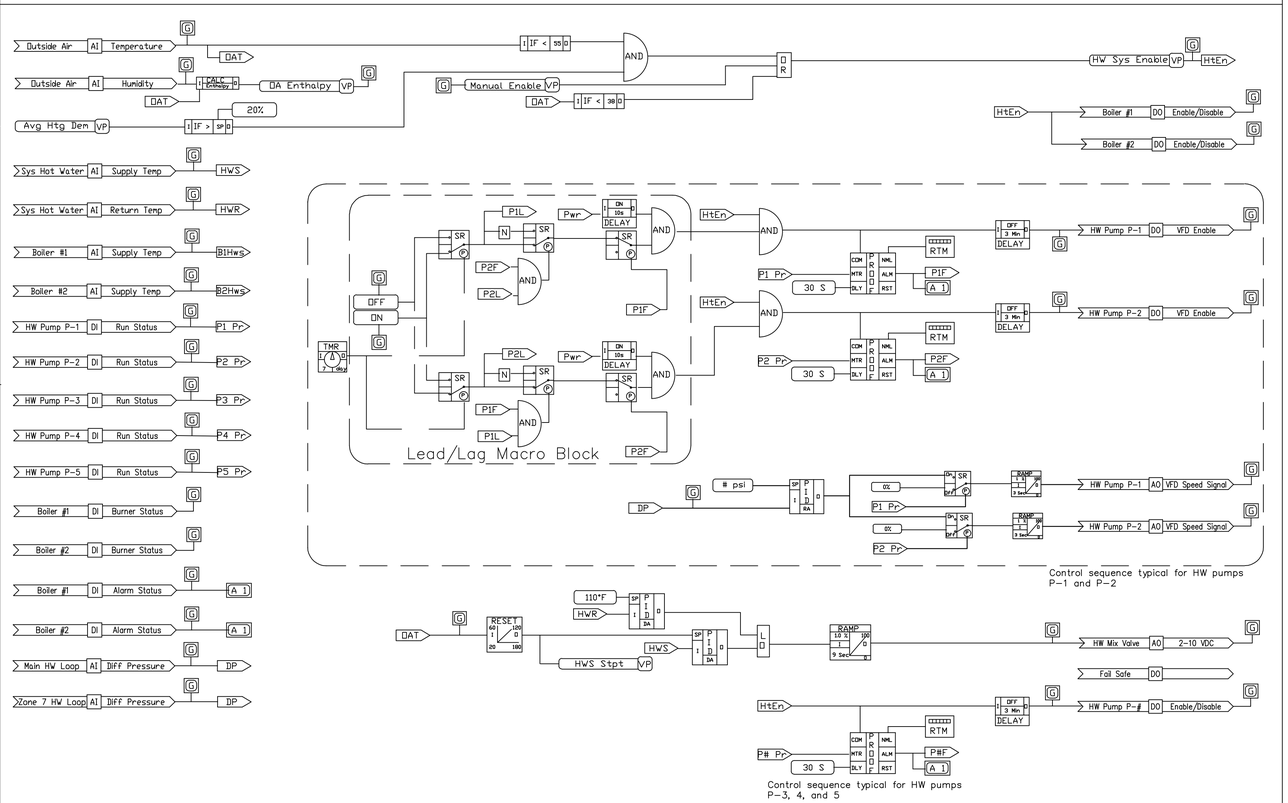
Virtual Points

Program Variables – Binary & Analog

1. Boiler System Enable
2. HW Lead Pump
3. HW Pump P# Fail Flag
4. HW Pump P# Fail Flag
5. HW Low Temp Alarm Setp
6. Outside Air Enthalpy (calculated)
7. OA Htg Continuous Run Setp
8. HW Pump P# Runtime (Hrs)
9. HW Pump P# Runtime (Hrs)
10. HW Diff Press Setp Main Loop
12. Average Heating Demand
13. Average Heating Demand Setpoint
14. OA Heating Lockout Setpoint

Above Points to be Displayed on HW System Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended

FAIL SAFE RELAY: BOLER 1, BOILER 2, AND ALL HOT WATER PUMP ENABLE/DISABLE AT THE EQUIPMENT SHALL BE CONNECTED TO NORMALLY CLOSED TERMINALS OF THE CONTROL RELAYS. THE CONTROL RELAYS' AND THE MAIN THREE-WAY HOT WATER VALVE'S CONTROL POWER SHALL BE WIRED THROUGH A NORMALLY OPEN FAIL SAFE RELAY. THE FAIL SAFE RELAY SHALL BE CONTROLLED BY A NORMALLY OPEN OUTPUT ON THE HOT WATER SYSTEM CONTROLLER. THE FAIL SAFE RELAY SHALL BE CONSTANTLY COMMANDED ON BY THE BAS. BOILERS' AND PUMPS' CONTROL OUTPUTS SHALL BE NORMALLY OPEN.



CENTRAL PLANT HOT WATER HEATING SYSTEM W/ PUMP VFDS

FAIRFAX COUNTY PUBLIC SCHOOLS
OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
TEL.: 703-764-2423

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

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PROJECT # MMB-064-24

REVISIONS

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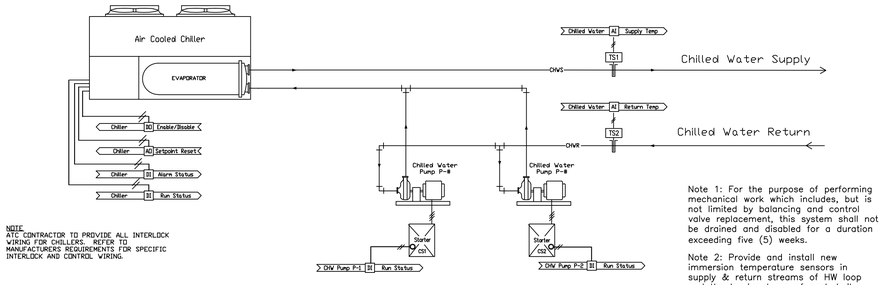
DRAWING TITLE

HOT WATER SYSTEM

DRAWING NUMBER

M-4



NOTE
ATC CONTRACTOR TO PROVIDE ALL INTERLOCK WIRING FOR CHILLERS. REFER TO MANUFACTURERS REQUIREMENTS FOR SPECIFIC INTERLOCK AND CONTROL WIRING.

Note 1: For the purpose of performing mechanical work which includes, but is not limited by balancing and control valve replacement, this system shall not be drained and disabled for a duration exceeding five (5) weeks.

Note 2: Provide and install new immersion temperature sensors in supply & return streams of HW loop and the leaving temp of each boiler.

Air Cooled Chilled Water System Control Sequence

General: BAS shall control the chilled water system which includes the air cooled Chiller and provide monitoring and diagnostic information for management purposes.

Cooling Enable/Disable:

1) The Chilled Water System shall be Enabled when the outside air temperature is above 60°F (adj.) AND the average cooling demand from the units served by the plant stays above 20% (adj.) continuously for 10 min. (adj.)

2) The Chiller System shall be Disabled when the average cooling demand from the units served by the plant stays below 20% (adj.) continuously for 10 min. (adj.) or if the outside air temperature falls 2°F below the OA setpoint .

Chiller Start Sequence

1) On a request for the chilled water system to start, BAS shall Enable the chiller

2) BAS shall monitor the Chiller status and the Chiller panel alarm point and if the alarm point is active, generate a "Chiller Failure" alarm message. Also, the BAS shall monitor CHW Supply Temperature and generate an Alarm if it stays above 60°F (adj.) for at least 20 minutes while chiller is enabled.

Chiller Stop Sequence

1) When the Chiller is no longer needed, the BAS shall remove the Enable command and allow it to stop under its own control. The Chiller must remain off for at least 10 minutes (adj.) before being allowed to restart.

Chilled Water Temperature Control

1) The chilled water temperature shall be controlled by the individual chiller controller.

Log Total Runtime Hours for the chiller and for each Pump. The Runtime Hours variables shall be operator resetable.

Chiller System Hardwired Points

Universal Inputs (Sensors):

1. Chiller Run Status
2. CHW Supply Temperature
3. CHW Return Temperature
4. Chiller Alarm Status
5. CHW Pump P1 Status
6. CHW Pump P2 Status

Digital Outputs (Control):

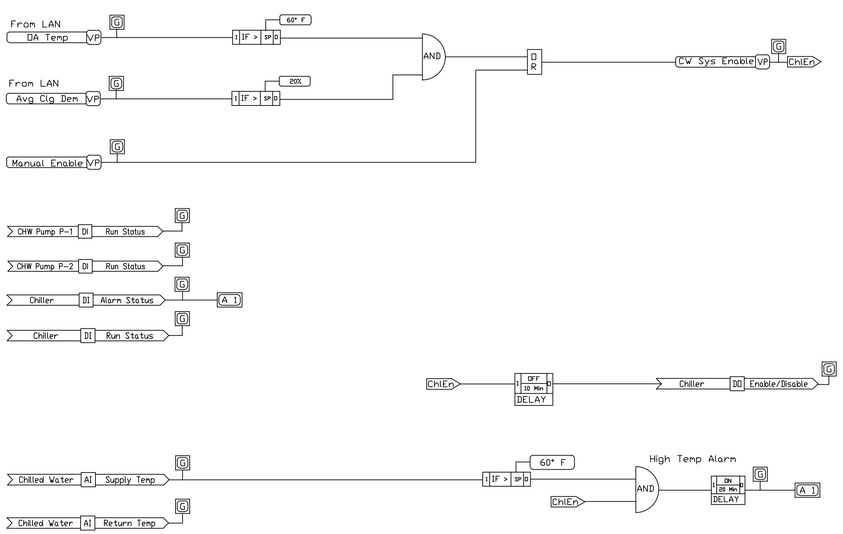
1. Chiller Start/Stop

Virtual Points

Software Flags & Setpoints

1. Chiller System Enable
2. CHW Hi Temp Alarm Setp
3. CHW Hi Temp Alarm Flag
4. CHWP P1 Runtime (Hrs)
5. CHWP P2 Runtime (Hrs)
6. Chiller Runtime Hours
7. Average Cooling Demand
8. Average Cooling Demand Setpoint
9. OA Chiller Enable Setpoint

Above Points to be Displayed on CHW System Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



CHILLER – 1

AIR COOLED CHILLED WATER SYSTEM

FAIRFAX COUNTY PUBLIC SCHOOLS
OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
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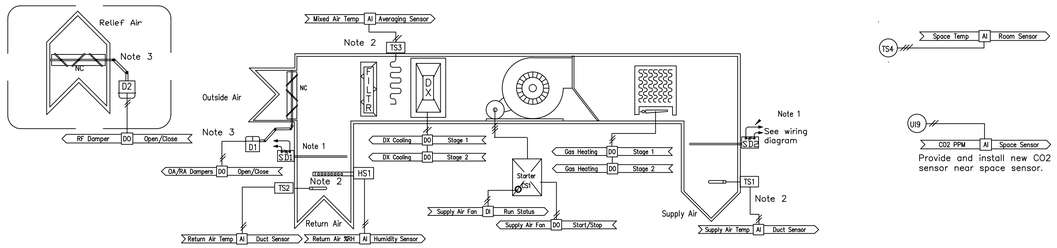
NO.	DATE	DESCRIPTION

DRAWING TITLE

CHILLER-1

DRAWING NUMBER

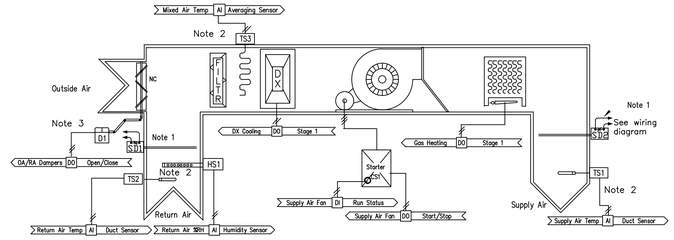
M-5



Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.

Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.

Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off – OA damper closed, DX cooling off & gas heat off.



Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.

Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.

Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off – OA damper closed, DX cooling off & gas heat off.

RTU w/DX, Gas Heat Min OA & CO2 Control Sequence
(This Lead/Lag sequence stages RTUs based on CO2 levels)

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:
a) Scheduled Occupancy
b) Sequenced heating and cooling control
c) Staggered RTU control based on CO2 levels
d) Night (unoccupied) setback

Supply Air Fan Lead/Lag: Lead/Lag shall be rotated weekly. The BAS shall control the starting and stopping of the supply air fans as follows:
1 – During the Occupied period, The lead unit shall be commanded to run continuously. The lag unit shall be activated whenever its respective CO2 sensor reading rises above the CO2 setpoint (1100ppm adj) during the Occupied period otherwise it shall remain off. If the space CO2 falls to 200ppm below the lag unit's respective setpoint, the lag unit shall be deactivated.
2 – BAS shall prove fan operation and use the status indication to accumulate runtime. The BAS shall generate an alarm if the fan fails to start after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active (as well as the alarm) until the unit can be serviced. If the lead unit fails to run the lag unit shall be activated.
3 – The unit fan shall be commanded Off when:
a) the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
b) it is the lag unit and the space CO2 level is below the setpoint during the Occupied period
4 – Once the Fan is shut down it must remain off for at least 3 minutes.
5 – These units may be overridden On or Off via operator command from a remote central location or via BAS controller on site.

Min OA Damper control: BAS shall control OA damper as follows:
1 – When the Unit is de-energized the OA damper shall be commanded to its closed position.
2 – When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
3 – When the unit is energized during during the Occupied period, the OA damper shall be commanded open to its preset minimum position.
4 – The RA damper shall track the OA damper proportionately.
5 – The OA Damper shall close if the mixed air temperature falls below 48F.
6 – The RF Damper shall open if OA damper in any one of the RTUs is commanded open.

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74F), unoccupied setback heating (55F), and unoccupied setup cooling (85F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F.

Heating Section: On a fall in space temperature below the heating setpoint, the BAS shall activate the 1st stage of gas heat. When the temperature rises to above the heating setpoint plus 1F the heat shall de-activate. If the space temp falls to 1F below the heating setpoint the BAS shall activate the 2nd stage of gas heat. On a rise in space temp to above the heating setpoint the 2nd stage heat shall de-activate. There shall be a minimum of five minute intervals between activating and de-activating the heating stages.

Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated. If the temperature rises to above 1F of the cooling setpoint the 2nd stage shall be activated. On a fall in space temp to below the cooling setpoint the 2nd stage shall be de-activated. There shall be a minimum of five minute intervals between activating and de-activating the cooling stages.

Unoccupied Setback: During the Unoccupied period:
1 – Heating and cooling shall be commanded off and the OA damper shall close.
2 – After a two minute delay the supply fan shall be commanded off.
3 – The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

Hardwired Points

Universal Inputs (Sensors):
1. Supply Fan Status
2. Supply Air Temperature
3. Return Air Temperature
4. Mixed Air Temperature
5. Return Air Humidity
6. Space Temperature
7. CO2 Sensor

Digital Outputs (Control):
1. Supply Fan Start/Stop
2. Stage 1 Cooling
3. Stage 2 Cooling
4. Stage 1 Gas Heat
5. Stage 2 Gas Heat
6. OA Damper
7. RF Damper

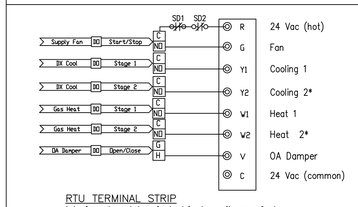
Virtual Points

Software Flags & Setpoints

1. Unit Start Signal
2. Occupied Mode (Sched)
3. Clg Setpoint (74F Adj)
4. Htg Setp (Clg Setp-3)
5. Night Setback (55F Adj)
6. Night Setup (85F Adj)

Analog Outputs (Control):
7. Supply Fan Fail Alarm
8. CO2 Min Setpoint
9. CO2 Max Setpoint
10. Lead RTU

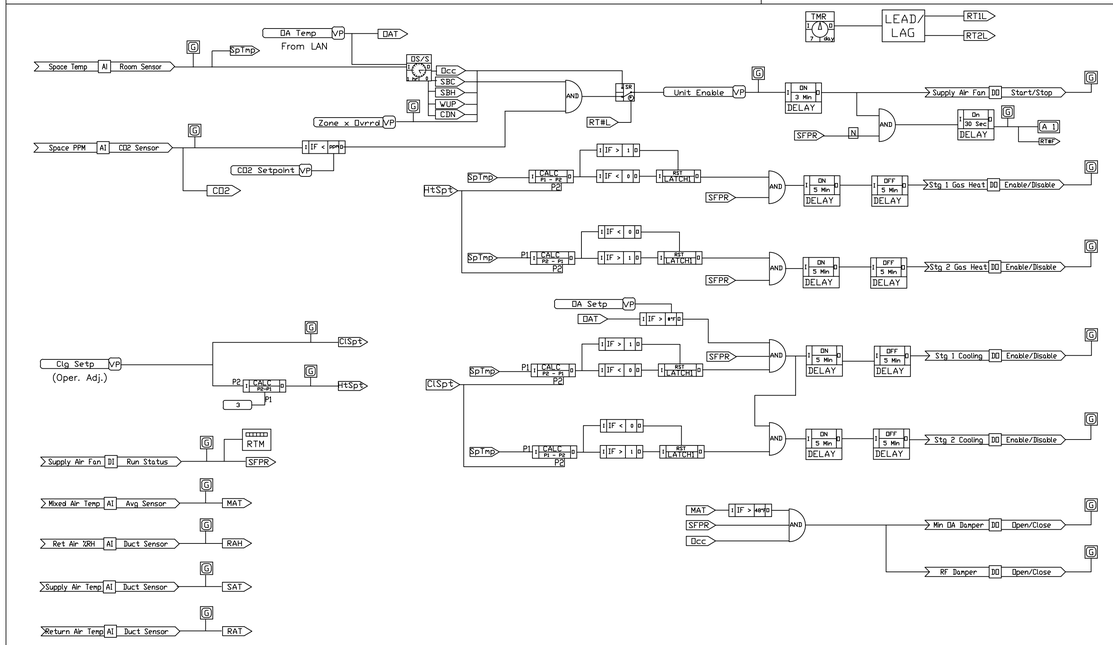
Above Points to be Displayed on RTU Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



RTU TERMINAL STRIP
Interface board terminal strip by unit manufacturer

* Provide number of stages as required

WIRING DIAGRAMS



RTU-1A, 1B, 1C, 1D

ROOFTOP UNIT W /DX CLG/GAS HEAT/MIN OA/CO2

RTU w/DX, Gas Heat Min OA & CO2 Control Sequence

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:
a) Scheduled Occupancy
b) Sequenced heating and cooling control
c) Outside air intake control based on CO2 levels
d) Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:

1 – During the scheduled Occupied period the unit fan shall be commanded to run continuously.
2 – BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
3 – The unit fan shall be commanded Off when:
a) the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
4 – Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
5 – The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Min OA Damper control: BAS shall control OA damper as follows:
1 – When the Unit is de-energized the OA damper shall be commanded to its closed position.
2 – When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
3 – During the occupied period AND when the space CO2 level rises above the setpoint of 500ppm (adj.), the OA damper shall be commanded open to its preset minimum position.
4 – The RA and RF dampers shall track the OA damper proportionately.
5 – The OA Damper shall close if the mixed air temperature falls below 48F.

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74F), unoccupied setback heating (55F), and unoccupied setup cooling (85F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F.

Heating Section: On a fall in space temperature below the heating setpoint, the BAS shall activate the 1st stage of gas heat. When the temperature rises to above the heating setpoint plus 1F the heat shall de-activate.

Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated.

Unoccupied Setback: During the Unoccupied period:
1 – Heating and cooling shall be commanded off and the OA damper shall close.
2 – After a two minute delay the supply fan shall be commanded off.
3 – The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

Hardwired Points

Universal Inputs (Sensors):
1. Supply Fan Status
2. Space Temp
3. Setpoint Adjust
4. Supply Air Temperature
5. Return Air Temperature
6. Mixed Air Temperature
7. Return Air Humidity
8. CO2 Sensor

Digital Outputs (Control):
1. Supply Fan Start/Stop
2. Stage 1 Cooling
3. Stage 1 Gas Heat
4. OA/RA Dampers

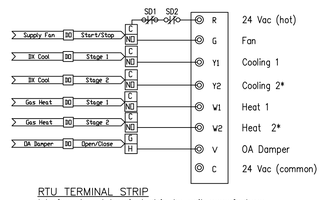
Analog Outputs (Control):

Virtual Points

Software Flags & Setpoints

1. Unit Start Signal
2. Occupied Mode (Sched)
3. Clg Setpoint (74F Adj)
4. Htg Setp (Clg Setp-3)
5. Adjusted Space Setpoint
6. Night Setback (55F Adj)
7. Night Setup (85F Adj)
8. Supply Fan Fail Alarm
9. Damper CO2 Setpoint

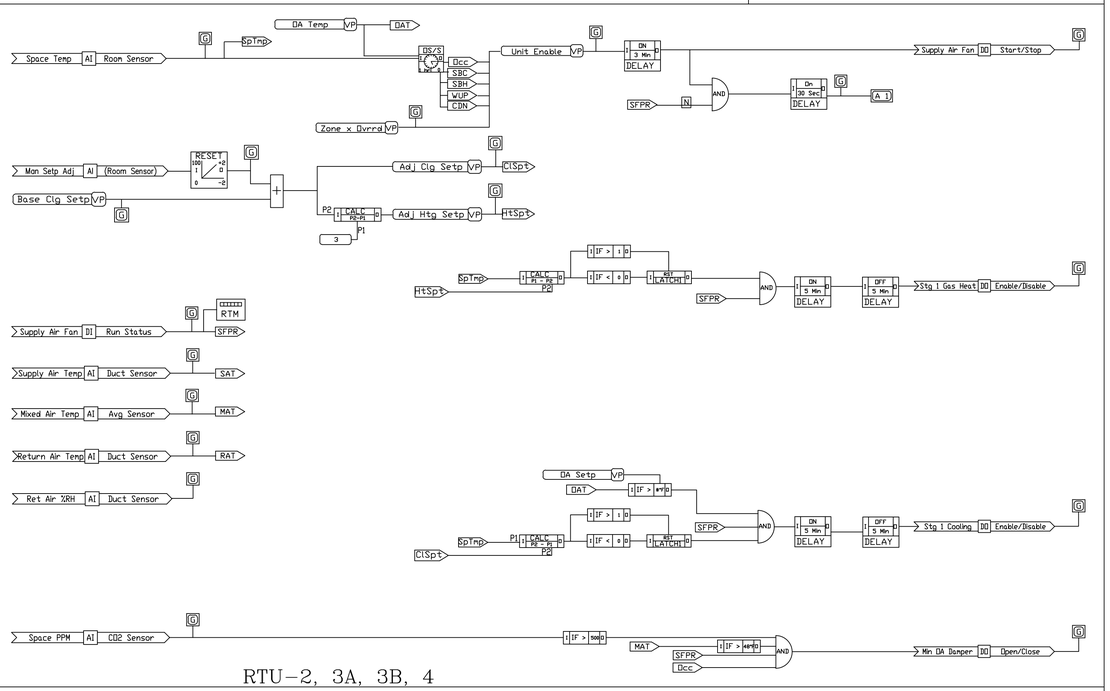
Above Points to be Displayed on RTU Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



RTU TERMINAL STRIP
Interface board terminal strip by unit manufacturer

* Provide number of stages as required

WIRING DIAGRAMS



RTU-2, 3A, 3B, 4

ROOFTOP UNIT W /DX CLG/GAS HEAT/MIN OA/CO2

FAIRFAX COUNTY PUBLIC SCHOOLS

OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
TEL.: 703-764-2423

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

QUANDER ROAD CENTER

6400 Quander Road
Alexandria, VA 22307

DRAWN SM

CHECKED

DATE 3/19/2024

PROJECT # MMB-064-24

REVISIONS

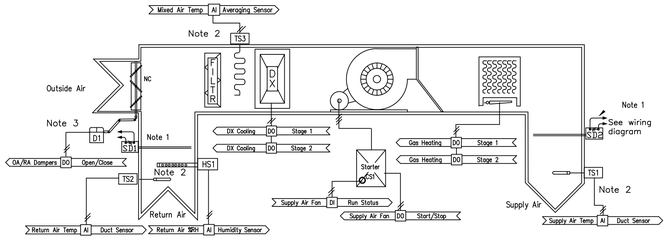
NO.	DATE	DESCRIPTION

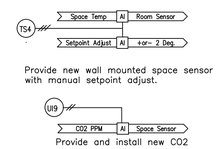
DRAWING TITLE

RTU- 1A, 1B, 1C, 1D, 2, 3A, 3B, 4 CONTROL DIAGRAMS

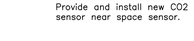
DRAWING NUMBER

M-6





Provide new wall mounted space sensor with manual setpoint adjust.

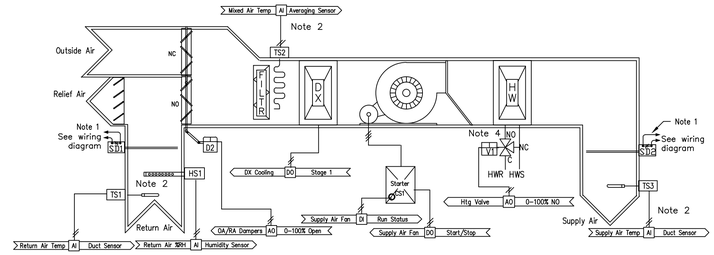


Provide and install new CO2 sensor near space sensor.

Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.

Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.

Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off – OA damper closed, DX cooling off & gas heat off.



Provide new wall mounted space sensor with manual setpoint adjust.

Note 4: Replace existing HW 3-way valve and actuator with new 3-way valve & electronic actuator.

Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.

Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.

Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off – OA damper closed, DX cooling off, etc.

RTU w/DX, Gas Heat Min OA & CO2 Control Sequence

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:
a) Scheduled Occupancy
b) Sequenced heating and cooling control
c) Outside air intake control based on CO2 levels
d) Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:

1 – During the scheduled Occupied period the unit fan shall be commanded to run continuously.
2 – BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
3 – The unit fan shall be commanded Off when:
a) the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
4 – Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
5 – The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Min OA Damper control: BAS shall control OA damper as follows:
1 – When the Unit is de-energized the OA damper shall be commanded to its closed position.
2 – When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
3 – During the occupied period AND when the space CO2 level rises above the setpoint of 500ppm (adj.), the OA damper shall be commanded open to its preset minimum position.
4 – The RA and RF dampers shall track the OA damper proportionately.
5 – The OA Damper shall close if the mixed air temperature falls below 48F.

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74F), unoccupied setback heating (55F), and unoccupied setup cooling (85F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F.

Heating Section: On a fall in space temperature below the heating setpoint, the BAS shall activate the 1st stage of gas heat. When the temperature rises to above the heating setpoint plus 1F the heat shall de-activate. If the space temp falls to 1F below the heating setpoint the BAS shall activate the 2nd stage of gas heat. On a rise in space temp to above the heating setpoint the 2nd stage heat shall de-activate. There shall be a minimum of five minute intervals between activating and de-activating the heating stages.

Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated. If the temperature rises to above 1F of the cooling setpoint the 2nd stage shall be activated. On a fall in space temp to below the cooling setpoint the 2nd stage shall be de-activated. There shall be a minimum of five minute intervals between activating and de-activating the cooling stages.

Unoccupied Setback: During the Unoccupied period:
1 – Heating and cooling shall be commanded off and the OA damper shall close.
2 – After a two minute delay the supply fan shall be commanded off.
3 – The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

Hardwired Points

Universal Inputs (Sensors):
1. Supply Fan Status
2. Space Temp
3. Setpoint Adjust
4. Supply Air Temperature
5. Return Air Temperature
6. Mixed Air Temperature
7. Return Air Humidity
8. CO2 Sensor

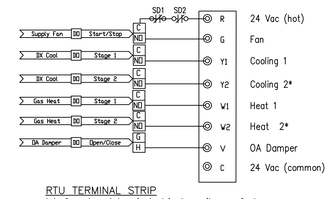
Digital Outputs (Control):
1. Supply Fan Start/Stop
2. Stage 1 Cooling
3. Stage 2 Cooling
4. Stage 1 Gas Heat
5. Stage 2 Gas Heat
6. OA Damper

Analog Outputs (Control):

Virtual Points

Software Flags & Setpoints
1. Unit Start Signal
2. Occupied Mode (Sched)
3. Clg Setpoint (74F Adj)
4. Htg Setp (Clg Setp–3)
5. Adjusted Space Setpoint
6. Night Setback (55F Adj)
7. Night Setup (85F Adj)
7. Supply Fan Fail Alarm
8. CO2 Min Setpoint
9. CO2 Max Setpoint

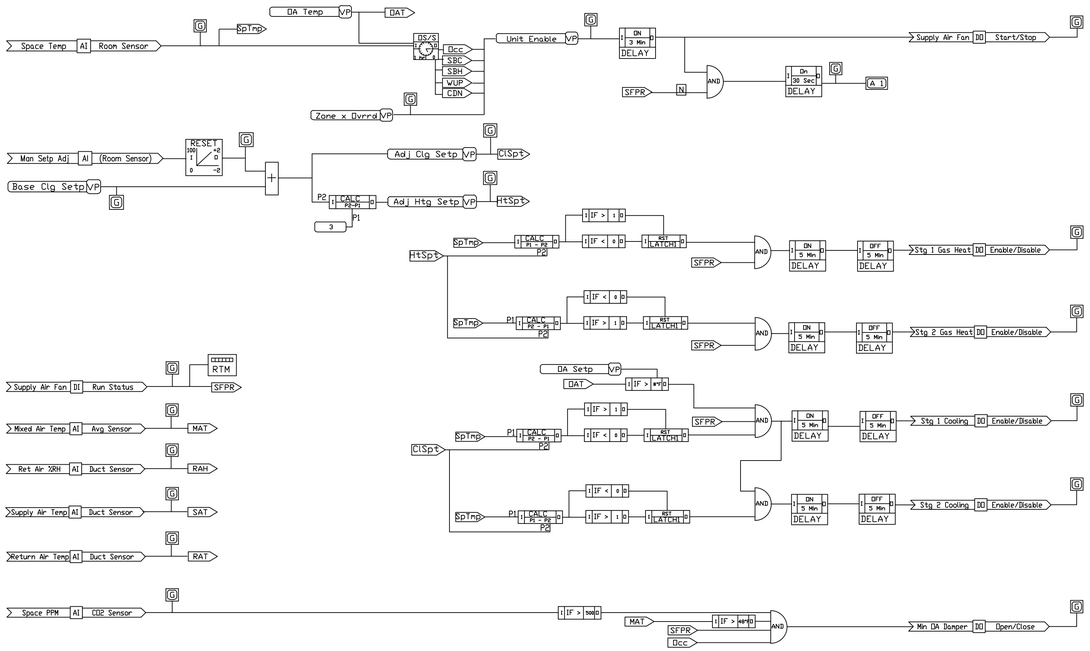
Above Points to be Displayed on RTU Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



RTU TERMINAL STRIP
Interface board terminal strip by unit manufacturer

* Provide number of stages as required

WIRING DIAGRAMS



RTU–5

ROOFTOP UNIT W /DX CLG/GAS HEAT/MIN OA/CO2

RTU w/DX, Gas Heat Economizer Control Sequence

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:
a) Scheduled Occupancy
b) Sequenced heating and cooling control
c) Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:

1 – During the scheduled Occupied period the unit fan shall be commanded to run continuously.
2 – BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
3 – The unit fan shall be commanded Off when:
a) the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
4 – Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
5 – The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Mixed Air Dampers: BAS shall control OA damper as follows:
1 – When the Unit is de-energized the OA damper shall be commanded to its closed position.
2 – When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
3 – During the occupied period, the OA damper shall be commanded open to its design minimum position (ref. AHU/RTU Data Dwg M–1).
4 – On a call for Cooling and enthalpy conditions allow, the OA damper shall be modulated open as needed to satisfy cooling needs (ref. Economizer section).
5 – The RA and RF dampers shall track the OA damper proportionately.
6 – The OA Damper shall close if the mixed air temperature falls below 48F.

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74F), unoccupied setback heating (55F) and unoccupied setup cooling (85F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F.

Heating Section: N.O. heating valve shall modulate simultaneously in a PID loop to maintain applicable space temperature setpoints within a 2F throttling range. No other control loops except those indicated on the logic diagram shall control the valve. In heating mode, the BAS shall maintain the supply air temperature no less than 52F (Adj.).

Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated. If the temperature rises to above 1F of the cooling setpoint the 2nd stage shall be activated. On a fall in space temp to below the cooling setpoint the 2nd stage shall be de-activated. There shall be a minimum of five minute intervals between activating and de-activating the cooling stages.

Economizer Section: On a call for Cooling And if the OA Enthalpy is less than 28 btu/lb (adj.) And the OA Enthalpy is less than the unit's RA Enthalpy, the OA damper shall be modulated open to maintain a mixed air temp setpoint of 52F based on the needs of the space but not lower than 48F.

Unoccupied Setback: During the Unoccupied period:
1 – Heating and cooling shall be commanded off and the OA damper shall close.
2 – After a two minute delay the supply fan shall be commanded off.
3 – The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

Hardwired Points

Universal Inputs (Sensors):
1. Supply Fan Status
2. Space Temp
3. Setpoint Adjust
4. Supply Air Temperature
5. Return Air Temperature
6. Mixed Air Temperature
7. Return Air Humidity

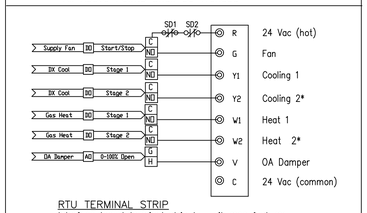
Digital Outputs (Control):
1. Supply Fan Start/Stop
2. Stage 1 Cooling

Analog Outputs (Control):
1. OA/RA Dampers
2. DHC–1 Hot Water Valve

Virtual Points

Software Flags & Setpoints
1. Unit Start Signal
2. Occupied Mode (Sched)
3. Clg Setpoint (74F Adj)
4. Htg Setp (Clg Setp–3)
5. Adjusted Space Setpoint
6. Night Setback (55F Adj)
7. Night Setup (85F Adj)
7. Supply Fan Fail Alarm

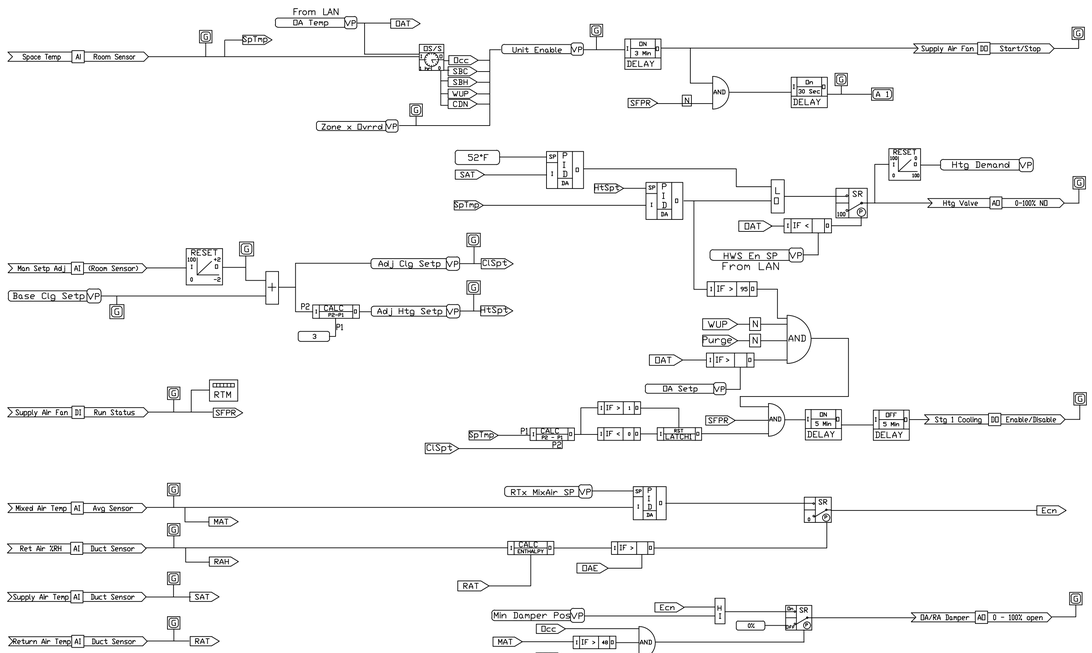
Above Points to be Displayed on RTU Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



RTU TERMINAL STRIP
Interface board terminal strip by unit manufacturer

* Provide number of stages as required

WIRING DIAGRAMS



RTU–6

ROOFTOP UNIT W /DX CLG/HYDRONIC HEAT/ECONOMIZER

FAIRFAX COUNTY PUBLIC SCHOOLS
OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
TEL.: 703-764-2423

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

QUANDER ROAD CENTER

6400 Quander Road Alexandria, VA 22307

DRAWN SM

CHECKED

DATE 3/19/2024

PROJECT # MMB-064-24

REVISIONS

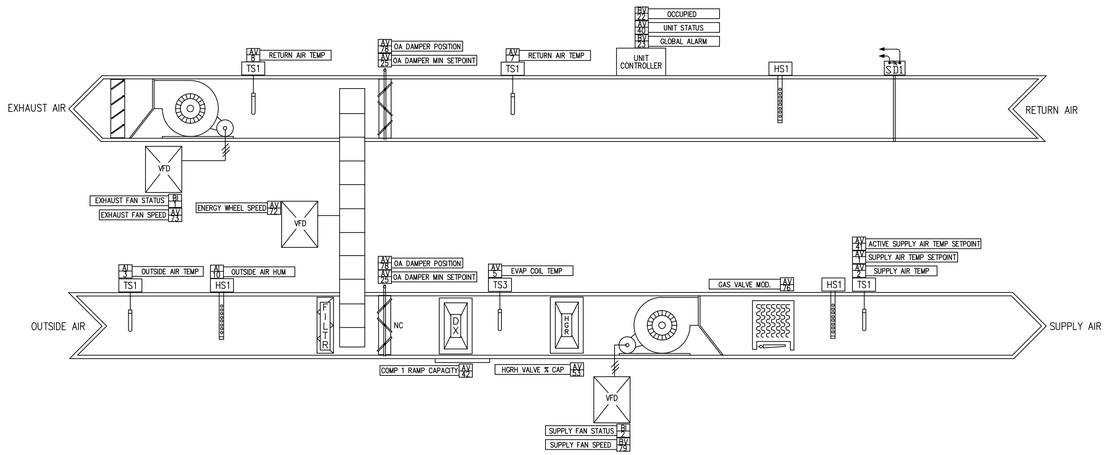
NO.	DATE	DESCRIPTION

DRAWING TITLE

RTU- 5, 6 CONTROL DIAGRAMS

DRAWING NUMBER

M-7



DOAS-E, W

DEDICATED OUTDOOR AIR SYSTEM W /DX CLG/GAS HEAT/HOT GAS REHEAT

DOAS w/ DX Cool/Gas Heat

Except for the Occupancy command, all the functions of the unit will be controlled by the logic embedded in the factory installed controller.

Unit Enable: The BAS shall change the occupancy mode of this unit via a physical Occupancy input based on the corresponding zone Occupancy schedule.

Hardwired Points

Digital Outputs (Control):

1. Occupied command

Virtual Points

BACnet virtual points shall be as per point list included in contract

Above Points to be Displayed on Unit's Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended

FAIRFAX COUNTY PUBLIC SCHOOLS

OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
TEL.: 703-764-2423

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

QUANDER ROAD CENTER

6400 Quander Road,
Alexandria, VA 22307

DRAWN SM

CHECKED

DATE 3/19/2024

PROJECT # MMB-064-24

REVISIONS

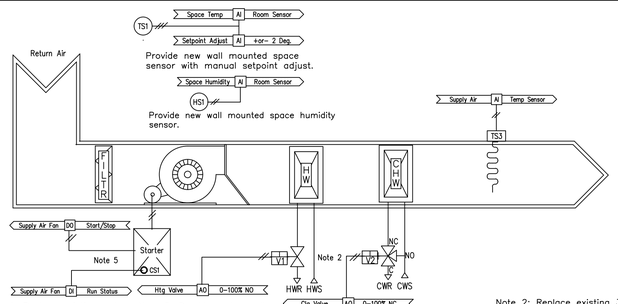
NO.	DATE	DESCRIPTION

DRAWING TITLE

DOAS- E, W CONTROL DIAGRAMS

DRAWING NUMBER

M-8

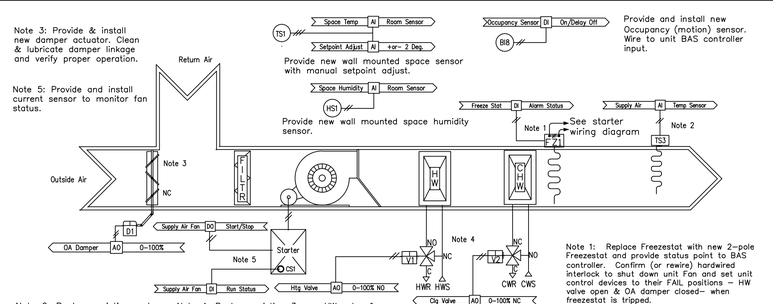


Note 4: Replace existing water balancing valve with new Victaulic (Tour & Andersson) series 786 balancing valve. Replace supply side isolation valve with new.

Note 3: Provide and install current sensor to monitor fan status.

Note 1: Provide and install sensor centrally mounted on CHW coil to monitor discharge air temp

Note 2: Replace existing 3-way HW valve & actuator with new normally open 2-way valve and electronic actuator. Remove bypass pipe, blank off tee & open associated balance valves. Replace existing CHW valve & actuator with new 3-way valve and electronic actuator .



Note 6: Replace existing water balancing valve with new Victaulic (Tour & Andersson) series 786 balancing valve. Replace supply side isolation valve with new.

Note 4: Replace existing 3-way HW valve & actuator with new normally open 3-way valve and electronic actuator. Replace existing CHW valve & actuator with new 3-way valve and electronic actuator.

Note 2: Provide and install sensor centrally mounted on CHW coil to monitor discharge air temp

Note 1: Replace Freezestat with new 2-pole Freezestat and provide status point to BAS controller. Confirm (or rewire) hardwired interlock to shut down unit Fan and set unit control devices to their FAIL positions - HW valve open & OA damper closed- when freezestat is tripped.

Do NOT hardwire unit fan status to "Fail" valve actuators. These are to remain under BAS control when Fan is commanded Off.

Unit Vent & FCU w/HW/CHW Coils

General: Each unit will have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:
a) Scheduled occupancy
b) Sequenced heating and cooling control
c) Night (unoccupied) Setback

Supply Air Fan: The BAS shall control the starting and stopping of the supply air fan as follows:
1 – The unit fan shall run continuously during the scheduled Occupied period (Or the zone override is active)
2 – BAS shall prove fan operation and use the status indication to accumulate runtime. The BAS shall generate an Alarm if the fan fails to start after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active (as well as the Alarm) until the unit can be serviced and the Alarm is acknowledged.
3 – The unit fan shall be commanded Off when:
a) the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints.
4 – Once the Fan is shut down it must remain off for at least 2 minutes.
5 – The unit may be overridden On or Off via operator command from a remote central location.

Space Temperature Control: Control space temperature by modulating the heating & cooling on the Unit as needed. The space temperature setpoints shall be as follows:
Two operator adjustable setpoints shall apply. Occupied Cooling (74F), setback heating (55F), and setup cooling (85F). These values shall be changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F. The actual Occupied setpoints shall be offset +or- 2F by a manual adjuster on the room sensor.

Valves: N.C. cooling and N.O. heating valves shall modulate in a cooling or heating PI loop respectively to maintain applicable space temperature setpoints within a 2F throttling range. No other control loops except those indicated on the logic diagram shall control the valve.

Unoccupied Setback: During the (scheduled) UnOccupied period the HW Valve shall close. If, during this period, the space temperature falls below the night setback setpoint, the unit fan shall run with the HW valve fully open until the space temp rises to at least 2F above the NSB setpoint.

Unoccupied Setup: During the (scheduled) Unoccupied period the CHWV shall close. If, during this period, the space temperature rises above the night setup setpoint, the unit fan shall run with the CHW valve fully open until the space temp drops to at least 1F below the NSU setpoint.

Hardwired Points

Universal Inputs (Sensors):
1. Space Temperature
2. Setpoint Adjust
3. Supply Air Temp
4. Fan Status
5. Space Humidity

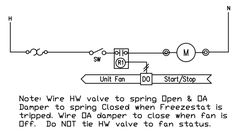
Digital Outputs (Control):
1. Supply Fan Start/Stop

Analog Outputs (Control):
1. Hot Water Valve
2. Chilled Water Valve

Virtual Points

Software Flags & Setpoints
1. Unit Start Signal
2. Occupied
3. Cooling Setp (74F Adj)
4. Heating Setp (Clg Setp – 3)
5. Adjusted Space Setpoint
6. Night Setback (55F Adj)
7. Night Setup (85F Adj)
8. Heat/Cool Mode

Above Points to be Displayed on Unit Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



Note: Wire HW valve to spring Open & DA Damper to spring Closed when Freezestat is tripped. Wire DA damper to close when fan is OFF. Do NOT tie HW valve to fan status.

Unit Fan & Actuators

WIRING DIAGRAMS

Unit Vent & FCU w/HW/CHW Coils

General: Each unit will have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:
a) Scheduled occupancy
b) Sequenced heating and cooling control
c) Night (unoccupied) Setback
d) Outdoor air intake control based on occupancy

Supply Air Fan: The BAS shall control the starting and stopping of the supply air fan as follows:
1 – The unit fan shall run continuously during the scheduled Occupied period (Or the zone override is active)
2 – BAS shall prove fan operation and use the status indication to accumulate runtime. The BAS shall generate an Alarm if the fan fails to start after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active (as well as the Alarm) until the unit can be serviced and the Alarm is acknowledged.
3 – The unit fan shall be commanded Off when:
a) the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints.
4 – Once the Fan is shut down it must remain off for at least 2 minutes.
5 – The unit may be overridden On or Off via operator command from a remote central location.

Outside Air Damper BAS shall control the Outside Air (OA) Damper as follows:
1 – When the Unit is de-energized, the OA Damper shall remain in its closed position.
2 – When the Unit is energized for Night Setback, the OA damper shall remain closed.
3 – When the zone is in scheduled Occupied, the Occupancy sensor is active, and the supply air temperature is higher than 46F the BAS shall open the OA Damper to a preset minimum position determined by air balancer.

Space Temperature Control: Control space temperature by modulating the heating & cooling on the Unit as needed. The space temperature setpoints shall be as follows:
Two operator adjustable setpoints shall apply. Occupied Cooling (74F), setback heating (55F), and setup cooling (85F). These values shall be changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F. The actual Occupied setpoints shall be offset +or- 2F by a manual adjuster on the room sensor.

Valves: N.C. cooling and N.O. heating valves shall modulate in a cooling or heating PI loop respectively to maintain applicable space temperature setpoints within a 2F throttling range. No other control loops except those indicated on the logic diagram shall control the valve. In heating mode, the BAS shall maintain the supply air temperature no less than 46F.

Unoccupied Setback: During the (scheduled) UnOccupied period the HW Valve shall close. If, during this period, the space temperature falls below the night setback setpoint, the unit fan shall run with the HW valve fully open until the space temp rises to at least 2F above the NSB setpoint.

Unoccupied Setup: During the (scheduled) Unoccupied period the CHWV shall close. If, during this period, the space temperature rises above the night setup setpoint, the unit fan shall run with the CHW valve fully open until the space temp drops to at least 1F below the NSU setpoint.

Hardwired Points

Universal Inputs (Sensors):
1. Space Temperature
2. Setpoint Adjust
3. Supply Air Temp
4. Freeze Stat
5. Occupancy Sensor
6. Fan Status
7. Space Humidity

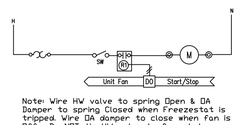
Digital Outputs (Control):
1. Supply Fan Start/Stop

Analog Outputs (Control):
1. Hot Water Valve
2. Chilled Water Valve
3. OA Damper Control

Virtual Points

Software Flags & Setpoints
1. Unit Start Signal
2. Occupied
3. Cooling Setp (74F Adj)
4. Heating Setp (Clg Setp – 3)
5. Adjusted Space Setpoint
7. Night Setback (55F Adj)
8. Night Setup (85F Adj)
9. Heat/Cool Mode

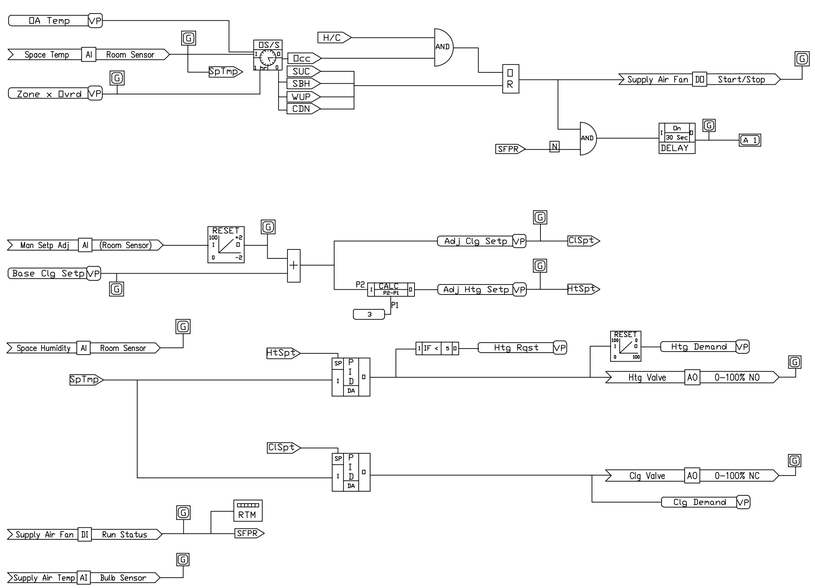
Above Points to be Displayed on Unit Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



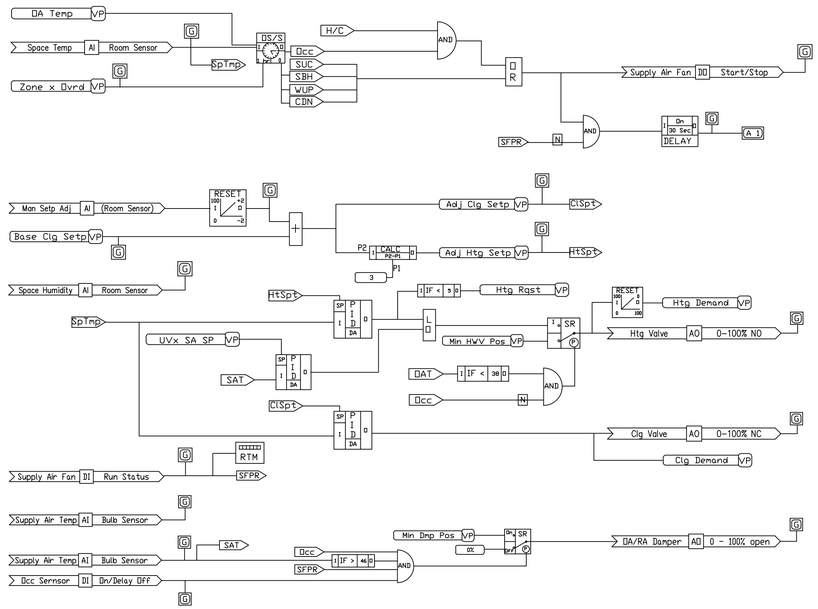
Note: Wire HW valve to spring Open & DA Damper to spring Closed when Freezestat is tripped. Wire DA damper to close when fan is OFF. Do NOT tie HW valve to fan status.

Unit Fan & Actuators

WIRING DIAGRAMS



UVS & FCU W/ HOT/CHILLED WATER



UV-105, 149

UVS & FCU W/ HOT/CHILLED WATER

FAIRFAX COUNTY PUBLIC SCHOOLS
OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
TEL.: 703-764-2423

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

QUANDER ROAD CENTER

6400 Quander Rd
Alexandria, VA 22307

DRAWN SM

CHECKED

DATE 3/19/2024

PROJECT # MMB-064-24

REVISIONS

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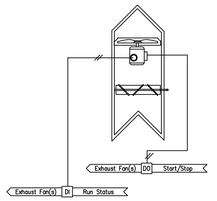
DRAWING TITLE

UV, FCU CONTROL DIAGRAMS

DRAWING NUMBER

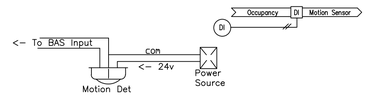
M-9

Typical PRV/Exh Fan



Activate exhaust fans to run during Occupied period.

Provide run status for all exhaust fans controlled by BAS



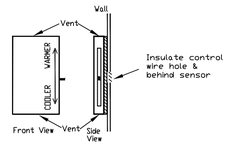
Motion (Occupancy) Sensor:

Provide Passive Infrared (PIR) motion sensor and ceiling mount in approximate center of room.

Set internal timer for 20 minutes. Timer will be reset whenever motion is detected sending an Occupancy signal to BAS controller.

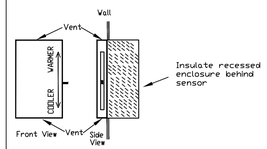
If no motion is detected continuously for 20 minutes, the BAS controller shall respond as specified.

Wall Mounted Vented Cover for Space Sensor

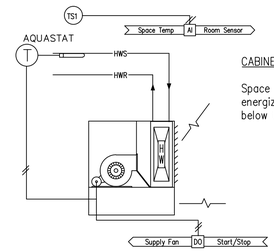


Wall Mounted

Sensor cover should be sufficiently vented to allow room air to freely flow over sensor.



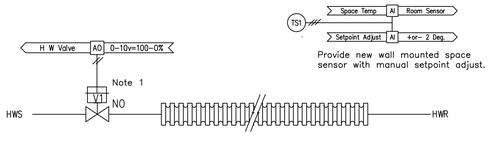
Recessed Enclosure Mounted



CABINET UNIT HEATERS

Space Temperature Control: Fan shall be energized when the space temperature falls below the thermostat setpoint.

Finned Tube Radiator (FTR)

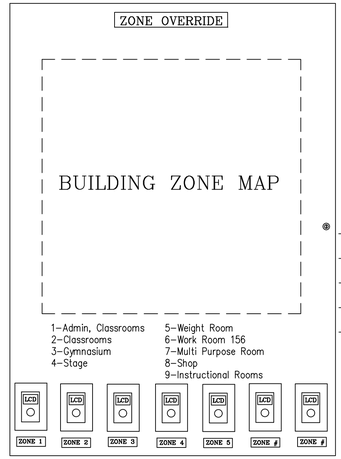


Provide new wall mounted space sensor with manual setpoint adjust.

Space Temperature Control: normally open heating valve shall modulate in a PI loop to maintain space temperature setpoint within a 2°F throttling range.

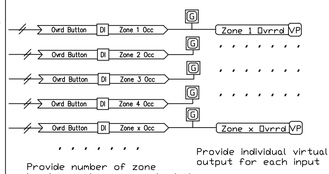
Note 1: Replace existing 2-way HW valve and actuator with new valve and electronic spring return actuator.

ZONE OVERRIDE



ZONES - AREA SERVED

1 - ADMIN OFFICES, CLASSROOMS
2 - CLASSROOMS
3 - GYMNASIUM
4 - STAGE
5 - WEIGHT ROOM
6 - WORKROOM 156
7 - MULTI PURPOSE ROOM
8 - SHOP
9 - INSTRUCTIONAL ROOM



Provide number of zone inputs as shown on mechanical control zone diagram

Provide individual virtual output for each input

OVERRIDE PANEL

General: Provide override panel for manual override of HVAC systems by zone. Location of panel to be determined by FCPS. Panel shall have hinged cover with color coded graphic of building floor plan displaying HVAC control zones and zone descriptions. Face mount momentary contact push buttons along bottom of panel as shown. Provide nameplates designating zones for each override timer.

Override Push Buttons shall be digital time switch with LCD display (Wattstopper TS-400-24), and shall be programmed to provide two hours overtime use when pushed. Zones shall be defined by the Control Zone Diagrams as shown on these control drawings. Upon activation of the zone timer, BAS shall place all HVAC equipment located in the applicable zone into the occupied mode. Whenever the override button is pushed while in the active mode, the timer shall be reset to zero and the zone override run request removed.

Reports: The BAS shall log all override data and be made available in a report via operator command.

Global Override Disable Point: Provide an override disable point embedded in the program code which will disable all zone overrides at the same time.

TYPICAL OVERRIDE PANEL

FAIRFAX COUNTY PUBLIC SCHOOLS

OFFICE OF FACILITIES MANAGEMENT
5025 SIDEBURN ROAD
FAIRFAX, VIRGINIA 22032-2637
TEL.: 703-764-2423

PROJECT TITLE

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REVISIONS

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DRAWING TITLE

MISC CONTROL DIAGRAMS

DRAWING NUMBER

M-10

DDC FUNCTION BLOCK LOGIC SYMBOLS

SYMBOL	DESCRIPTION
POINT NAME AO ADDRESS	OUTPUT POINT - TRANSMITS A VALUE FROM THE FB TO A PHYSICAL OUTPUT CHANNEL ON THE CONTROLLER. DESCRIPTOR - CONTROLLER ADDRESS, POINTNAME AND POINT TYPE AI - ANALOG OUTPUT DO - DIGITAL OUTPUT
ADDRESS AI POINT NAME	INPUT POINT - READS A VALUE FROM A PHYSICAL INPUT ON THE CONTROLLER AND CONVERTS FOR USE INSIDE THE FB. DESCRIPTOR - CONTROLLER ADDRESS, POINTNAME AND POINT TYPE AI - ANALOG INPUT DI - DIGITAL INPUT
POINT-NAME VP	VIRTUAL POINT - ANALOG OR DIGITAL VALUE USED WITHIN A FB OR BROADCAST ACROSS THE LAN.
	DIGITAL WIRE - DIGITAL LOGIC CONNECTION BETWEEN FB'S
	ANALOG WIRE - ANALOG LOGIC CONNECTION BETWEEN FB'S
CONST	CONSTANT - CONSTANT VALUE INPUTS
G	GRAPHIC INTERFACE - VALUE APPEARS ON GRAPHIC SCREEN
A#	ALARM & PRIORITY - TRANSMITS AN ALARM AND ALARM PRIORITY TO APPROPRIATE DEVICES.
M#	MESSAGE AND NUMBER - TRANSMITS A MESSAGE AND MESSAGE NUMBER TO APPROPRIATE DEVICES.
T	TREND - ESTABLISHES TREND IN CONTROLLER.
RTM	RUN TIME MONITOR - ACCUMULATES RUNTIME FOR DIGITAL OUTPUT AND CONVERTS TIME TO HOURS.
REF#	REFERENCE FLAG - USED AS CONNECTION TO FB'S BY REFERENCE INSTEAD OF WIRES.
AND	DIGITAL AND GATE- OUTPUT IS ON IF ALL INPUTS ARE TRUE
OR	DIGITAL OR GATE - OUTPUT IS ON IF ANY INPUT IS TRUE.
XOR	DIGITAL EXCLUSIVE OR GATE - OUTPUT IS ON IF ONLY ONE INPUT IS TRUE.
N	INVERSE (NOT)- IF INPUT = ON, OUTPUT = OFF; CONVERSELY IF INPUT =OFF, OUTPUT =ON
RST LATCHO	LATCH OFF- OUTPUT IS OFF WHENEVER INPUT IS ON. OUTPUT REMAINS OFF UNTIL RESET CHANGES FROM OFF TO ON.
RST LATCHT	LATCH ON- OUTPUT IS ON WHENEVER INPUT IS ON. OUTPUT REMAINS ON UNTIL RESET CHANGES FROM OFF TO ON.
ON/OFF DELAY	ON/OFF DELAY TIMER- AFTER INPUT IS ON, OUTPUT IS ON/OFF AFTER A PREDETERMINED TIME (#) HAS ELAPSED.
CYCLE DELAY	CYCLE DELAY TIMER - WHEN SET TIME HAS ELAPSED, THE FIRST TIME INPUT IS ON, OUTPUT IS ON AND TIMER RESETS. BEFORE SET TIME HAS ELAPSED, OUTPUT IS OFF WHEN INPUT IS OFF. IF INPUT GOES FROM OFF TO ON BEFORE SET TIME HAS ELAPSED, OUTPUT WILL REMAIN OFF.
PWR	POWER FLAG - ON WHEN CONTROLLER IS INITIALLY POWERED ON AND NO PHASE LOSS IS DETECTED
R FF	FLIP FLOP - CHANGE STATE OF OUTPUT WHEN INPUT CHANGES FROM OFF TO ON. OUTPUT SET TO OFF WHEN RESET (R) GOES CHANGES FROM OFF TO ON
OPTIMUM (DB, HI, I, O, INC, LO)	SETPOINT OPTIMIZATION - RESET OF OUTPUT FROM A MAXIMUM VALUE TO A MINIMUM VALUE BASED ON VALUES OR REQUESTS) DB - DEAD BAND INC - INCREMENT/DECREMENT VALUE HI - MAXIMUM RESET VALUE LO - MINIMUM RESET VALUE
SP, INTVL, MX, >, +100+10, I, S & B, O, <, -100-10, MN	SAMPLE & BUMP - CHANGE IN OUTPUT (WITH DEFINED MINIMUM & MAXIMUM VALUES) BY A DEFINED AMOUNT WHEN INPUT DEVIATES FROM SETPOINT (SP) BY A DEFINED AMOUNT AT A DEFINED INTERVAL. I - INPUT O - OUTPUT MX - MAXIMUM OUTPUT MN - MINIMUM OUTPUT INTVL - INTERVAL > +IE, +DA - WHEN INPUT RISES ABOVE SETPOINT BY AMOUNT '+IE', OUTPUT IS INCREASED BY AMOUNT '+DA' < -IE, -DA - WHEN INPUT FALLS BELOW SETPOINT BY AMOUNT '-IE', OUTPUT IS REDUCED BY AMOUNT '-DA'

SYMBOL	DESCRIPTION
SP I PID O DA	PID CONTROLLER - PROPORTIONAL, INTEGRAL, DERIVATIVE LOOPS USE STANDARD ALGORITHMS TO CALCULATE AN OUTPUT BASED ON A VARIABLE INPUT. PROPORTIONAL IS BASED ON THE DIFFERENCE BETWEEN THE INPUT AND THE SETPOINT. INTEGRAL IS BASED ON THE THE TIME THE INPUT DEVIATES FROM THE SETPOINT. DERIVATIVE IS BASED ON THE THE RATE THE INPUT IS APPROACHING THE SETPOINT. THE PID CAN BE EITHER DIRECT ACTING (DA) OR REVERSE ACTING (RA). IN A DA PID WHEN THE INPUT INCREASES THE OUTPUT INCREASES. IN A RA PID WHEN THE INPUT INCREASES THE OUTPUT DECREASES.
SP I FLTG INC DEC DA	FLOATING CONTROLLER - OUTPUT WILL INCREASE OR DECREASE INCREMENTALLY AS INPUT DEVIATES FROM SETPOINT. IN A DA CONTROLLER WHEN THE INPUT INCREASES THE OUTPUT INCREASES. IN A RA CONTROLLER WHEN THE INPUT INCREASES THE OUTPUT DECREASES.
RESET 100 I 0 180 O 100	RESET CONTROLLER - USER DEFINED OUTPUT VALUE WILL RESET IN A LINEAR RELATIONSHIP BASED ON USER DEFINED INPUT VALUE.
OFF SR ON IP	SWITCHING RELAY - SWITCHES OUTPUT BETWEEN TWO INPUTS WHEN DIGITAL PILOT INPUT IS ON. SWITCH SHOWN IN NORMAL POSITION
OFF DSR ON SP1 SP2	DEADBAND SWITCHING RELAY - DIGITAL OUTPUT CHANGES WHEN INPUT VALUE RISES/FALLS ABOVE/BELOW SETPOINT 1 (SP1). DIGITAL OUTPUT RESTORES TO NORMAL WHEN INPUT RISES/FALLS ABOVE/BELOW SETPOINT 2 (SP2). SWITCH SHOWN IN NORMAL POSITION
I IF > SP O	LOGICAL IF EXPRESSION - THE OUTPUT IS ON IF THE INPUT MEETS THE CONDITION OF THE SETPOINT.
RAMP I O # SEC MAX MIN	RAMP CONTROLLER - LIMITS THE RATE OF CHANGE OF AN OUTPUT ON AN INCREASE IN VALUE OR A DECREASE IN VALUE. CHNGX - % OF TOTAL MAXIMUM OUTPUT VALUE ALLOWED FOR OUTPUT CHANGE # = TIME IN SECONDS MAX = MAXIMUM OUTPUT VALUE MIN = MINIMUM OUTPUT VALUE
TMR I Δ O DLY	TIMER - OUTPUT IS ON FOR A USER SPECIFIED TIME AFTER INPUT CHANGES FROM OFF TO ON
ATS I O OVRFLAG	AUTOMATIC TIME SCHEDULER - INCLUDES SCHEDULES ENTERED INTO CONTROLLER FOR 7 DAY SCHEDULING WITH HOLIDAYS AND OVERRIDE SCHEDULES. INCLUDES OVERRIDE INPUT FOR UNSCHEDULED OVERRIDE. OUTPUTS REFERENCE FLAGS CAN INCLUDE : HEATING SETBACK, COOLING SETBACK, AND UNOCCUPIED
OS/S I O OVRFLAG	OPTIMUM START/STOP TIME SCHEDULER - INCLUDES SCHEDULES ENTERED INTO CONTROLLER FOR 7 DAY SCHEDULING WITH HOLIDAYS AND OVERRIDE SCHEDULES. INCLUDES OPTIMUM START STOP ROUTINE. OUTPUTS REFERENCE FLAGS CAN INCLUDE : WARM-UP, COOL-DOWN, HEATING SETBACK, COOLING SETBACK, AND UNOCCUPIED. INCLUDES OVERRIDE INPUT (OVR) FOR UNSCHEDULED OVERRIDE
I CALC O	CALCULATION BLOCK - OUTPUT IS EQUAL TO CALCULATION USING INPUT(S). EQUATION CAN BE MATHEMATICAL OR A PREDEFINED INDUSTRY STANDARD ALGORITHM (ie. CFM, VELOCITY PRESSURE, ENTHALPY, DEW POINT ETC.)
HI	HIGH SELECTOR - SELECTS HIGHER OF INPUT VALUES
LO	LOW SELECTOR - SELECTS LOWER OF INPUT VALUES
AVE	AVERAGING BLOCK - MATHEMATICALLY AVERAGES INPUT VALUES.
DLY MTR COM PROOF RST ALM NML	PROOFING MODULE - GENERATES VALUES BASED ON A COMPARISON OF COMMAND AND MONITORING INPUTS. DLY - PROOFING DELAY PERIOD MTR - MONITOR (INPUT FOR PROOF) COM - COMMAND (INPUT FOR PROOF) RST - RESET (IF LATCHING IS USED) ALM - (ON WHEN MONITOR INPUT IS NOT EQUAL TO COMMAND INPUT) NML - OUTPUT IS ON WHEN MONITOR AND COMMAND INPUTS ARE ON AND NORMAL CONDITIONS ARE MET
I TIME AVG O	TIME AVERAGE BLOCK - OUTPUT IS EQUAL TO SUM OF INPUTS FROM USER SPECIFIED PREVIOUS TIME PERIOD (OR NUMBER OF SCANS) TO CURRENT TIME (OR SCAN) DIVIDED BY NUMBER OF DISCRETE POINTS IN THE SUMMATION PERIOD. OUTPUT IS A ROLLING TIME BASED AVERAGE OF THE INPUT VALUE.
REQUEST BLCK BLCK CLCK BLCK STAGE ROTATE A B C D	STAGER BLOCK - OUTPUT IS EQUAL TO SUM OF REQUESTS FROM USER SPECIFIED INPUTS. ROTATION SHALL BE DETERMINED BY USER DEFINED PARAMETERS. EACH INDIVIDUAL OUTPUT CAN BE LOCKED OUT BY USER DEFINED INDIVIDUAL INPUTS. LOCKED OUT OUTPUTS SHALL BE SKIPPED IN ROTATION. (SEE SEQUENCE OF OPERATION FOR DETAILS)

CONTROL SYMBOLS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
AI POINT NAME / POINT NAME AO	DDC POINT DESCRIPTOR WITH NAME AI - ANALOG INPUT DI - DIGITAL INPUT AO - ANALOG OUTPUT DO - DIGITAL OUTPUT		DISCONNECT SWITCH
TS1	TEMPERATURE SENSOR WITH AVERAGING ELEMENT	480V / 120V	CONTROL TRANSFORMER
TS1	TEMPERATURE SENSOR WITH SINGLE POINT ELEMENT	MS EP1 S	RELAY COILS
TS1	TEMPERATURE SENSOR WITH PIPE WELL		FUSE
HS1	HUMIDITY SENSOR	OL	THERMAL OVERLOAD
LFZ1	LOW TEMPERATURE SWITCH (FREEZESTAT)		NORMALLY OPEN AND NORMALLY CLOSED CONTACTS
HS1	HIGH TEMPERATURE SWITCH (FIRESTAT)	HAND AUTO OFF	HAND-OFF-AUTO SELECTOR SWITCH
SD1	SMOKE DETECTOR		WIRING DESIGNATION. (NO. OF HATCHES INDICATES NO. OF CONDUCTORS)
DPST	DIFFERENTIAL PRESSURE SWITCH		WIRING CONNECTION
FS1	WATER FLOW SWITCH	ON-OFF	ON-OFF SELECTOR SWITCH
AQ1	DUCT AIR QUALITY SENSOR	TS1	STRAP-ON TEMPERATURE SENSOR
IP1 M	CURRENT TO PNEUMATIC TRANSDUCER	T	ROOM TEMPERATURE SENSOR AS SHOWN ON FLOOR PLANS
V1 N.C.	TWO WAY CONTROL VALVE	H	ROOM HUMIDITY SENSOR AS SHOWN ON FLOOR PLANS
V2 C. N.C. N.O.	THREE WAY CONTROL VALVE	DCS	DIGITAL CONTROL STATION
D1	DAMPER ACTUATOR	WI	WAN INTERFACE
WD	WATER DETECTOR	C	PILOT LIGHT (WITH LENS COLOR)
	CURRENT SENSOR	FAR	FIRE ALARM RELAY BY DIV. 16
LS1	LIMIT SWITCH	TDR	TIME DELAY RELAY DELAY ON MAKE OR BREAK
	DPST FREEZESTAT		AIR FLOW MONITORING STATION
R	RELAY - NORMALLY OPEN		

LEGEND	
WIRING DESIGNATIONS	
————	NEW WIRING
————	WIRING BY OTHERS

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STANDARD CONTROL & LOGIC SYMBOLS

DRAWING NUMBER

M-11