

1 MAIN CONCOURSE LEVEL PLAN - QUAD B - MECHANICAL - NEW WORK
SCALE: 1/16" = 1'-0"

GENERAL NOTES:

- REFER TO M001 FOR MECHANICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
- ALL IDENTIFIED EQUIPMENT IS EXISTING TO REMAIN AND SHALL BE RETROFIT WITH NEW CONTROLS (I.E. SENSORS, VALVES, DAMPERS, ETC.). ALL EQUIPMENT SHALL BE CONNECTED TO THE NEW BAS. REFER TO ATC CONTROLS DRAWINGS FOR ADDITIONAL INFORMATION.
- ALL EXISTING THERMOSTATS SHALL BE REMOVED AND REPLACED.

DRAWING NOTES:

- EXISTING ELECTRIC CONVECTOR. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING TOILET EXHAUST FAN. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING HEAT PUMP UNIT ON ROOF ABOVE. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING ELECTRIC CABINET UNIT HEATER. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING VENDOR COOLER / FREEZER SHALL BE CONNECTED TO BAS. PROVIDE CONTROLS FOR MONITORING STATUS AND INTERNAL TEMPERATURE. PENETRATIONS THRU COOLER / FREEZER SHALL BE SEALED TO MAINTAIN THERMAL BARRIER.
- EXISTING VENTILATION FAN. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING GENERAL EXHAUST FAN. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING FAN COIL UNIT. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING ELECTRIC UNIT HEATER. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING MAKEUP AIR UNIT. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING KITCHEN EXHAUST FAN. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING SPLIT SYSTEM AIR CONDITIONING UNIT. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION.
- EXISTING FAN POWERED VAV TERMINAL UNIT. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.
- EXISTING FAN COIL UNIT LOCATED IN SERVICE LEVEL STEAM ROOM 1-26-03. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION. EXISTING THERMOSTAT SERVING THIS UNIT SHALL BE REMOVED AND REPLACED.

LEGEND	
EQUIPMENT DESIGNATION (CONTROLS RETROFIT)	DESIG
THERMOSTAT (REMOVE AND REPLACE)	①
ABBREVIATIONS	
AIR HANDLING UNIT	AHU
CONVECTOR	CONV
CABINET UNIT HEATER	CUH
FAN COIL UNIT	FCU
GENERAL EXHAUST FAN	GEF
HEAT PUMP UNIT	HPU
KITCHEN EXHAUST FAN	KEF
MAKEUP AIR UNIT	MAU
TOILET EXHAUST FAN	TEF
UNIT HEATER	UH
VENTILATION FAN	VF

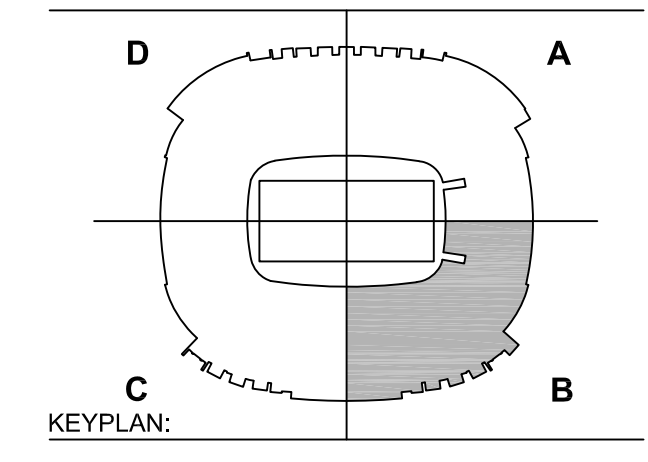
bkm
Burdette, Koehler, Murphy & Associates, Inc.
Mechanical / Electrical Engineers
6300 Star Hill Lane, Suite 400
Baltimore, Maryland 21209
P: 410.323.0600 | www.bkma.com

PROJECT NAME:
**M&T BANK STADIUM
HVAC CONTROLS,
LIGHTING CONTROLS
AND SUBMETERING
SYSTEMS
IMPROVEMENTS**

MSA PROJECT NO. 20-071

THE MARYLAND STADIUM
AUTHORITY
333 WEST CAMDEN STREET, SUITE 500
BALTIMORE, MD 21201

CONSULTANTS:
WFT ENGINEERING, INC.
1801 RESEARCH BOULEVARD, SUITE 100
ROCKVILLE, MARYLAND 20850
P: 301-230-0811



SEAL:

PROFESSIONAL CERTIFICATION:
I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND. LICENSE NO. _____ EXPIRATION DATE: _____

ISSUED FOR:	
DATE	DESCRIPTION
02/12/21	BID SET
04/02/21	ADDENDUM 01

PROJECT NO: 20092.01

SCALE: AS NOTED

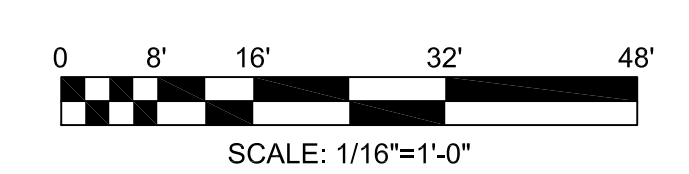
DRAWN BY: BAS

CHECKED BY: CMP / MAF

DATE: FEBRUARY 12, 2021

SHEET TITLE:
**MAIN CONCOURSE LVL
QUAD B
MECHANICAL
NEW WORK**

DRAWING NO:
M1.12
BKM# 20092.01



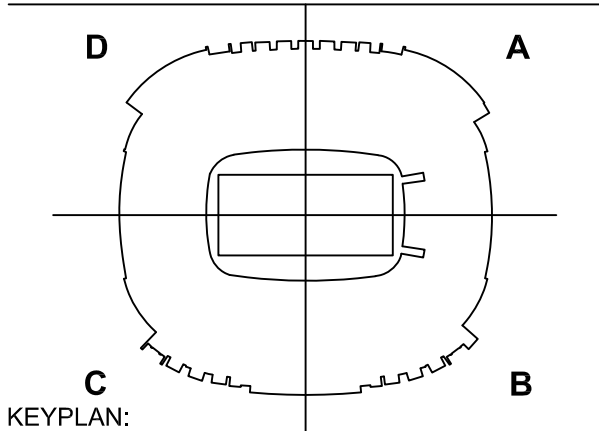
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DRAWN BY: MJG

CHECKED BY: CMP

DATE: FEBRUARY 12, 2021

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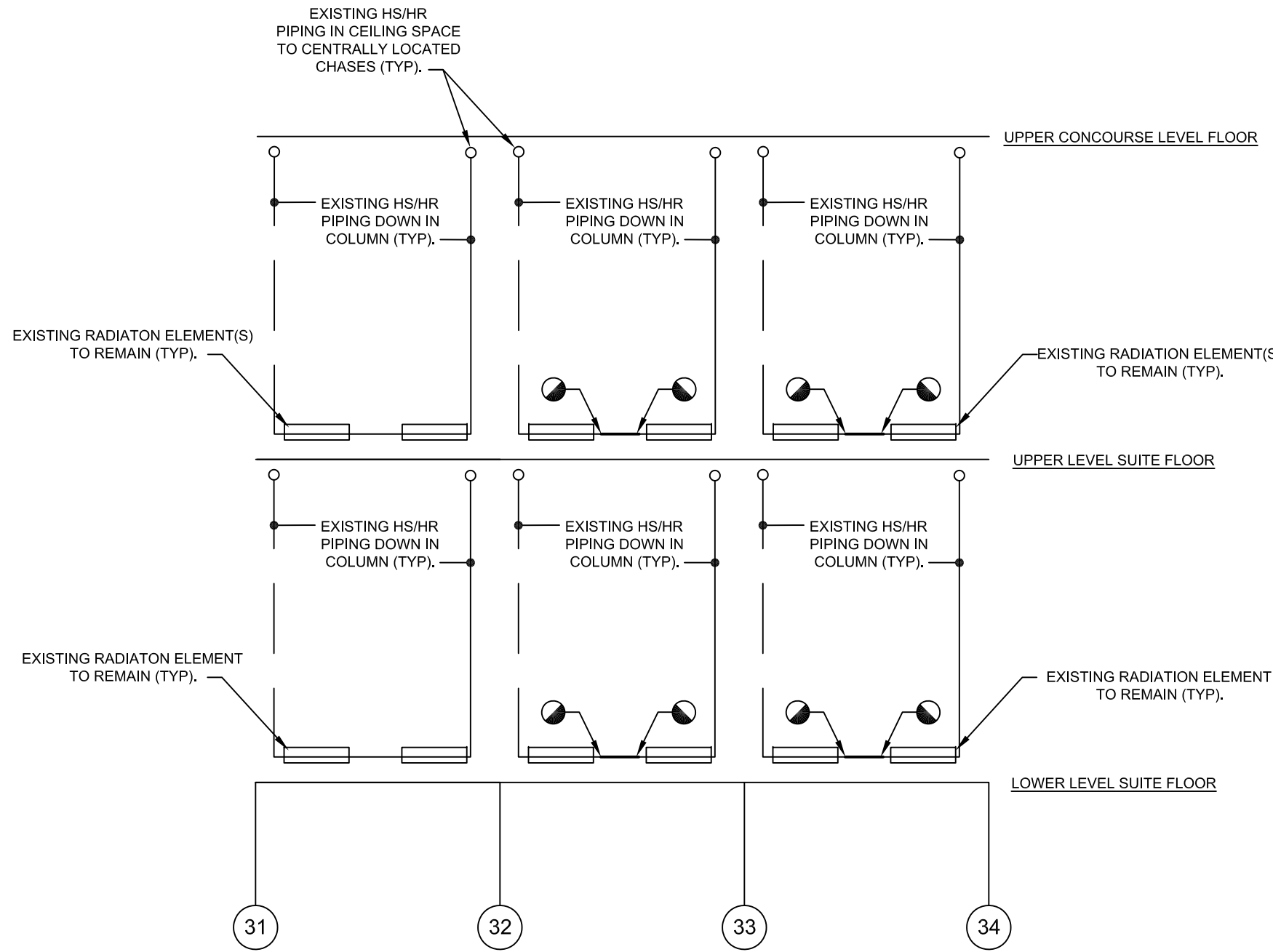
RAVENS OFFICE
SCHEMATICS, DETAILS AND
CONTROLS

DRAWING NO:

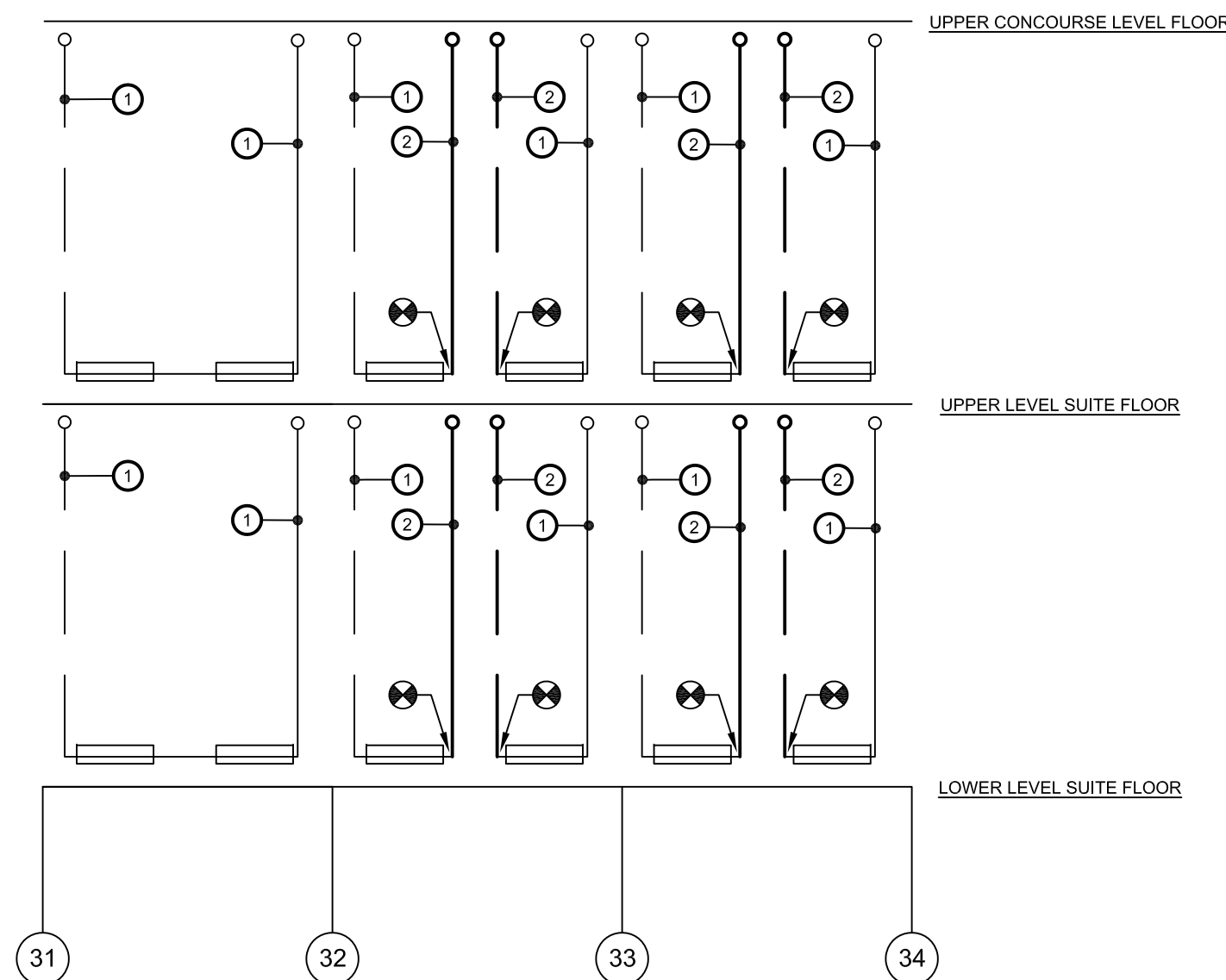
M2.02b

BKM# 20092.01

DEMOLITION



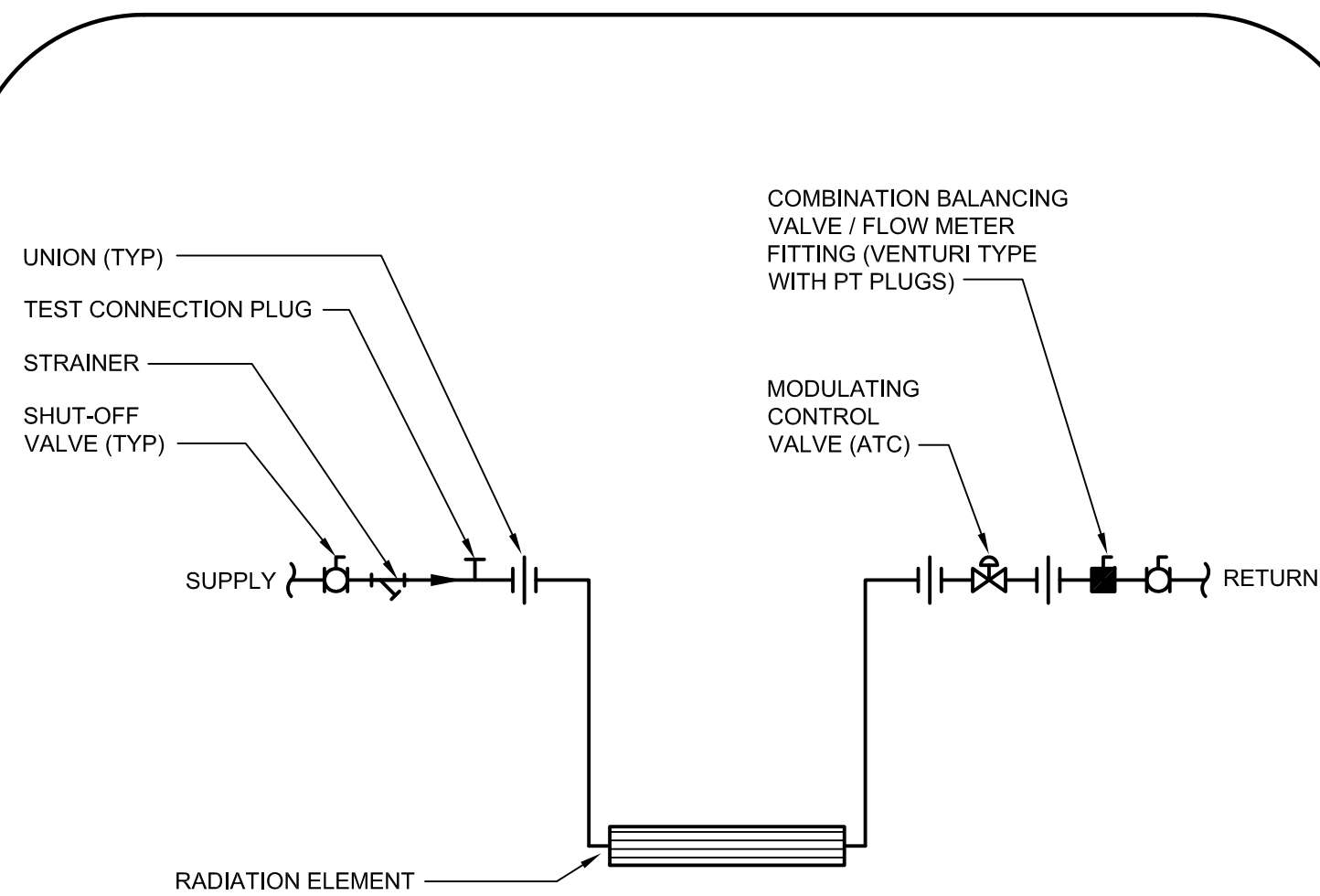
NEW WORK



1 LOWER & UPPER SUITE LEVEL PIPING SCHEMATIC - DEMOLITION & NEW WORK
NO SCALE

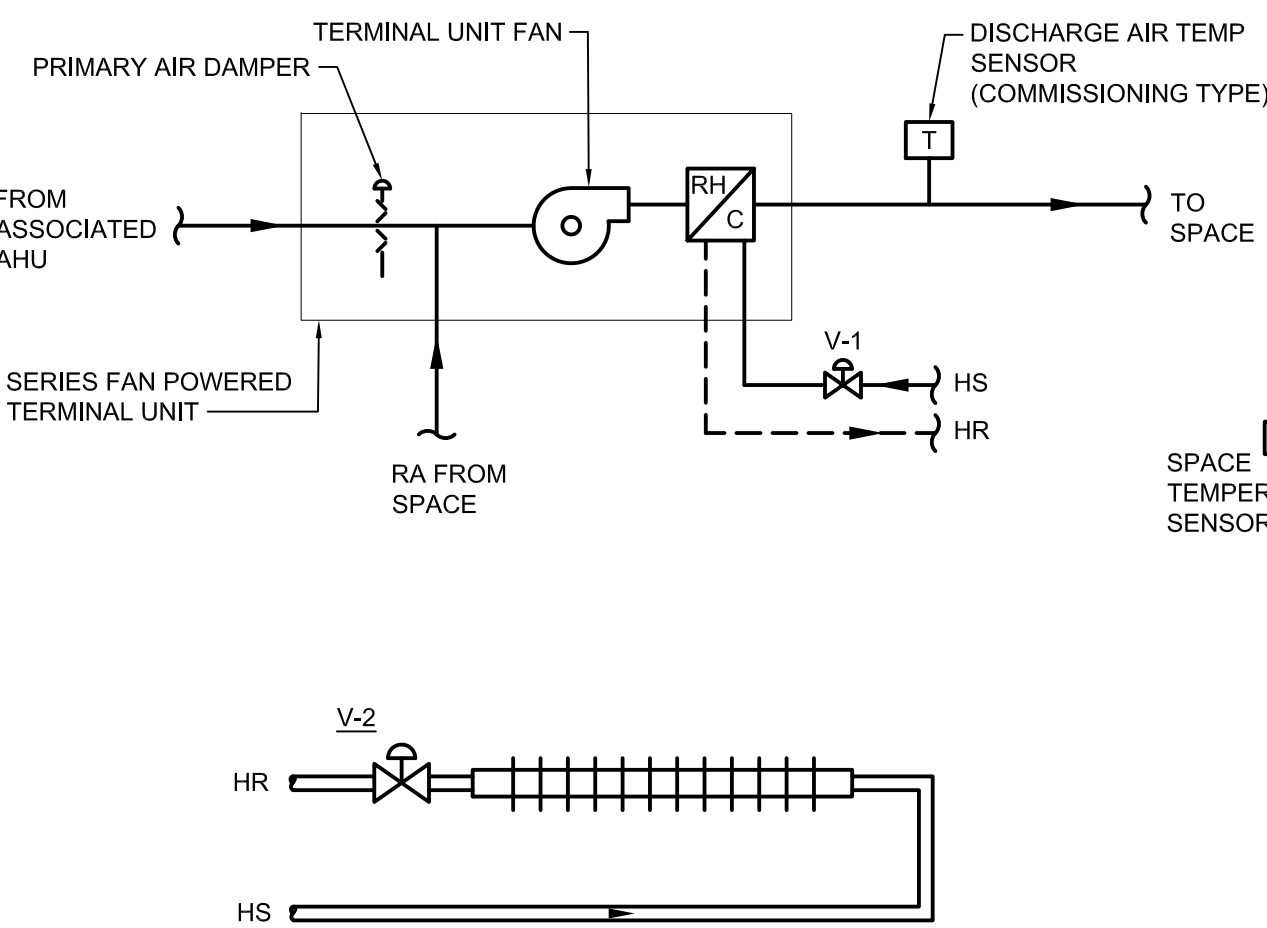
- GENERAL NOTES:
- ALL VALVES AND CONTROLS SHALL BE LOCATED BEFORE PIPES DROP DOWN IN COLUMN ENCLOSURE. PROVIDE ACCESS PANELS WHERE REQUIRED TO ENSURE ALL VALVES ARE ACCESSIBLE.
 - ALL HSHR PIPING SERVING RADIATORS IS APPROXIMATELY 1". CONTRACTOR SHALL CONFIRM EXACT SIZE IN FIELD AND ANY NEW PIPING SHALL MATCH EXISTING SIZES.

- DRAWING NOTES:
- EXISTING HSHR PIPING DOWN IN COLUMN ENCLOSURE.
 - NEW HSHR PIPING DOWN IN COLUMN ENCLOSURE.



2 FINNED TUBE RADIATION PIPING DETAIL
NO SCALE

- NOTE:
- ALL VALVES AND CONTROLS SHALL BE LOCATED BEFORE PIPES DROP DOWN IN COLUMN ENCLOSURE. PROVIDE ACCESS PANELS WHERE REQUIRED TO ENSURE ALL VALVES ARE ACCESSIBLE.
 - ALL VALVES SHOWN IN THIS DETAIL SHALL BE NEW AND BE PROVIDED FOR EACH RADIATION ELEMENT SHOWN ON SHEET M2.03.



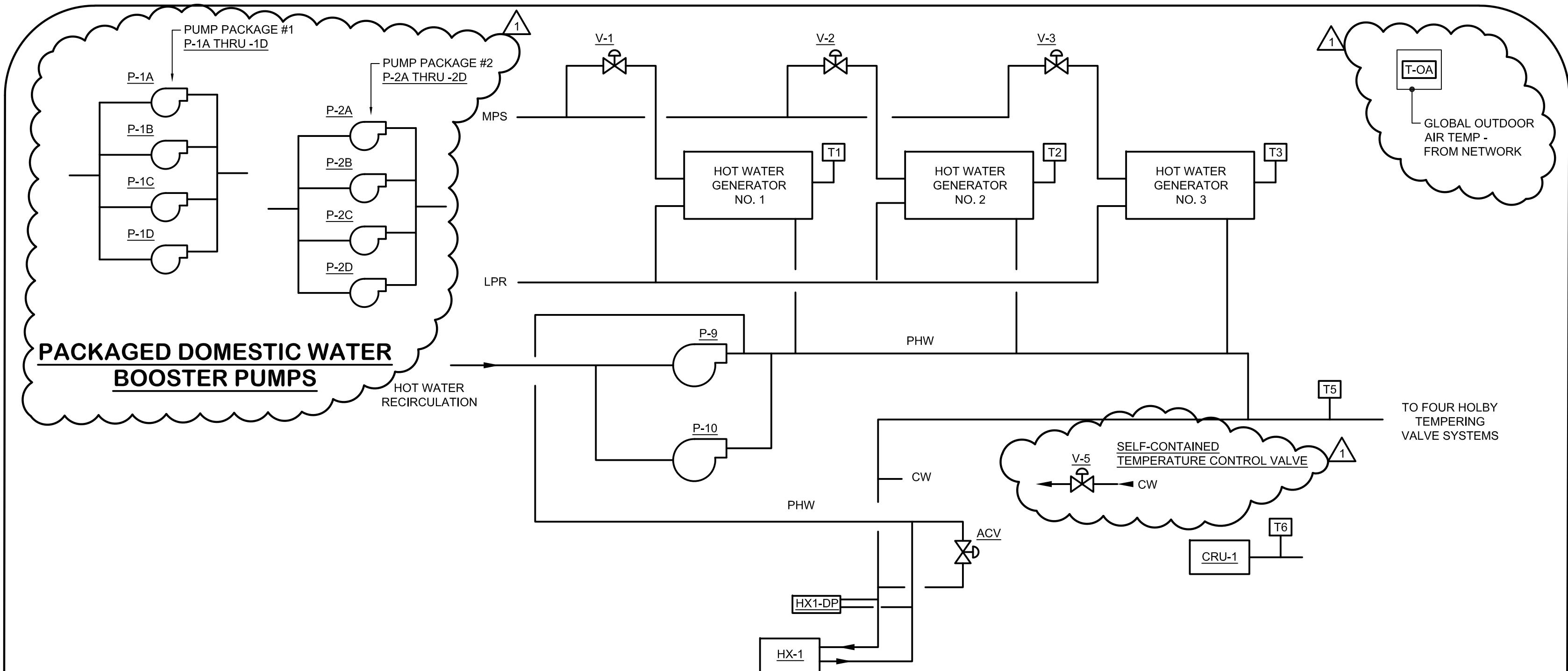
RAVEN'S OFFICE - SERIES FAN POWERED
TERMINAL UNIT & RADIATOR CONTROL

CONTROL SEQUENCE (ASSOCIATED AHU-3):

- WHEN THE ASSOCIATED AHU SYSTEM IS ENERGIZED, THE PRIMARY AIR DAMPER SHALL OPEN TO THE MINIMUM POSITION AND FAN SHALL START AND RUN CONTINUOUSLY. TERMINAL UNIT FAN SHALL START THIRTY (30) SECONDS (ADJUSTABLE) BEFORE OPENING OF PRIMARY AIR DAMPER TO PREVENT BACK SPINNING OF FAN.

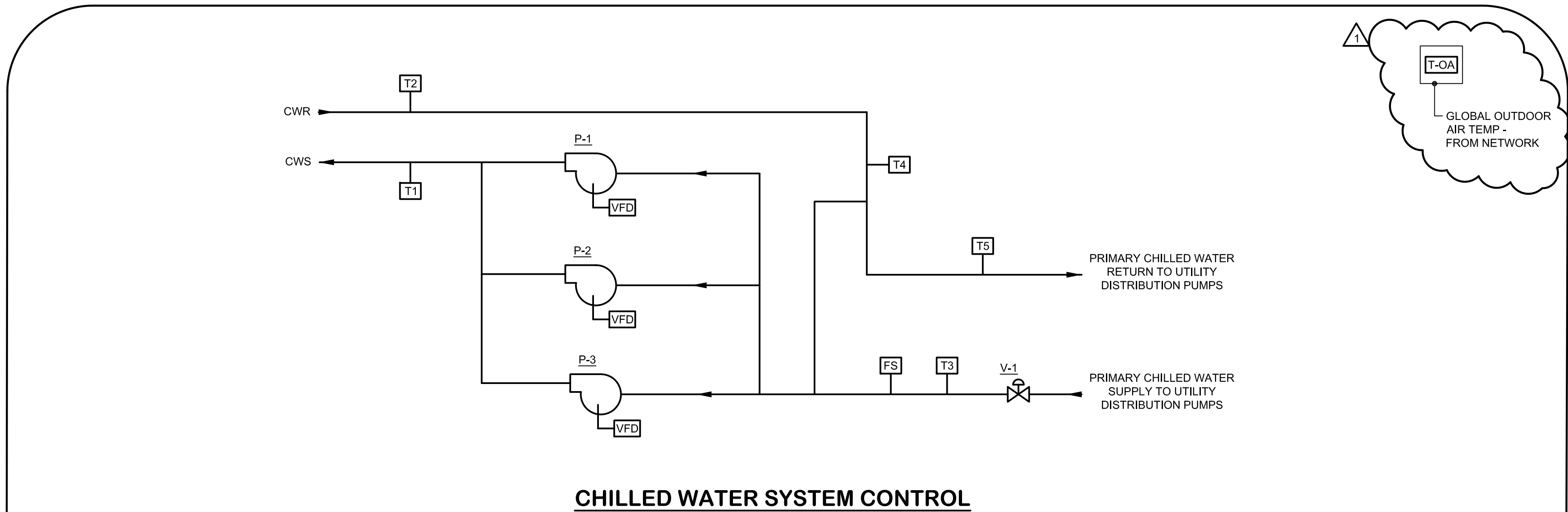
THE SPACE THERMOSTAT SHALL MODULATE THE TERMINAL UNIT PRIMARY AIR DAMPER TO MAINTAIN OCCUPIED SPACE TEMPERATURE SETPOINT. ON A RISE IN SPACE TEMPERATURE, DAMPER SHALL MODULATE TOWARD MAXIMUM POSITION. ON A FALL IN SPACE TEMPERATURE, DAMPER SHALL MODULATE TOWARD MINIMUM POSITION. WHEN THE PRIMARY AIR DAMPER REACHES MINIMUM POSITION, AND THE SPACE TEMPERATURE CONTINUES TO FALL, THE THERMOSTAT SHALL MODULATE THE HEATING COIL CONTROL VALVES, V-1 & V-2 TO MAINTAIN SPACE TEMPERATURE SETPOINT. ON A RISE IN SPACE TEMPERATURE, THE OPPOSITE SHALL OCCUR.
- WHEN THE ASSOCIATED AHU SYSTEM IS INDEXED TO "UNOCCUPIED", THE TERMINAL UNIT PRIMARY AIR DAMPER SHALL BE CLOSED. WHEN THE SPACE TEMPERATURE FALLS BELOW THE UNOCCUPIED SETPOINT, THE TERMINAL UNIT FAN SHALL ENERGIZE AND THE HEATING COIL CONTROL VALVE, V-1 SHALL OPEN. WHEN SPACE THERMOSTAT IS SATISFIED THE HEATING COIL VALVE SHALL CLOSE AND THE FAN SHALL BE DE-ENERGIZED. FAN SHALL RUN A MINIMUM OF TEN (10) MINUTES (ADJUSTABLE). TO AVOID OVER CYCLING, RADIATOR CONTROL VALVE, V-2, SHALL REMAIN CLOSED DURING "UNOCCUPIED" MODE.
- WHEN THE ASSOCIATED AHU SYSTEM IS INDEXED TO "MORNING WARM-UP", THE TERMINAL UNIT PRIMARY AIR DAMPER SHALL OPEN TO MAXIMUM POSITION AND THE TERMINAL UNIT FAN SHALL BE ENERGIZED TO PERMIT FULL FLOW TO THE SPACE. THE HEATING COIL CONTROL VALVES, V-1 & V-2, SHALL BE MODULATED IN RESPONSE TO THE SPACE THERMOSTAT TO MAINTAIN THE SPACE TEMPERATURE SETPOINT.
- WHEN THE ASSOCIATED AHU SYSTEM IS INDEXED TO "MORNING COOL DOWN", THE TERMINAL UNIT PRIMARY AIR DAMPER SHALL OPEN TO MAXIMUM POSITION AND THE TERMINAL UNIT FAN SHALL BE ENERGIZED TO PERMIT FULL FLOW TO THE SPACE.





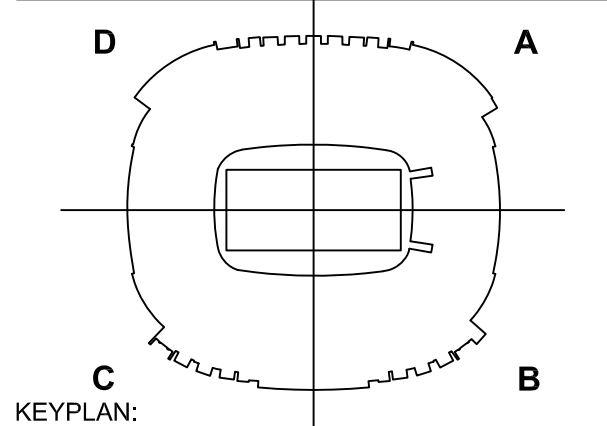
DOMESTIC HOT WATER SYSTEM CONTROL

- GENERAL:
 - OUTDOOR AIR TEMPERATURE SHALL BE BASED ON THE GLOBAL AVERAGE TEMPERATURE.
- DOMESTIC WATER HEATERS:
 - TANK MOUNTED SENSORS T-1, T-2 & T-3 SHALL MODULATE STEAM VALVES V-1, V-2 & V-3 TO MAINTAIN ITS SETTING OF 140°F (ADJUSTABLE).
 - THREE (3) STORAGE WATER HEATERS ARE PIPED IN PARALLEL TO HANDLE THE DESIGN LOAD.
 - EACH HEATER WILL HAVE SELF CONTAINED CONTROL OF ITS OWN TANK TEMPERATURE AND THAT TEMPERATURE SHALL BE MONITORED AT THE BAS.
 - TWO (2) DOMESTIC HOT WATER RETICULATION PUMPS ARE PROVIDED TO MAINTAIN LOOP WATER TEMPERATURE. ONE (1) PUMP IS REQUIRED FOR DESIGN LOAD AND WILL RUN CONTINUOUSLY.
 - THE LEAD PUMP WILL ENERGIZE AND RUN CONTINUOUSLY. IF THE LEAD PUMP FAILS OR FAILS TO START, THE LAG PUMP WILL AUTOMATICALLY START AND RUN CONTINUOUSLY.
 - FAILURE OF EITHER PUMP WILL BE ALARMED AT THE BAS.
- DOMESTIC HOT WATER SUPPLY TEMPERATURE SENSOR T-5 WILL MONITOR LOOP TEMPERATURE AND TEND DATA DURING STADIUM EVENTS IN TEN (10) MINUTE INCREMENTS.
- DOMESTIC HOT WATER SUPPLY TEMPERATURE TO DISTRIBUTION WILL BE MECHANICALLY REGULATED TO 120°F USING MANUALLY ADJUSTING TEMPERING VALVES, LOCATED DOWNSTREAM OF WATER HEATERS.
- HEAT EXCHANGER HX-1 WILL BE USED TO PREHEAT DOMESTIC HOT WATER AND TO COOL DOWN STEAM CONDENSATE BEFORE DISCHARGING TO THE DRAINAGE SYSTEM. SELF-CONTAINED TEMPERATURE CONTROL VALVE V-5 WILL BE USED TO INJECT COLD WATER INTO STEAM CONDENSATE DOWNSTREAM OF OF HX-1 AS REQUIRED TO FURTHER REDUCE CONDENSATE TEMPERATURE TO 140°F. HEAT EXCHANGER HX-1 IS A MECHANICAL DEVICE THAT REQUIRES NO TEMPERATURE CONTROLS. ALARM AT BAS WHEN TEMPERATURE RISES ABOVE 145°F (ADJUSTABLE).
- BYPASS COLD WATER VALVE ACV WILL MODULATE OPEN AS THE DIFFERENTIAL PRESSURE AS SENSED BY HX1-DP INLET AND OUTLET PIPING RISES ABOVE ITS SETTING (AS HOT WATER DEMAND RISES ABOVE CAPACITY OF HX-1 AND PREHEATING IS MAXIMIZED).
- DOMESTIC WATER BOOSTER PUMPS:
 - TWO (2) PACKAGED DOMESTIC WATER BOOSTER PUMP SYSTEMS WITH FOUR (4) PUMPS EACH ARE PROVIDED FOR THE FACILITY.
 - EACH SYSTEM SHALL BE SELF CONTAINED WITH FULLY PACKAGED CONTROLS AND STATUS INDICATIONS SHALL BE PROVIDED ON THE BAS THROUGH THE BOOSTER PUMP CONTROL PANEL FOR EACH PUMP.



CHILLED WATER SYSTEM CONTROL

- GENERAL:
 - THE BAS SHALL CONTROL THE CHILLED WATER SYSTEM. WHEN THE SYSTEM IS DE-ENERGIZED, THE PRIMARY CHILLED WATER VALVE, V-1 SHALL CLOSE AND BUILDING SECONDARY CHILLED WATER DISTRIBUTION PUMPS P-1, P-2 & P-3 SHALL BE OFF. CONTROL OF THE UTILITY DISTRIBUTION PUMPS SHALL BE PROVIDED BY THE UTILITY COMPANY. WHEN THE CHILLED WATER SYSTEM IS ENERGIZED BY THE BUILDING HEATING-COOLING CONTROL, CHILLED WATER VALVE V-1 SHALL MODULATE OPEN TO ITS MAXIMUM POSITION. THE SECONDARY CHILLED WATER DISTRIBUTION PUMPS MAY BE STARTED MANUALLY OR THROUGH THE BAS AFTER PRIMARY CHILLED WATER FLOW HAS BEEN CONFIRMED BY THE UTILITY FLOW METER AND SYSTEM FLOW SWITCH, FS-1.
 - THE VARIABLE FREQUENCY DRIVE (VFD) SYSTEM FOR THE SECONDARY CHILLED WATER DISTRIBUTION PUMPS SHALL BE CONFIGURED WITH THREE (3) INDEPENDENT VFD CABINETS, ONE FOR EACH PUMP. VFD CABINETS SHALL BE CAPABLE OF MANUAL OPERATION THROUGH OPERATOR INTERVENTION IF REQUIRED.
 - AFTER PRIMARY CHILLED WATER FLOW HAS BEEN CONFIRMED, THE LEAD PUMP WILL START AT REDUCED SPEED AND RUN CONTINUOUSLY. PROVIDE ALTERNATORS AS REQUIRED TO CONTROL LEADLAG PUMP OPERATION. LEAD PUMP SHALL BE ALTERNATED EVERY 300 HOURS (ADJ) OF RUN TIME.
 - REDUCED SPEED STARTING WILL BE THE MINIMUM SETTING OF THE VARIABLE FREQUENCY PUMP DRIVE AND WILL BE FULLY ADJUSTABLE THROUGHOUT THE RANGE OF THE DRIVE. IF PUMP P-1 FAILS OR FAILS TO START AS SENSED BY THE VFD PANEL CONTACT, PUMP P-2 OR P-3 WILL AUTOMATICALLY START AND RUN CONTINUOUSLY.
 - A FAILURE OF ANY DISTRIBUTION PUMP WILL BE ALARMED AT THE BAS.
 - EACH DISTRIBUTION PUMP WILL BE STARTED AT REDUCED SPEED THROUGH INDIVIDUAL VARIABLE FREQUENCY PUMP DRIVES AND SEQUENCED WITH THE PROGRAMMED LEADLAG OPERATION. THREE (3) DIFFERENTIAL PRESSURE TRANSMITTERS DPT-1, DPT-2 & DPT-3 WITH ADJUSTABLE SETPOINT, WILL MODULATE THE VARIABLE FREQUENCY PUMP DRIVE TO MAINTAIN THEIR SETPOINT. THE TRANSMITTER CALLING FOR AN INCREASE IN DIFFERENTIAL PRESSURE ABOVE ITS MINIMUM SETPOINT WILL TAKE CONTROL OF THE PUMP DRIVE. ON A FALL IN THE REQUIRED DIFFERENTIAL PRESSURE AS SENSED BY EITHER TRANSMITTER THE PUMP DRIVE WILL GRADUALLY INCREASE THE PUMP SPEED FROM MINIMUM TO MAXIMUM AS REQUIRED TO MAINTAIN THE SETPOINT. ON A RISE IN DIFFERENTIAL PRESSURE THE REVERSE WILL OCCUR.
 - THREE (3) DIFFERENTIAL PRESSURE TRANSMITTERS DPT-1, DPT-2 & DPT-3 AND THREE (3) TEMPERATURE SENSORS T-5, T-6 & T-7 WILL BE LOCATED THROUGHOUT THE STADIUM COMPLEX AS FOLLOWS:
DPT-1 & T-5: LOCATED ADJACENT TO AHU-3 ON THE PRESS LEVEL - QUAD C.
DPT-2 & T-6: LOCATED AT THE TOP OF RISER ON UPPER LEVEL SUITES - QUAD C.
DPT-3 & T-7: LOCATED ADJACENT TO AHU-4 ON THE PRESS LEVEL - QUAD D
 - ON A CONTINUED FALL IN DIFFERENTIAL PRESSURE AS SENSED BY EITHER TRANSMITTER WITH PUMP P-1 AT MAXIMUM SPEED, A SECOND PUMP P-2 OR P-3 AS APPLICABLE SHALL START. PRIOR TO STARTING THE SECOND PUMP, P-1 WILL BE REDUCED TO 50% FULL LOAD. THE SECOND PUMP WILL BE STARTED AT REDUCED SPEED.
 - BOTH PUMPS WILL THEN GRADUALLY MODULATE AT THE SETPOINTS TO MAINTAIN THE SETPOINTS OF THE DPT-1, DPT-2 & DPT-3 AS DETERMINED BY THE BAS. PUMP SPEED SHALL INCREASE AS REQUIRED TO SATISFY DEMAND OF ALL DP TRANSMITTERS.
 - ON A CONTINUED FALL IN DIFFERENTIAL PRESSURE AS SENSED BY EITHER TRANSMITTER WITH PUMP P-1 & P-2 AT MAXIMUM SPEED, THE THIRD PUMP P-3 WILL START. PRIOR TO STARTING THE THIRD PUMP, P-1 & P-2 WILL BE REDUCED TO 67% FULL LOAD.1.9.
 - ALL THREE PUMPS WILL THEN GRADUALLY MODULATE AT THE SAME SPEED TO MAINTAIN THE SETPOINTS OF THE DPT-1, DPT-2 & DPT-3 AS DETERMINED BY THE BAS.
 - ON A RISE IN DIFFERENTIAL PRESSURE ABOVE THE SETPOINT, THE REVERSE SEQUENCE WILL OCCUR.
 - TEMPERATURE SENSOR T-1 WILL MODULATE VALVE V-1 TO MAINTAIN ITS SETTING OF 36°F (ADJUSTABLE).
 - TEMPERATURE SENSORS T-2, T-3, T-4 WILL MONITOR CHILLED WATER TEMPERATURE AT LOCATIONS INDICATED.
 - UTILITY FLOW METER SHALL MONITOR AND TEND CHILLED WATER CONSUMPTION AT THE FACILITY.
 - OUTDOOR AIR TEMPERATURE SHALL BE BASED ON THE GLOBAL AVERAGE TEMPERATURE.



SEAL:

PROFESSIONAL CERTIFICATION:

PROFESSIONAL CERTIFICATION: I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND. LICENSE NO. _____ EXPIRATION DATE: _____.

ISSUED FOR:

DATE	DESCRIPTION
02/12/21	BID SET
04/02/21	ADDENDUM 01

PROJECT NO: 20092.01

SCALE: AS NOTED

DRAWN BY: MJG

CHECKED BY: CMP / MAF

DATE: FEBRUARY 12, 2021

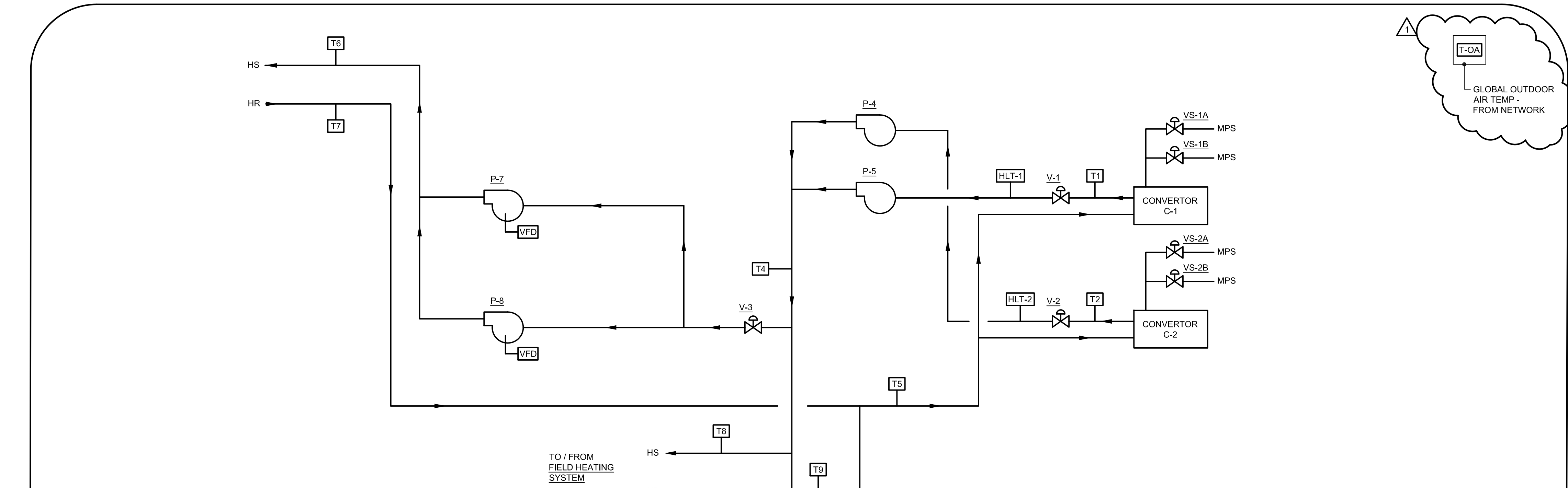
SHEET TITLE:

AUTOMATIC TEMPERATURE CONTROLS

DRAWING NO:

M4.21

BKM# 20092.01



HEATING WATER SYSTEM CONTROL

- GENERAL:
 - WHEN THE SYSTEM IS DE-ENERGIZED, THE STEAM / HEATING WATER CONVERTORS AND BUILDING HEAT PUMPS SHALL BE OFF.
 - HEATING SYSTEM SHALL RUN ALL YEAR WITH A REDUCED CAPACITY IN THE COOLING SEASON.
 - WHEN SYSTEM IS ENERGIZED, PRIMARY HEATING WATER PUMPS AND CONVERTORS WILL ENERGIZE IN STAGES TO MAINTAIN HEATING WATER TEMPERATURE DIFFERENCE.
 - OUTDOOR AIR TEMPERATURE SHALL BE BASED ON THE GLOBAL AVERAGE TEMPERATURE.
- PUMPS & CONVECTOR STARTER SEQUENCE:
 - LEAD PUMP (P-4 OR P-5) & LEAD CONVERTOR (C-1 OR C-2) SHALL RUN CONTINUOUSLY AFTER V-1 OR V-2 OPENS. LAG PUMP AND CONVERTOR SHALL START AUTOMATICALLY & RUN CONTINUOUSLY WHEN LOSS OF POWER IS SENSED BY CURRENT SENSING RELAYS AT EACH PUMP. PROVIDE ALTERNATOR TO CONTROL LEADLAG PUMP OPERATION. LEAD PUMP SHALL BE ALTERNATED EVERY 300 HOURS (ADJUSTABLE) OF RUN TIME. A FAILURE OF ANY COMPONENT SHALL BE ALARMED AT THE BAS.
 - STEAM CONTROL VALVES VS-1A AND VS-1B SERVING C-1 CONVERTOR, V-1 WILL BE MODULATED IN SEQUENCE BY TEMPERATURE SENSOR T-1 TO MAINTAIN HEATING WATER SUPPLY TEMPERATURE AS INDICATED ON HEATING WATER RESET SCHEDULE. CONTROL FOR CONVERTOR C-2 WILL BE SIMILAR TO C-1 AND INDEPENDENT OF EACH OTHER.
 - TEMPERATURE SENSORS, HLT-1 & HLT-2 ARE HIGH LIMIT THERMOSTATS IN THE SUPPLY LINE WHICH SHALL PREVENT SUPPLY WATER FROM EXCEEDING 210°F.
 - WITH THE LEAD HEATING PUMP AND LEAD CONVERTOR OPERATIONAL, IF THE HEATING WATER TEMPERATURE DIFFERENCE BETWEEN T-4 & T-5 EXCEEDS 24°F, THE LAG PUMP AND LAG CONVERTOR WILL BE ENERGIZED.
 - WHEN BOTH HEATING WATER PUMPS AND CONVERTORS ARE OPERATIONAL AND THE PRIMARY HEATING WATER TEMPERATURE DIFFERENCE IS REDUCED TO 12°F, THE LEAD PUMP AND CONVERTOR WILL BE DE-ENERGIZED.
- DIFFERENTIAL PRESSURE CONTROL:
 - THE VFD FOR THE SECONDARY HEATING WATER DISTRIBUTION PUMPS WILL BE CONFIGURED WITH TWO INDEPENDENT VFD CABINETS (ONE FOR EACH PUMP). VFD CABINETS WILL BE CAPABLE OF MANUAL OPERATION THROUGH OPERATOR INTERVENTION IF REQUIRED.
 - THE LEAD PUMP WILL START AT A REDUCED SPEED RAMP UP AND DOWN AS REQUIRED. IF PUMP P-2 FAILS OR FAILS TO START AS SENSED BY THE VFD PANEL CONTACT, PUMP P-4 WILL AUTOMATICALLY START AND RUN CONTINUOUSLY.
 - THREE DIFFERENTIAL PRESSURE TRANSMITTERS (DPT-1, DPT-2 & DPT-3) WILL MODULATE THE VARIABLE FREQUENCY PUMP DRIVE TO MAINTAIN THEIR SETPOINT. THE TRANSMITTER CALLING FOR AN INCREASE IN DIFFERENTIAL PRESSURE AS SENSED BY EITHER TRANSMITTER, THE PUMP DRIVE WILL GRADUALLY INCREASE THE PUMP SPEED FROM MINIMUM TO MAXIMUM AS REQUIRED TO MAINTAIN THE SETPOINT. ON A RISE IN DIFFERENTIAL PRESSURE, THE REVERSE WILL OCCUR. THE DIFFERENTIAL PRESSURE TRANSMITTERS AND TEMPERATURE SENSORS WILL BE LOCATED THROUGHOUT THE STADIUM COMPLEX AS FOLLOWS:
DPT-1 & TH-10: LOCATED ADJACENT TO AHU-3 ON THE PRESS LEVEL - QUAD C.
DPT-2 & TH-11: LOCATED AT THE TOP OF RISER ON UPPER LEVEL SUITES - QUAD C.
DPT-3 & TH-12: LOCATED ADJACENT TO AHU-4 ON THE PRESS LEVEL - QUAD D
 - ON A CONTINUED FALL IN DIFFERENTIAL PRESSURE AND THE LEAD PUMP AT MAXIMUM SPEED, THE LAG PUMP WILL BE STARTED AT A REDUCED SPEED AND THE LEAD PUMP WILL BE REDUCED TO 50% FULL LOAD. BOTH PUMPS SHALL GRADUALLY INCREASE THE PUMP SPEED TO MAINTAIN THE SETPOINTS OF THE DPT-1, DPT-2 & DPT-3. PUMP SPEED SHALL INCREASE AS REQUIRED TO SATISFY DEMAND OF ALL DP TRANSMITTERS.
- T-3 SHALL MODULATE V-4 TO MAINTAIN SETPOINT (ADJUSTABLE), AS INDICATED ON RESET SCHEDULE.

RESET SCHEDULE	
OA	SYSTEM WATER TEMP HS
0° F	200° F
65° F	120° F
95° F	120° F

*TEMPERATURES SHALL BE LINEAR BETWEEN INTERMEDIATE SETPOINTS.



1. D-2 (RELIEF AIR) SHALL FULLY OPEN.
 2. D-2 (RELIEF AIR) SHALL BE CLOSED WHEN D-18 (MAX AIR) IS CLOSED. WHEN THE UNIT GOES TO ECO, MAX AIR BEGINS TO OPEN THEN D-2 (RELIEF AIR) SHALL MODULATE OPEN AND TRACK WITH D-18.
 3. WHEN THE OUTSIDE AIR ENTHALPY IS LESS THEN THE RETURN AIR ENTHALPY, D-1A, D-1B, D-2 & D-3 SHALL MAXIMIZE ATMOSPHERIC (FREE) COOLING AND MAINTAIN A LARGE AIR TEMPERATURE EQUAL TO THE OUTSIDE AIR SETPOINT. WHEN THE RETURN AIR ENTHALPY IS GREATER THAN THE OUTSIDE AIR ENTHALPY, THE ECONOMIZER MODE SUCH THAT D-3 POSITION (% OPEN) = 100% MINUS D-2 POSITION (% OPEN).
 4. THE SUPPLY AIR TEMPERATURE, SENSED BY T3, SHALL THEN BE MAINTAINED AT SETPOINT BY MODULATING REHEAT COILS. AS REQUIRED, THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE FOLLOWING SUPPLY AIR RESET SCHEDULE (ALL TEMPERATURES SHALL BE ADJUSTABLE).

- PROVIDE SUPPLY AIR TEMP. RESET (SATR) SCHEDULE PROGRAMMING.
- INPUT DEFAULT VALUES AS INDICATED.
- FINAL VALUES SHALL BE REVIEWED WITH OWNER.
- ALL VALUES SHALL BE ADJUSTABLE.

4.6. **FREEZE PROTECTION:**

A. WHEN THE MIXED AIR TEMPERATURE, AS SENSED BY T3, FALLS BELOW "FREEZE WARNING" SETPOINT OF 40°F (ADJ), MODULATE OA DAMPER CLOSE TO 50% (ADJ.) AND THE HEATING VALVE SHUT OFF AN MINIMUM OF 5% (ADJUSTABLE). HEATING SHALL BE SENT TO THE BAS AND BAS GROUPING SHALL DISPLAY "STATUS".

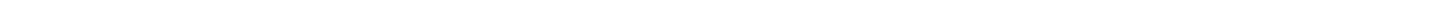
B. IF THE TEMPERATURE RISES TO THE BAS AND BAS GROUPING DISPLAY "STATUS", THE OA DAMPER SHALL CLOSE FOR A MINIMUM FIFTEEN (15) MINUTES (ADJ.) TO ALLOW TEMPERATURE TO RISE. IF THIS TEMPERATURE FALLS TO 36°F (ADJ.) OR BELOW, THE OA DAMPER SHALL REMAIN CLOSED AND HEATING VALVE SHALL FULL OPEN. IF TEMPERATURE BECOMES TO RISE, OPERATION SHALL REVERSE.

C. WHEN THE AIR TEMPERATURE, AS SENSED BY FREEZE STAT, FZ, FALLS BELOW 35°F (ADJ), THE SUPPLY FAN SHALL SHUT-DOWN, AND A CRITICAL ALARM SHALL BE INDICATED AT THE BAS.



- 4.8. FIRE PROTECTION:
- A. WHEN THE MIXED AIR TEMPERATURE, AS SENSED BY 73, FALLS BELOW "FIRE WARNING" SETPOINT OF 40°F (ADJ.), MODULATE OA DAMPER CLOSED TO 80% (ADJ.) AND THE HEATING VALVE SHALL OPEN A MINIMUM OF 5% (ADJUSTABLE). A WARNING SIGNAL, BE SENT TO THE BAS AND BAS GRAPHIC SHALL DISPLAY THE STATUS.
 - B. IF TEMPERATURE CONTINUES TO FALL 2°F BELOW SETPOINT (ADJ.), OA DAMPER SHALL CLOSE FOR A MINIMUM FIFTEEN (15) MINUTES TO 10% TO 20% TO RISE. IF THE HEATING VALVE FULLY OPEN A MINIMUM OF 5% (ADJ.) FOR 15 MINUTES, DAMPER SHALL REMAIN CLOSED AND HEATING VALVE SHALL FULL OPEN. IF TEMPERATURE BEGINS TO RISE, OPERATION SHALL REVERSE.
 - C. WHEN THE AIR TEMPERATURE, AS SENSED BY FREEZE STAT, FZ, FALLS BELOW 35°F (ADJ.), THE SUPPLY FAN SHALL SHUT-DOWN, AND A CRITICAL ALARM SHALL BE INDICATED AT THE BAS.



- 

DESIG.	ASSOCIATED EXHAUST FAN
AHU-1	TEF-A10, TEF-A11, TEF-A12, TEF-A15, TEF-A16, TEF-A23
AHU-2	TEF-B14, TEF-B15, TEF-B16, TEF-B17, TEF-B25
AHU-3	TEF-C6, TEF-C7, TEF-C8, TEF-C9, TEF-C14
AHU-4	TEF-D6, TEF-D7, TEF-D8, TEF-D9, TEF-D11, TEF-D15, TEF-D17
AHU-9	TEF-C5
AHU-10	TEF-B3
AHU-11	TEF-B1
AHU-12	TEF-B2
AHU-13	TEF-B4
AHU-14	TEF-B5
AHU-15	TEF-B8
AHU-16	TEF-B7
AHU-17	TEF-B6
AHU-19	TEF-A3
HVU-1	TEF-A1
HVU-2	TEF-A2
HVU-3	TEF-A3



- 2.4. MORNING WARM-UP: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)
- 2.5. MORNING COOL-DOWN: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)
3. AIR FLOW CONTROL
- 3.1 OCCUPIED: AIR FLOW MONITOR, AFM-1, LOCATED IN OUTSIDE AIR DUCT SHALL MODULATE D-1 TO MAINTAIN VENTILATION AIR QUANTITY AS INDICATED ON AIR HANDLING UNIT SCHEDULE.
4. MISCELLANEOUS
- 4.1 SMOKE DETECTORS SD, LOCATED IN THE SUPPLY AND RETURN AIR SHALL DE-ENERGIZE FAN AND CLOSE ASSOCIATED SMOKE DAMPERS SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
- 4.2 HIGH LIMIT STATIC PRESSURE SENSOR, SP5-1, SHALL DE-ENERGIZE FANS WHEN STATIC PRESSURE REACHES 6.0" (ADJUSTABLE). ALARM AT THE BAS.
- 4.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.
- 4.4 ON FAILURE OF SUPPLY FAN, DAMPERS D-1 & D-2 SHALL CLOSE. ALARM AT BAS.
- 4.5 MONITOR RETURN AIR CO2 SENSORS AT THE BAS.
- 4.6 FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)



- ## FAN COIL UNIT CONTROL
1. GENERAL
 - 1.1. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
 - 1.2. ALL SUITE FAN COIL UNITS SHALL OPERATE PER THE OCCUPIED-UNOCCUPIED SCHEDULE. MANUAL OVERRIDE OF INDIVIDUAL UNITS THROUGH THE BAS SHALL BE FREQUENTLY REQUIRED IN ALL MODES.
 - 1.3. COOLING COIL VALVE AND HEATING COIL CONTROL VALVES SHALL BE CLOSED WITH THE UNIT IS DE-ENERGIZED.
 2. TEMPERATURE CONTROL
 - 2.1. OCCUPIED:
 - A. UNIT FAN SHALL CYCLE ON/OFF, THE SPACE TEMPERATURE, SENSED BY T-1 SHALL THEN BE MAINTAINED AT SETPOINT BY MODULATING VALVES V-1 AND V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED.
 - 2.1. UNOCCUPIED:
 - A. ON A FALL IN SPACE TEMPERATURE BELOW 50°F (ADJUSTABLE), SPACE THERMOSTAT, SHALL CYCLE FAN AND OPEN HEATING VALVE V-1, TO MAINTAIN UNOCCUPIED LOW LIMIT TEMPERATURE SETPOINT, 55°F (ADJUSTABLE).
 - B. ON A RISE IN SPACE TEMPERATURE ABOVE 90°F (ADJUSTABLE), SPACE THERMOSTAT, SHALL CYCLE FAN AND OPEN COOLING VALVE V-2, TO MAINTAIN UNOCCUPIED HIGH LIMIT TEMPERATURE SETPOINT, 85°F (ADJUSTABLE).
 - 2.1. WARM UP / COOL DOWN MODES:
 - A. WARM UP MODE: FAN SHALL BE ENERGIZED TO RUN CONTINUOUSLY AND HEATING VALVE SHALL BE FULL OPEN UNTIL SPACE TEMPERATURE IS MET.
 - B. COOL DOWN MODE: FAN SHALL BE ENERGIZED TO RUN CONTINUOUSLY AND COOLING VALVE SHALL BE FULL OPEN UNTIL SPACE TEMPERATURE IS MET.
 - C. AFTER SPACE TEMPERATURE IS MET, FAN SHALL CYCLE AND VALVES SHALL MODULATE, WITHOUT OVERLAPPING CONTROL, AS REQUIRED.
 3. MISCELLANEOUS
 - 3.1. IN THE EVENT OF AN OVERFLOW, WATER LEAK DETECTOR, LK, SHALL SHUT-OFF UNIT AND ALARM AT THE BAS.



- AS REQUIRED, TO MAINTAIN NIGHT SETBACK TEMPERATURE (ADJUSTABLE).
- 2.3 MORNING WARM-UP: WHEN SYSTEM IS FIRST INDEXED TO "MORNING WARM-UP" MODE, DAMPERS D-1 & D-3 SHALL REMAIN CLOSED AND D-2 SHALL REMAIN OPEN. FAN SHALL ENERGIZE AND HEATING VALVE (V-1) SHALL OPEN TO 100% (ADJ). WHEN RETURN AIR SETPOINT, AS SENSED BY T1, REACHES 70°F (ADJ.), OR WHEN OCCUPIED SCHEDULE BEGINS, THE SYSTEM SHALL TRANSITION FROM "MORNING WARM-UP" MODE TO "OCCUPIED" MODE.
- 2.4 MORNING COOL-DOWN: WHEN SYSTEM IS FIRST INDEXED TO "MORNING COOL-DOWN" MODE, DAMPERS D-1 & D-3 SHALL REMAIN CLOSED AND D-2 SHALL REMAIN OPEN. FAN SHALL ENERGIZE WITH COOLING VALVE OPEN UNTIL OCCUPIED SETPOINT IS MET OR WHEN OCCUPIED SCHEDULE BEGINS. THE SYSTEM SHALL TRANSITION FROM "MORNING COOL-DOWN" MODE TO "OCCUPIED" MODE.
3. AIR FLOW CONTROL
- 3.1 OCCUPIED: AIR FLOW MODULATOR, AFM-1, LOCATED IN OUTSIDE AIR DUCT SHALL MODULATE D-1 TO MAINTAIN VENTILATION AIR QUANTITY AS INDICATED ON AIR HANDLING UNIT SCHEDULE.
4. MISCELLANEOUS
- 4.1 SMOKE DETECTORS SD, LOCATED IN THE SUPPLY AND RETURN AIR SHALL DE-ENERGIZE FAN AND CLOSE ASSOCIATED SMOKE DAMPERS SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
- 4.2 HIGH LIMIT STATIC PRESSURE SENSOR, SPS-1, SHALL DE-ENERGIZE FANS WHEN STATIC PRESSURE REACHES 6.0" (ADJUSTABLE). ALARM AT THE BAS.
- 4.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.
- 4.4 ON FAILURE OF SUPPLY FAN, DAMPERS D-1, D-2, D-3 SHALL CLOSE. ALARM AT BAS.
- 4.5 FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)



1. WHEN THE ASSOCIATED AHU SYSTEM IS ENERGIZED, THE PRIMARY AIR DAMPER SHALL OPEN TO THE MINIMUM POSITION AND FAN SHALL START AND RUN CONTINUOUSLY. TERMINAL UNIT FAN SHALL START THIRTY (30) SECONDS (ADJUSTABLE) BEFORE OPENING OF PRIMARY AIR DAMPER TO PREVENT BACK SPINNING OF FAN.

THE SPACE THERMOSTAT SHALL MODULATE THE TERMINAL UNIT PRIMARY AIR DAMPER TO MAINTAIN OCCUPIED SPACE TEMPERATURE SETPOINT. ON A RISE IN SPACE TEMPERATURE, DAMPER SHALL MODULATE TOWARD MAXIMUM POSITION, ON A FALL IN SPACE TEMPERATURE, DAMPER SHALL MODULATE TOWARD MINIMUM POSITION, WHEN THE PRIMARY AIR DAMPER REACHES MINIMUM POSITION, AND THE SPACE TEMPERATURE CONTINUES TO FALL, THE THERMOSTAT SHALL MODULATE THE HEATING COIL CONTROL VALVE TO MAINTAIN SPACE TEMPERATURE SETPOINT, ON A RISE IN SPACE TEMPERATURE, THE OPPOSITE SHALL OCCUR.
2. WHEN THE ASSOCIATED AHU SYSTEM IS INDEXED TO "UNOCCUPIED", THE TERMINAL UNIT PRIMARY AIR DAMPER SHALL BE CLOSED, WHEN THE SPACE TEMPERATURE FALLS BELOW THE UNOCCUPIED SETPOINT, THE TERMINAL UNIT FAN SHALL ENERGIZE AND THE HEATING COIL CONTROL VALVE SHALL OPEN, WHEN SPACE TEMPERATURE IS SATISFIED, THE HEATING COIL VALVE SHALL CLOSE AND THE FAN SHALL BE DE-ENERGIZED, FAN SHALL RUN A MINIMUM OF TEN (10) MINUTES (ADJUSTABLE), TO AVOID OVER CYCLING.
3. WHEN THE ASSOCIATED AHU SYSTEM IS INDEXED TO "MORNING WARM-UP", THE TERMINAL UNIT PRIMARY AIR DAMPER SHALL OPEN TO MAXIMUM POSITION AND THE TERMINAL UNIT FAN SHALL BE ENERGIZED TO PERMIT FULL FLOW TO THE SPACE, THE HEATING COIL CONTROL VALVE SHALL BE MODULATED IN RESPONSE TO THE SPACE THERMOSTAT TO MAINTAIN THE SPACE TEMPERATURE SETPOINT.
4. WHEN THE ASSOCIATED AHU SYSTEM IS INDEXED TO "MORNING COOL DOWN", THE TERMINAL UNIT PRIMARY AIR DAMPER SHALL OPEN TO MAXIMUM POSITION AND THE TERMINAL UNIT FAN SHALL BE ENERGIZED TO PERMIT FULL FLOW TO THE SPACE.



- 3.4 FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)

MISC. HEATERS CONTROL

- A. HOT WATER WATER HEATERS (UH):
 - 1. PROVIDE NEW CONTROLS AND CONNECT TO BAS. EXISTING THERMOSTAT SHALL BE REMOVED AND REPLACED.
 - 2. THERMOSTATS SHALL BE DESIGNED TO OPERATE ON A 2" F DIFFERENTIAL OVER A RANGE OF 40° F-90° F. THERMOSTATS SHALL BE OF THE START/STOP TYPE WITH AN INTEGRAL "AUTO-OFF-FAN" SWITCH.
 - 3. IN THE "AUTO" POSITION THE UNIT FAN SHALL CYCLE TO MAINTAIN SETPOINT. PROVIDE AQUASTAT MOUNTED TO HEATING RETURN LINE TO PREVENT OPERATION OF CABINET UNIT HEATER FAN MOTOR WHEN HOT WATER HEATER IS NOT AVAILABLE TO COIL. AQUASTAT SETTING SHALL BE APPROXIMATELY 90° F
 - 4. IN THE "OFF" POSITION, FAN SHALL BE DE-ENERGIZED.
 - 5. IN THE "FAN" POSITION, FAN SHALL RUN REGARDLESS OF HOT WATER TEMPERATURE.
- B. ELECTRIC UNIT HEATERS (UH) & CABINET UNIT HEATERS (CUH):
 - 1. PROVIDE NEW CONTROLS AND CONNECT TO BAS. EXISTING THERMOSTAT SHALL BE REMOVED AND REPLACED.
 - 2. THERMOSTAT SHALL ENERGIZE HEATING ELEMENT AND FAN TO MAINTAIN SETPOINT.
- C. CONVECTORS (CONV):
 - 1. PROVIDE NEW CONTROLS AND CONNECT TO BAS. EXISTING THERMOSTAT SHALL BE REMOVED AND REPLACED.
 - 2. THERMOSTAT SHALL ENERGIZE HEATING ELEMENT TO MAINTAIN SETPOINT.
- D. FINNED TUBE RADIATORS (ALONG WINDOWS):
 - 1. PROVIDE NEW CONTROLS AND CONNECT TO BAS. EXISTING THERMOSTAT SHALL BE REMOVED AND REPLACED.
 - 2. THERMOSTAT SHALL MODULATE HEATING VALVE TO MAINTAIN SETPOINT.
- E. ELECTRIC BASEBOARD RADIATION:
 - 1. PROVIDE NEW CONTROLS AND CONNECT TO BAS. EXISTING THERMOSTAT SHALL BE REMOVED AND REPLACED.
 - 2. THERMOSTAT SHALL ENERGIZE HEATING ELEMENT TO MAINTAIN SETPOINT.

MISC. AIR CONDITIONING CONTROL

- A. SPLIT SYSTEM AC UNITS:
1. EACH THERMOSTAT/SENSOR SHALL HAVE INDIVIDUAL OCCUPIED AND UNOCCUPIED HEATING AND COOLING SETPOINTS. ALL SETPOINTS SHALL BE ADJUSTABLE THROUGH THE BAS. DEFAULT VALUES SHALL BE AS FOLLOVED, UNLESS OTHERWISE NOTED.
- B. HEAT PUMP AC UNITS:
1. EACH THERMOSTAT/SENSOR SHALL HAVE INDIVIDUAL OCCUPIED AND UNOCCUPIED HEATING AND COOLING SETPOINTS. ALL SETPOINTS SHALL BE ADJUSTABLE THROUGH THE BAS. DEFAULT VALUES SHALL BE AS FOLLOVED, UNLESS OTHERWISE NOTED.
- C. COMPUTER ROOM AC UNITS:
1. EACH THERMOSTAT/SENSOR SHALL HAVE INDIVIDUAL OCCUPIED AND UNOCCUPIED HEATING AND COOLING SETPOINTS. ALL SETPOINTS SHALL BE ADJUSTABLE THROUGH THE BAS. DEFAULT VALUES SHALL BE AS FOLLOVED, UNLESS OTHERWISE NOTED.

PROJECT NAME:

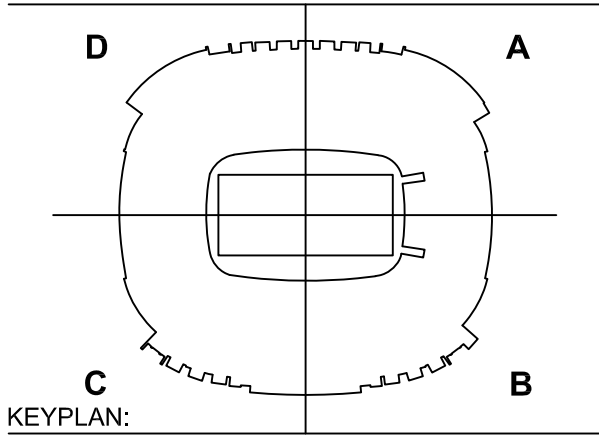
M&T BANK STADIUM
HVAC CONTROLS,
LIGHTING CONTROLS
AND SUBMETERING
SYSTEMS
IMPROVEMENTS

MSA PROJECT NO. 20-071

THE MARYLAND STADIUM
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SEAL:

PROFESSIONAL CERTIFICATION:

PROFESSIONAL CERTIFICATION: I HEREBY
CERTIFY THAT THESE DOCUMENTS WERE
PREPARED OR APPROVED BY ME, AND
THAT I AM A DULY LICENSED
PROFESSIONAL ENGINEER UNDER THE
LAWS OF THE STATE OF MARYLAND.
LICENSE NO. _____
EXPIRATION DATE: _____.

ISSUED FOR:

DATE DESCRIPTION

02/12/21 BID SET

04/02/21 ADDENDUM 01

PROJECT NO: 20092.01

SCALE: AS NOTED

DRAWN BY: MJG

CHECKED BY: CMP / MAF

DATE: FEBRUARY 12, 2021

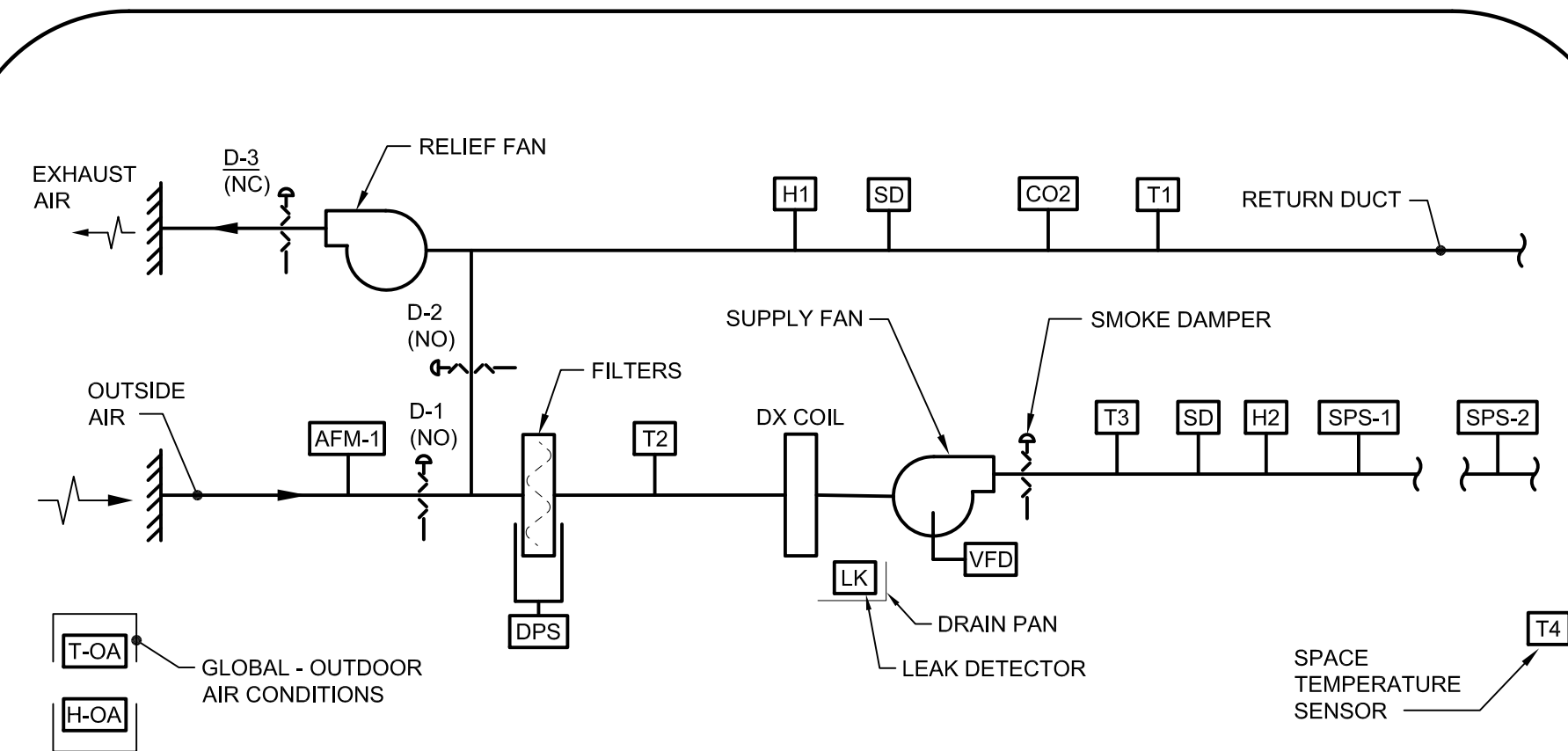
SHEET TITLE:

AUTOMATIC TEMPERATURE
CONTROLS

DRAWING NO:

M4.24

BKM# 20092.01



VAV ROOFTOP HEAT PUMP UNITS
(RTU-1 THRU 4)

- GENERAL
 - SUPPLY AIR FAN AND RELIEF AIR FAN OPERATION SHALL BE INTERLOCKED. SUPPLY AND RELIEF FANS SHALL OPERATE CONTINUOUSLY IN THE OCCUPIED MODE. H-O-A SWITCH SHALL BE KEPT IN 'AUTO' POSITION. IN 'OFF' POSITION, D-1 AND D-3 SHALL BE FULLY CLOSED AND D-2 SHALL BE FULLY OPEN. WHEN FANS ARE DE-ENERGIZED, D-1 AND D-3 SHALL BE FULLY CLOSED.
 - OCCUPIED-UNOCCUPIED MODE SHALL BE DETERMINED THE BUILDING AUTOMATION SYSTEM (BAS).
 - PROVIDE SEPARATE, INDEPENDENT LINKAGE CONTROL FOR EACH M.O.D. (D-1, D-2 & D-3).
 - OUTSIDE AIR TEMPERATURE AND HUMIDITY VALUES SHALL BE PROVIDED BY THE ASSOCIATED GLOBAL OA SENSORS. REFER TO GLOBAL OUTSIDE AIR CONDITIONS CONTROLS FOR ADDITIONAL INFORMATION. EACH UNIT SHALL REFERENCE THE GLOBAL SENSORS IN THE SAME QUADRANT IN WHICH THE UNIT IS LOCATED (DEFAULT), UNLESS OVERRIDDEN BY THE BAS.
- TEMPERATURE CONTROL
 - OCCUPIED:
 - WHEN THE OUTSIDE AIR ENTHALPY IS ABOVE THE RETURN AIR ENTHALPY, D-1, D-2 & D-3 SHALL MODULATE AS FOLLOWS:
 - D-1 (OUTSIDE AIR) SHALL MODULATE TO MINIMUM OUTSIDE AIR POSITION IN RESPONSE TO AIRFLOW MONITOR, AFM-1. SEE AIR FLOW CONTROL BELOW.
 - D-2 (RETURN AIR) SHALL FULLY OPEN.
 - D-3 (RELIEF AIR) SHALL BE CLOSED WHEN THE OUTSIDE AIR DAMPER IS AS MINIMUM OUTSIDE AIR POSITION (OR LESS), WHEN THE UNIT GOES TO ECONOMIZER, AND THE OUTSIDE AIR IS ABOVE MINIMUM AIRFLOW, THEN RELIEF DAMPER SHALL MODULATE OPEN AND TRACK WITH THE OA DAMPER. ALSO, RELIEF DAMPER SHALL OPEN WHENEVER BUILDING PRESSURE (P) VERSUS P₀ EXCEEDS 0.05" W.C.
 - WHEN THE OUTSIDE AIR ENTHALPY IS LESS THEN THE RETURN AIR ENTHALPY, D-1, D-2 & D-3 SHALL MODULATE TO MAXIMIZE ATMOSPHERIC (FREE) COOLING AND MAINTAIN A DISCHARGE AIR TEMPERATURE EQUAL TO THE SUPPLY AIR TEMPERATURE SETPOINT. D-2 (RETURN AIR) AND D-3 (RELIEF AIR) DAMPERS SHALL BE INTERLOCKED IN ECONOMIZER MODE SUCH THAT D-3 POSITION (% OPEN) = [100% MINUS D-2 POSITION (% OPEN)].
 - THE SUPPLY AIR TEMPERATURE, SENSED BY T3, SHALL THEN BE MAINTAINED AT SETPOINT BY MODULATING THE DX COIL AS REQUIRED. THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE AS PER THE FOLLOWING SUPPLY AIR RESET SCHEDULE (ALL TEMPERATURES SHALL BE ADJUSTABLE).

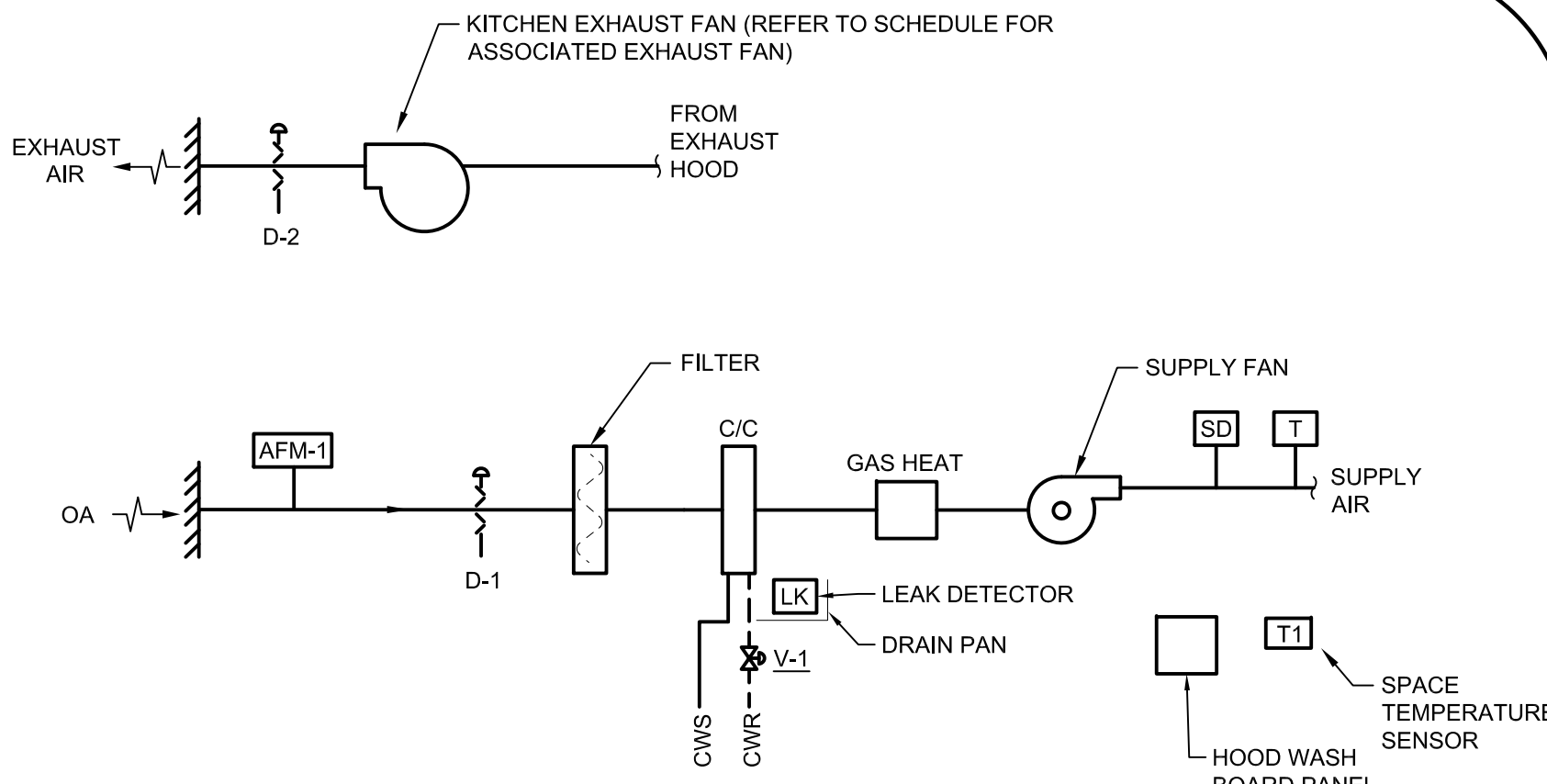
SUPPLY AIR RESET SCHEDULE	
OA TEMP (°F)	SUPPLY AIR TEMP (°F)
ABOVE 65	55
55 - 65	*
BELOW 55	60

SUPPLY AIR TEMPERATURE SHALL BE LINEAR BETWEEN
'ABOVE 65' SETPOINT AND 'BELOW 55' SETPOINT.

- UNOCCUPIED (HEATING): CYCLE FANS AND ENERGIZE DX COIL TO MAINTAIN ALL NIGHT SETBACK TEMPERATURES. D-1 AND D-3 SHALL BE FULLY CLOSED AND D-2 FULLY OPEN. WHEN SUPPLY FAN CYCLES 'ON' THE ASSOCIATED VAV TERMINAL DAMPERS SHALL OPEN. BELOW 35°F OUTSIDE AIR TEMPERATURE, DX COIL SHALL ENERGIZE TO MAINTAIN INTERIOR UNIT TEMPERATURE OF 90°F (ADJUSTABLE).
- UNOCCUPIED (COOLING): NIGHT THERMOSTAT/SENSOR AND HUMIDITY SENSOR SHALL CYCLE FAN(S) AND ENERGIZE DX COIL TO MAINTAIN NIGHT SETBACK TEMPERATURE AND HUMIDITY SETPOINTS (ADJUSTABLE). D-1 AND D-3 SHALL BE FULLY CLOSED AND D-2 FULLY OPEN.
- MORNING WARM-UP: WHEN SYSTEM IS FIRST INDEXED TO 'MORNING WARM-UP' MODE, DAMPERS D-1 & D-3 SHALL REMAIN CLOSED AND D-2 SHALL REMAIN OPEN. FANS SHALL ENERGIZE AND HEAT PUMP SHALL MODULATE TO MAINTAIN AN AHU LEAVING AIR TEMPERATURE OF 80°F (ADJ.), WHEN ALL SPACES REACH HEATING SETPOINT, OR WHEN OCCUPIED SCHEDULE BEGINS. THE SYSTEM SHALL TRANSITION FROM 'MORNING WARM-UP' TO 'OCCUPIED' MODE.
- MORNING COOLING DOWN: WHEN SYSTEM IS FIRST INDEXED TO 'MORNING COOL-DOWN' MODE, DAMPERS D-1 & D-3 SHALL REMAIN CLOSED, UNLESS ECONOMIZER CONDITIONS EXIST (SEE 2.1.B). SUPPLY AIR TEMPERATURE SHALL BE MAINTAINED AS PER 2.1.C ABOVE. LOCAL THERMOSTATS/SENSORS SHALL CONTROL VAV TERMINALS AS PER 'SPACE CONTROL'. SEQUENCE OF OPERATION TO MAINTAIN OCCUPIED COOLING SETPOINTS. WHEN ALL SPACES REACH COOLING SETPOINT, OR WHEN OCCUPIED SCHEDULE BEGINS, THE SYSTEM SHALL TRANSITION FROM 'MORNING COOL-DOWN' TO 'OCCUPIED' MODE.

3. AIR FLOW / FAN CONTROL

- OCCUPIED:
 - STATIC PRESSURE SENSOR, SPS-2, SHALL MODULATE THE SUPPLY FAN VARIABLE FREQUENCY DRIVE, VFD TO MAINTAIN THE SUPPLY DUCT STATIC PRESSURE SETPOINT.
 - FAN PRESSURE OPTIMIZATION (STATIC PRESSURE RESET): EVERY 10 MINUTES (ADJUSTABLE) DURING THE OCCUPIED MODE, THE DAMPER POSITIONS OF EACH VAV TERMINAL ASSOCIATED WITH THE RTU SHALL BE POLLED. BASED ON FEEDBACK FROM THE VAV DAMPER POSITIONS, THE STATIC PRESSURE SETPOINT SHALL BE RESET IN +0.1" W.C. INCREMENTS (MAX 0.1" PER 10 MINUTE POLLING CYCLE) BETWEEN A FIXED RANGE (LOW END SHALL BE MINIMUM 1.0" W.C. - ADJUSTABLE. UPPER END SHALL BE 0.25" W.C. ABOVE THE STATIC PRESSURE SETPOINT DETERMINED BY THE BALANCE CONTRACTOR). IF THERE ARE NO VAV DAMPER POSITIONS GREATER THAN 90% OPEN (ADJUSTABLE), THEN THE STATIC PRESSURE SET POINT SHALL BE LOWERED UNTIL AT LEAST ONE VAV DAMPER IS AT LEAST 90% OPEN (ADJUSTABLE). IF ANY ONE VAV DAMPER OPENS GREATER THAN 95% OPEN (ADJUSTABLE), THEN THE STATIC PRESSURE SET POINT SHALL BE RAISED UNTIL THE MAXIMUM VAV DAMPER POSITION IS BELOW 95% OPEN (ADJUSTABLE). IF THE MAX. VAV DAMPER POSITION IS BETWEEN 90% AND 95% OPEN (ADJUSTABLE), THEN THE STATIC PRESSURE SET POINT SHALL REMAIN IN STEADY STATE UNTIL THE NEXT TEN MINUTE POLLING CYCLE.
 - AIR FLOW MONITOR, AFM-1, LOCATED AT THE OUTSIDE AIR INTAKE SHALL MODULATE D-1 TO MAINTAIN VENTILATION AIR QUANTITY AS INDICATED ON AIR HANDLING UNIT SCHEDULE. AFM-1 CONTROL SHALL BE OVERRIDDEN DURING ECONOMIZER MODE (ATMOSPHERIC COOLING), OR BY AHU VENTILATION RESET CONTROL / DEMAND CONTROLLED VENTILATION (SEE ATC SPECIFICATION FOR AHU VENTILATION RESET REQUIREMENTS).
 - UNOCCUPIED: DURING NIGHT SETBACK AND MORNING WARM-UP OPERATION, FANS SHALL BE ENERGIZED AS PER 2.2 AND 2.3 ABOVE. RETURN FAN VARIABLE FREQUENCY DRIVE, VFD, SHALL MODULATE TO MAINTAIN FULL AIRFLOW (EQUAL TO SUPPLY AIRFLOW) DURING WARM-UP & NIGHT SETBACK OPERATION.
- MISCELLANEOUS
 - SMOKE DETECTORS, SD, LOCATED IN THE SUPPLY AND RETURN AIR SHALL DE-ENERGIZE FANS AND CLOSE ASSOCIATED SMOKE DAMPERS SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
 - HIGH LIMIT STATIC PRESSURE SENSOR, SPS-1 SHALL DE-ENERGIZE AHU FANS WHEN STATIC PRESSURE REACHES 6.0" (ADJUSTABLE). ALARM AT THE BAS.
 - THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.
 - ON FAILURE OF SUPPLY FAN OR RETURN FAN, DAMPERS D-1, D-2 AND D-3 SHALL CLOSE. ALARM AT BAS.
 - MONITOR RETURN AIR CO2 SENSORS AT THE BAS.
 - CONDENSATE WATER LEAK DETECTOR, LK, SHALL BE INSTALLED IN THE COOLING COIL DRAIN PAN AT A LEVEL HIGHER THAN THE DRAIN CONNECTION. WHEN AN OVERFLOW CONDITION IS SENSED THE LEAK DETECTOR SHALL SHUT DOWN THE UNIT (HARD-WIRED) AND ALARM AT THE BAS.

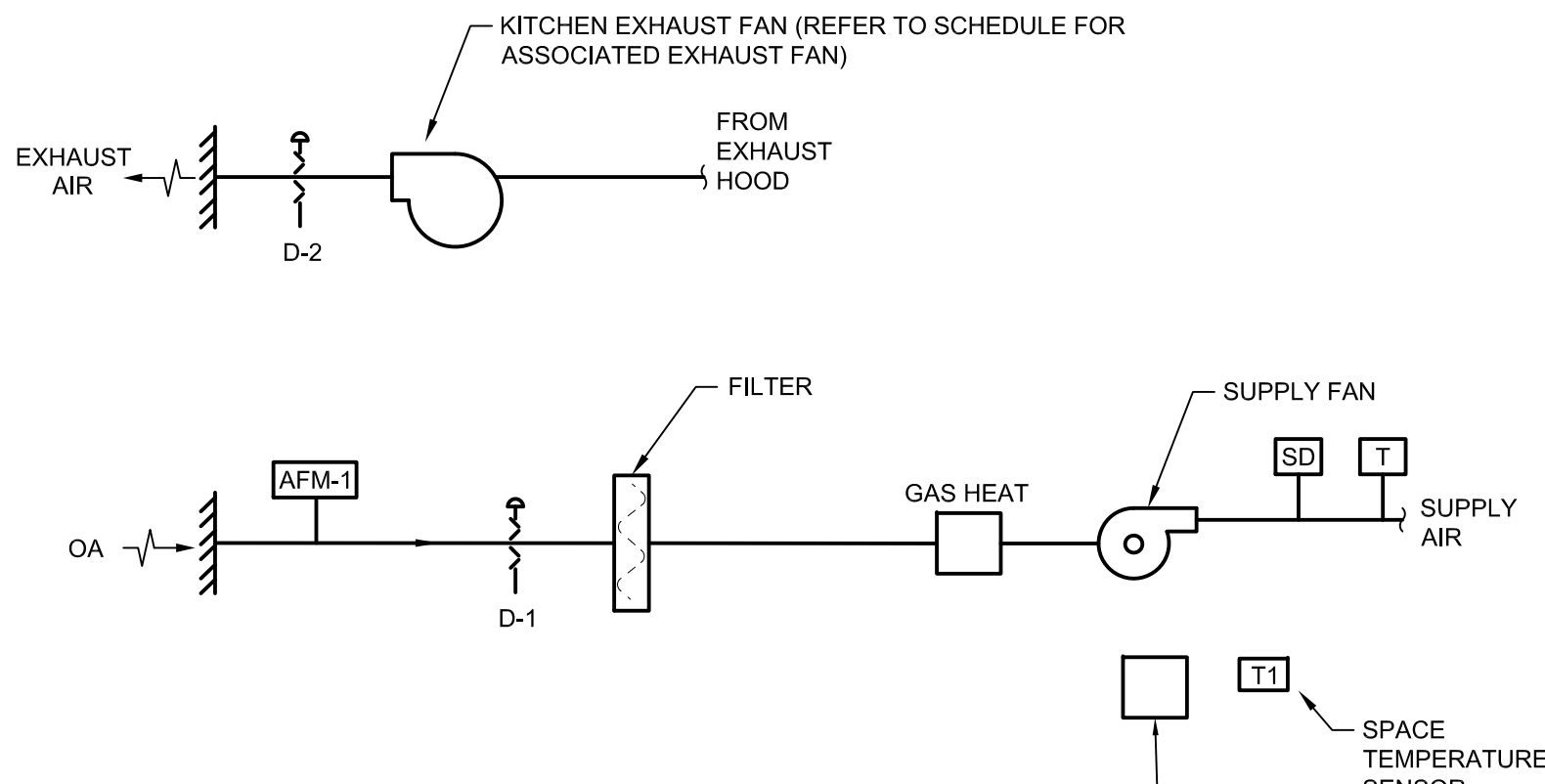


MAKEUP AIR UNIT & KITCHEN EXHAUST WITH COOLING COIL CONTROL

- GENERAL
 - IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN 'AUTO' POSITION. IN THE 'OFF' POSITION D-1 SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, D-1 SHALL BE FULLY CLOSED.
 - OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
 - HOOD WASH BOARD PANEL SHALL BE INTERLOCKED WITH THE MAKE-UP AIR UNIT AND KITCHEN EXHAUST FAN. PANEL MUST BE SET TO 'ON' FOR UNITS TO OPERATE.
- TEMPERATURE CONTROL
 - OCCUPIED HEATING MODE:
 - SUPPLY FAN AND EXHAUST FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) & D-2 (EXHAUST AIR) SHALL FULLY OPEN.
 - THE SPACE TEMPERATURE SHALL THEN BE MAINTAINED AT 50° (ADJUSTABLE) BY MODULATING GAS FIRED HEAT AS REQUIRED.
 - OCCUPIED COOLING MODE:
 - SUPPLY FAN AND EXHAUST FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) & D-2 (EXHAUST AIR) SHALL FULLY OPEN.
 - THE SPACE TEMPERATURE SHALL THEN BE MAINTAINED AT 80° (ADJUSTABLE) BY MODULATING VALVE V-1 AS REQUIRED.
 - UNOCCUPIED HEATING:
 - EXHAUST FANS WILL BE DE-ENERGIZED AND ASSOCIATED DAMPER D-2 SHALL BE CLOSED.
 - FOR CONCESSION STANDS WITH ELECTRIC HEATERS (STANDS 129 & 152): MAKEUP AIR UNIT WILL BE DE-ENERGIZED AND ASSOCIATED DAMPERS D-1 SHALL BE CLOSED.
ELECTRIC UNIT HEATERS WITHIN SPACE (WITH BUILT IN THERMOSTATS) WILL CYCLE ON & OFF TO MAINTAIN 50°F (ADJUSTABLE).
 - FOR CONCESSION STANDS WITHOUT ELECTRIC HEATERS (ALL OTHER STANDS): MAKEUP AIR UNIT MAINTAIN UNOCCUPIED HEATING SETPOINT OF 50°F (ADJ.), WHEN SPACE TEMPERATURE DROPS TO 5°F BELOW SETPOINT, UNIT SHALL CYCLE ON AND OPERATE THE GAS HEAT UNTIL SPACE TEMPERATURE IS MET, OR FOR A MINIMUM FIFTEEN (15) MINUTES (ADJ.).
 - UNOCCUPIED COOLING:
 - MAKEUP AIR UNIT AND ASSOCIATED EXHAUST FANS WILL BE DE-ENERGIZED AND DAMPERS D-1 & D-2 AND VALVE V-1 SHALL BE CLOSED.
- MISCELLANEOUS
 - ON A FAILURE OF SUPPLY FAN, DAMPER D-1 SHALL CLOSE. ALARM AT BAS.
 - SMOKE DETECTORS, SD, SHALL DE-ENERGIZE FANS SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
 - THE SYSTEM SHALL ALARM WHEN ROOM SENSOR T-1 DROPS BELOW 50°F (ADJUSTABLE).
 - DIRECT GAS FIRED HEATER CONTROL PANEL SHALL BE INTERLOCKED WITH GAS EMERGENCY SHUT OFF SYSTEM ASSOCIATED WITH GAS COOKING EQUIPMENT. AUTOMATIC SHUT-DOWN SHALL BE PROVIDED AS REQUIRED BY NFPA.
 - CONDENSATE WATER LEAK DETECTOR, LK, SHALL BE INSTALLED IN THE COOLING COIL DRAIN PAN AT A LEVEL HIGHER THAN THE DRAIN CONNECTION. WHEN AN OVERFLOW CONDITION IS SENSED THE LEAK DETECTOR SHALL SHUT DOWN THE UNIT (HARD-WIRED) AND ALARM AT THE BAS.

CONCESSION STAND EXHAUST FANS CONTROL

- EACH CONCESSION STAND EXHAUST FAN SHALL BE CONTROLLED BY A THERMOSTAT. UPON A RISE IN SPACE TEMPERATURE ABOVE 85°F (ADJUSTABLE), THE FAN SHALL ENERGIZE. UPON A FALL IN SPACE TEMPERATURE BELOW 80°F (ADJUSTABLE).
- ALL SETPOINTS LISTED ABOVE SHALL BE ADJUSTABLE.
- EACH FAN (TYP. 24) SHALL HAVE THE ABILITY TO BE TURNED ON/OFF AT THE BAS.
- ALL CONCESSION STAND EXHAUST FANS (TYP. 24) SHALL HAVE THE ABILITY TO BE TURNED ON/OFF AS A GROUP.
- MONITOR STATUS AND ALARM AT BAS UPON FAILURE OF EXHAUST FAN.



MAKEUP AIR UNIT & KITCHEN EXHAUST CONTROL

- GENERAL
 - IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN 'AUTO' POSITION. IN THE 'OFF' POSITION D-1 SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, D-1 SHALL BE FULLY CLOSED.
 - OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
 - HOOD WASH BOARD PANEL SHALL BE INTERLOCKED WITH THE MAKE-UP AIR UNIT AND KITCHEN EXHAUST FAN. PANEL MUST BE SET TO 'ON' FOR UNITS TO OPERATE.
- TEMPERATURE CONTROL
 - OCCUPIED HEATING MODE:
 - SUPPLY FAN AND EXHAUST FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) & D-2 (EXHAUST AIR) SHALL FULLY OPEN.
 - THE SPACE TEMPERATURE SHALL THEN BE MAINTAINED AT 50° (ADJUSTABLE) BY MODULATING GAS FIRED HEAT AS REQUIRED.
 - UNOCCUPIED HEATING:
 - EXHAUST FANS WILL BE DE-ENERGIZED AND ASSOCIATED DAMPER D-2 SHALL BE CLOSED.
 - FOR CONCESSION STANDS WITH ELECTRIC HEATERS (STANDS 129 & 152): MAKEUP AIR UNIT WILL BE DE-ENERGIZED AND ASSOCIATED DAMPERS D-1 SHALL BE CLOSED.
ELECTRIC UNIT HEATERS WITHIN SPACE (WITH BUILT IN THERMOSTATS) WILL CYCLE ON & OFF TO MAINTAIN 50°F (ADJUSTABLE).
 - FOR CONCESSION STANDS WITHOUT ELECTRIC HEATERS (ALL OTHER STANDS): MAKEUP AIR UNIT MAINTAIN UNOCCUPIED HEATING SETPOINT OF 50°F (ADJ.), WHEN SPACE TEMPERATURE DROPS TO 5°F BELOW SETPOINT, UNIT SHALL CYCLE ON AND OPERATE THE GAS HEAT UNTIL SPACE TEMPERATURE IS MET, OR FOR A MINIMUM FIFTEEN (15) MINUTES (ADJ.).
- MISCELLANEOUS
 - ON A FAILURE OF SUPPLY FAN, DAMPER D-1 SHALL CLOSE. ALARM AT BAS.
 - SMOKE DETECTORS, SD, SHALL DE-ENERGIZE FANS SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
 - THE SYSTEM SHALL ALARM WHEN ROOM SENSOR T-1 DROPS BELOW 50°F (ADJUSTABLE).
 - DIRECT GAS FIRED HEATER CONTROL PANEL SHALL BE INTERLOCKED WITH GAS EMERGENCY SHUT OFF SYSTEM ASSOCIATED WITH GAS COOKING EQUIPMENT. AUTOMATIC SHUT-DOWN SHALL BE PROVIDED AS REQUIRED BY NFPA.

RTU 1 THRU 4 POINTS LIST

OBJECT NAME	READ/WRITE
ANALOG INPUT	
DISCHARGE AIR TEMPERATURE	READ
SPACE TEMPERATURE LOCAL	READ
SPACE TEMPERATURE SETPOINT LOCAL	READ
DUCT STATIC PRESSURE	READ
ANALOG OUTPUT	
SUPPLY FAN VFD	READ
ANALOG VALUE	
DISCHARGE AIR COOLING SETPOINT	READ / WRITE
DISCHARGE AIR HEATING SETPOINT	READ / WRITE
DUCT STATIC PRESSURE SETPOINT	READ / WRITE
SPACE TEMPERATURE BAS	READ / WRITE
SPACE TEMPERATURE SETPOINT BAS	READ / WRITE
SPACE TEMPERATURE ACTIVE	READ
SPACE TEMPERATURE SETPOINT ACTIVE	READ
UNOCCUPIED COOLING SETPOINT	READ / WRITE
UNOCCUPIED HEATING SETPOINT	READ / WRITE
COOLING CALC	READ
HEATING CALC	READ
COOLING CALC P-GAIN	READ / WRITE
HEATING CALC P-GAIN	READ / WRITE
VFD CALC P-GAIN	READ / WRITE

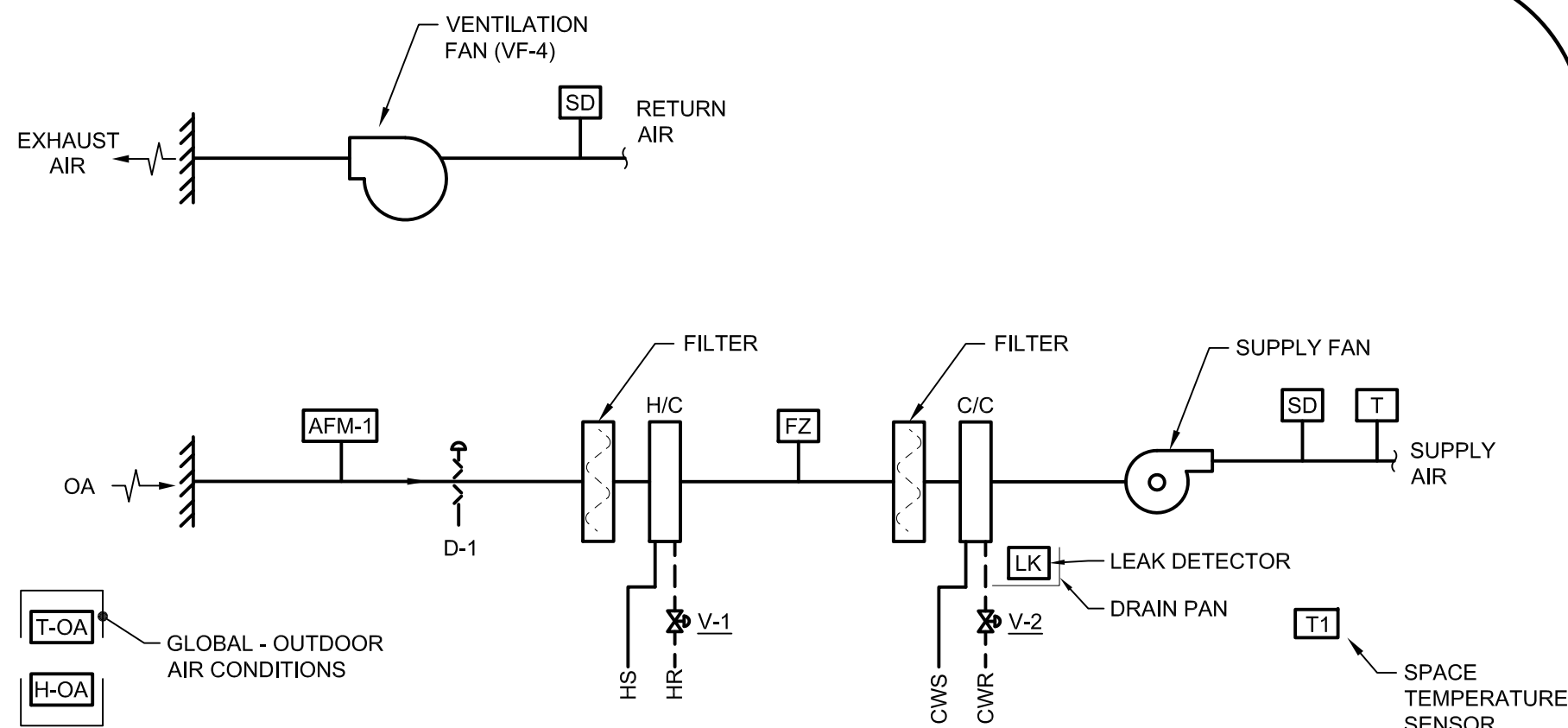
RTU 1 THRU 4 POINTS LIST

OBJECT NAME	READ/WRITE
BINARY INPUT	
OCCUPANCY SWITCH LOCAL	READ
DAYTIME WARMUP ALLOW LOCAL	READ
FROSTAT	READ
FAN PROVING SWITCH	READ
BINARY OUTPUT	
FAN S/S	READ
COMPRESSOR 1 S/S	READ
COMPRESSOR 2 S/S	READ
REVERSING VALVE	READ
AUXILIARY HEAT	READ
VHR	READ
BINARY VALUE	
UNIT CONTROL	READ / WRITE
OCCUPANCY SWITCH BAS	READ / WRITE
DAYTIME WARMUP ALLOW BAS	READ / WRITE
OCCUPANCY STATUS	READ
COOLING MODE	READ
HEATING COIL	READ
HEATING MODE	READ
UNOCCUPIED COOLING MODE	READ
UNOCCUPIED HEATING MODE	READ
LOW TEMPERATURE SAFETY	READ
CHANGEOVER DELAY	READ

VENTILATION FANS

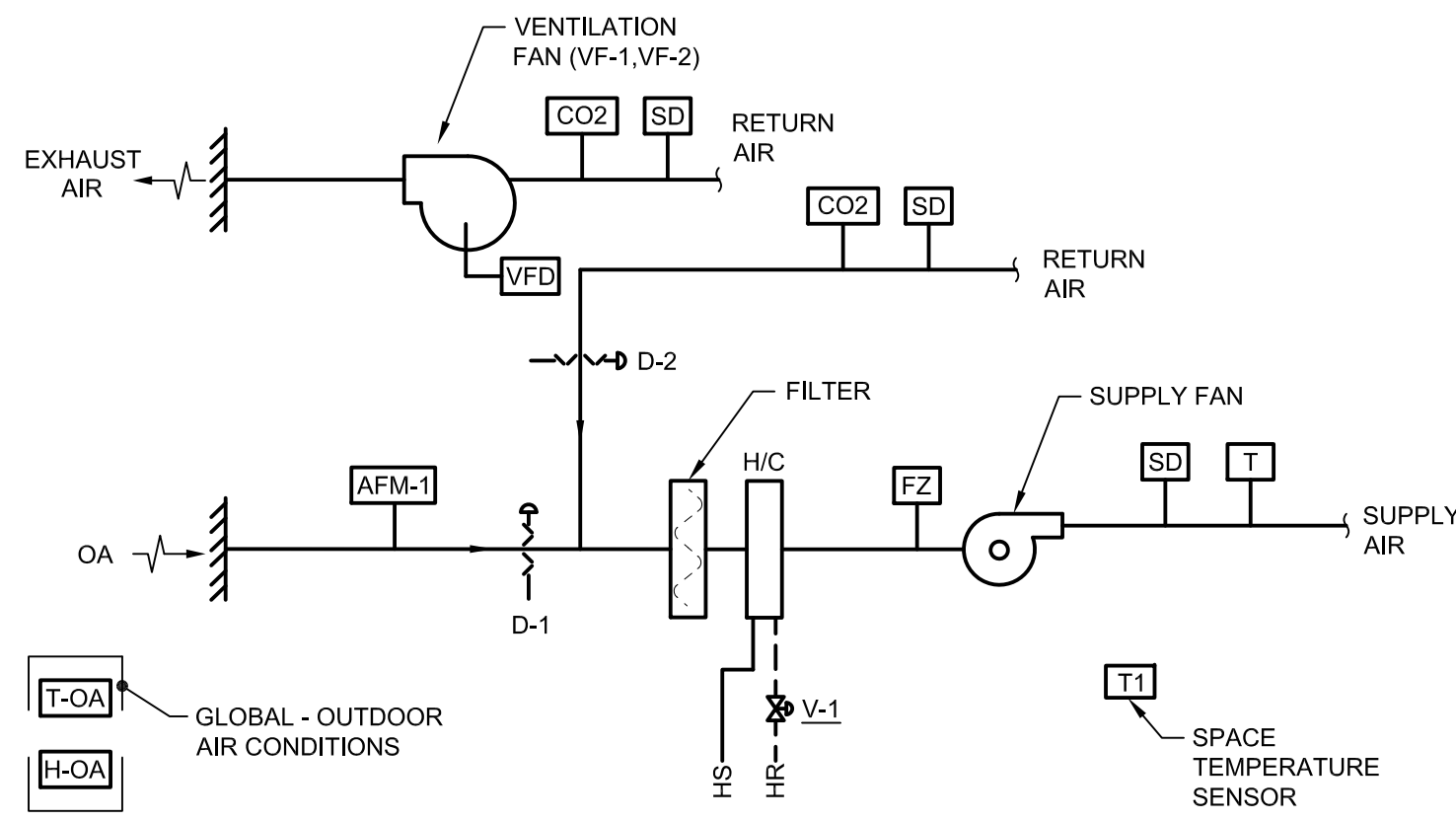
- GENERAL
 - MOTOR OPERATED DAMPERS (MOD) SHALL BE CLOSED WHEN FANS ARE NOT ENERGIZED. WHEN FANS FIRST RECEIVE A SIGNAL TO OPERATE, ASSOCIATED MOD SHALL OPEN. MOD SHALL OPEN TO 75% (ADJ.) PRIOR TO FANS ENERGIZING.
 - EACH MOD SHALL BE PROVIDED WITH AN END-SWITCH AND MONITORED THROUGH THE BAS.
 - PROVIDE SEPERATE BAS GRAPHICS PAGE FOR VENTILATION FANS.
- FAN CONTROL
 - VF-8 & VF-9: VENTILATION FANS SHALL BE CONTROLLED BY THE SAME THERMOSTAT. UPON A RISE IN SPACE TEMPERATURE, ABOVE 80°F (ADJUSTABLE), VF-8 SHALL ENERGIZE. ON A CONTINUED RISE IN SPACE TEMPERATURE, VF-9 SHALL ENERGIZE. UPON A FALL IN SPACE TEMPERATURE, BELOW 80°F (ADJUSTABLE), THE FANS SHALL DE-ENERGIZE. FANS SHALL BE INTERLOCKED WITH ASSOCIATED EXHAUST AND INTAKE MOD'S.
 - VF-11, 12, 13, 25 & 30: VENTILATION FANS SHALL BE CONTROLLED BY INDIVIDUAL THERMOSTATS. UPON A RISE IN SPACE TEMPERATURE, ABOVE 85°F (ADJUSTABLE), THE FAN SHALL ENERGIZE. UPON A FALL IN SPACE TEMPERATURE, BELOW 80°F (ADJUSTABLE), THE FAN SHALL DE-ENERGIZE. FAN SHALL BE INTERLOCKED WITH ASSOCIATED EXHAUST AND INTAKE MOD'S.
 - VF-10, 24, 26, 27, 28, 29 & 31: VENTILATION FANS SHALL BE CONTROLLED BY INDIVIDUAL THERMOSTATS. UPON A RISE IN SPACE TEMPERATURE, ABOVE 85°F (ADJUSTABLE), THE FAN SHALL ENERGIZE. UPON A FALL IN SPACE TEMPERATURE, BELOW 80°F (ADJUSTABLE), THE FAN SHALL DE-ENERGIZE. FAN SHALL BE INTERLOCKED WITH ASSOCIATED EXHAUST AND INTAKE MOD'S.

DESIG.	REMARKS	DESIG.	REMARKS
VF-1	REFER TO HVU-1	VF-12	REFER TO NOTE 2 ABOVE
VF-2	REFER TO HVU-2	VF-13	REFER TO NOTE 2 ABOVE
VF-3	REFER TO HVU-3	VF-14 THRU VF-23	DO NOT EXIST
VF-4	REFER TO HVU-4	VF-24	REFER TO NOTE 2 ABOVE
VF-5	REFER TO HVU-5	VF-25 (A, B, C, D)	REFER TO NOTE 2 ABOVE
VF-6	REFER TO AHU-6	VF-26 (A & B)	REFER TO NOTE 2 ABOVE
VF-7	REFER TO HVU-7	VF-27 (A & B)	REFER TO NOTE 2 ABOVE
VF-8	REFER TO NOTE 2 ABOVE	VF-28 (A & B)	REFER TO NOTE 2 ABOVE
VF-9	REFER TO NOTE 2 ABOVE	VF-29 (A & B)	REFER TO NOTE 2 ABOVE
VF-10	REFER TO NOTE 2 ABOVE	VF-30 (A, B, C, D)	REFER TO NOTE 2 ABOVE
VF-11	REFER TO NOTE 2 ABOVE	VF-31 (A & B)	REFER TO NOTE 2 ABOVE



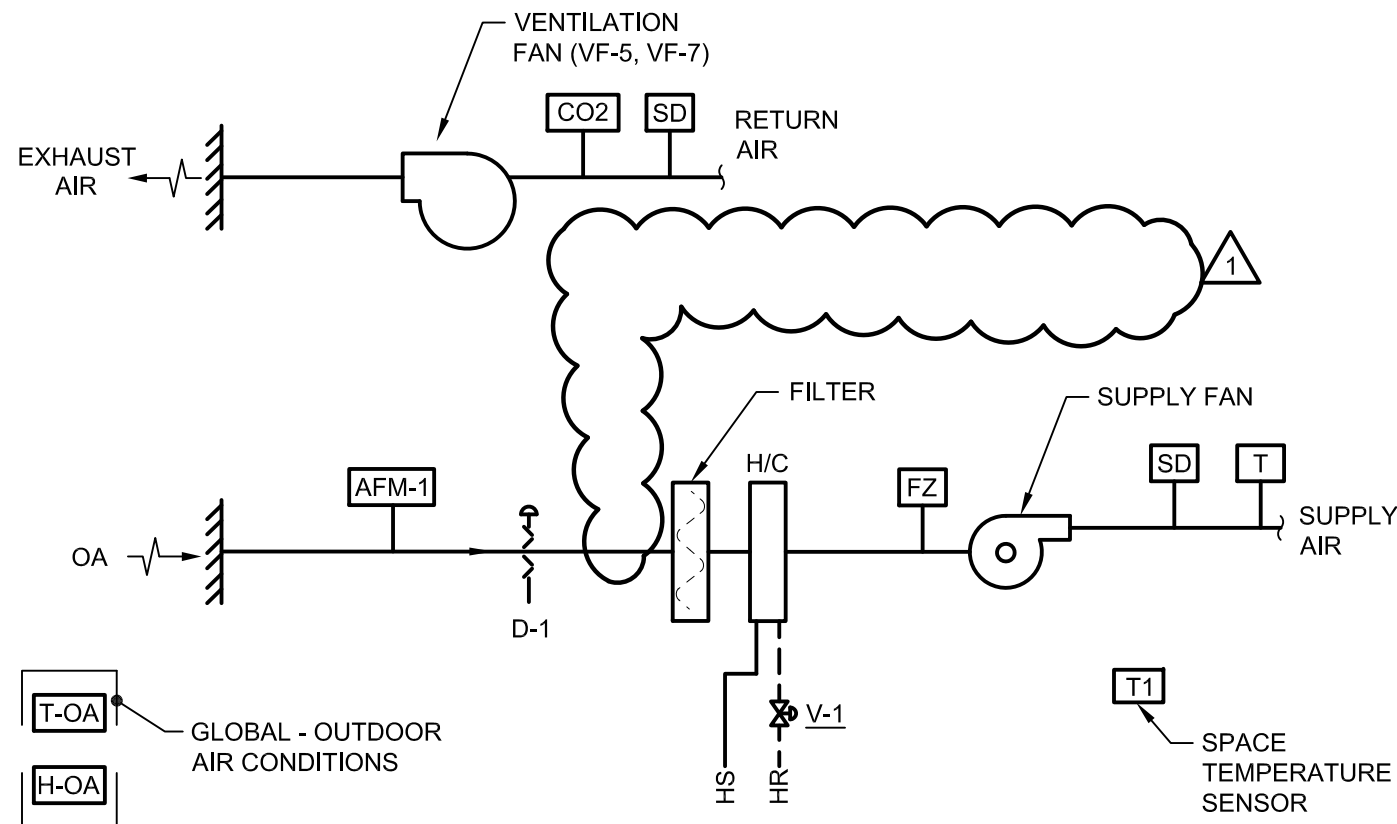
HVU-4 CONTROL

- GENERAL
 - IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION D-1 SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, D-1 SHALL BE FULLY CLOSED.
 - OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
 - OUTSIDE AIR TEMPERATURE AND HUMIDITY VALUES SHALL BE PROVIDED BY THE ASSOCIATED GLOBAL OA SENSORS. REFER TO GLOBAL OUTSIDE AIR CONDITIONS CONTROLS FOR ADDITIONAL INFORMATION. EACH UNIT SHALL REFERENCE THE GLOBAL SENSORS IN THE SAME QUADRANT IN WHICH THE UNIT IS LOCATED (DEFAULT), UNLESS OVERRIDDEN BY THE BAS.
- TEMPERATURE CONTROL
 - OCCUPIED MODE:
 - SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) SHALL FULLY OPEN.
 - THE SPACE TEMPERATURE, SENSED BY T1, SHALL THEN BE MAINTAINED BY MODULATING V-1 & V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED.
 - UNOCCUPIED:
 - ON A FALL IN SPACE TEMPERATURE BELOW 50°F (ADJUSTABLE), SYSTEM SHALL RUN IN OCCUPIED HEATING MODE UNTIL SPACE TEMPERATURE REACHES 55°F (ADJUSTABLE). ONCE SYSTEM REACHES DESIRED TEMPERATURE, THE SYSTEM SHALL DE-ENERGIZE.
 - MORNING WARM UP MODE:
 - WHEN SYSTEM IS INDEXED TO "MORNING WARM-UP MODE", DAMPER D-1 SHALL REMAIN CLOSED AND D-2 SHALL REMAIN OPEN. FAN SHALL ENERGIZE AND HEATING VALVE SHALL OPEN TO 100% (ADJ.). WHEN RETURN AIR TEMPERATURE, AS SENSED BY T1, REACHES SETPOINT OF 70°F (ADJUSTABLE) OR WHEN OCCUPIED SCHEDULE BEGINS, THE SYSTEM SHALL TRANSITION FROM "MORNING WARM-UP" MODE TO "OCCUPIED" MODE.
- MISCELLANEOUS
 - ON A FAILURE OF SUPPLY FAN, DAMPER D-1 SHALL CLOSE. ALARM AT BAS.
 - SMOKE DETECTORS, SD, LOCATED IN THE SUPPLY AND EXHAUST AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
 - THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.
 - FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)



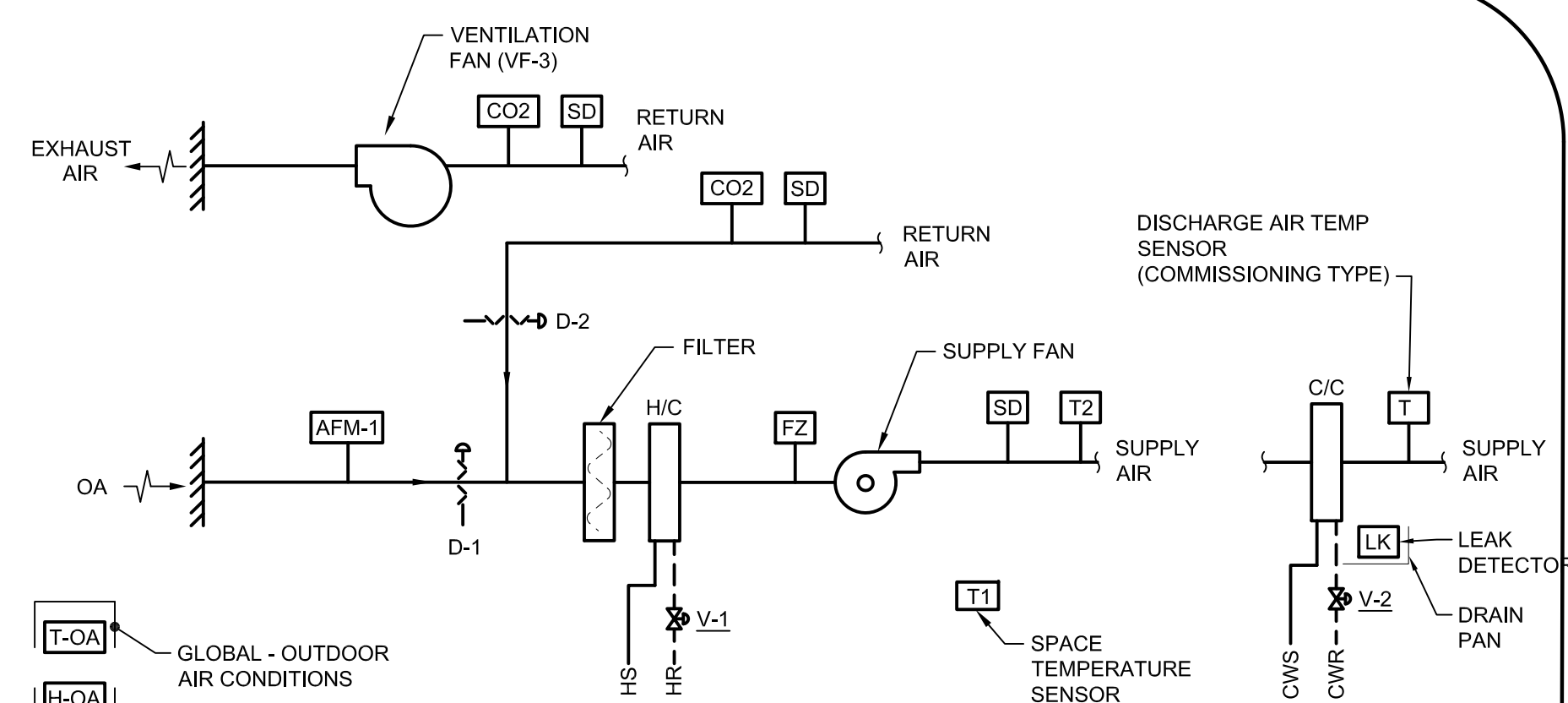
HVU-1 & 2 CONTROL

- GENERAL
 - IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION D-1 SHALL BE FULLY CLOSED AND D-2 SHALL BE FULLY OPEN. WHEN FANS ARE DE-ENERGIZED, D-1 SHALL BE FULLY CLOSED AND D-2 SHALL BE FULLY OPEN.
 - OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
 - OUTSIDE AIR TEMPERATURE AND HUMIDITY VALUES SHALL BE PROVIDED BY THE ASSOCIATED GLOBAL OA SENSORS. REFER TO GLOBAL OUTSIDE AIR CONDITIONS CONTROLS FOR ADDITIONAL INFORMATION. EACH UNIT SHALL REFERENCE THE GLOBAL SENSORS IN THE SAME QUADRANT IN WHICH THE UNIT IS LOCATED (DEFAULT), UNLESS OVERRIDDEN BY THE BAS.
- TEMPERATURE CONTROL
 - OCCUPIED HEATING MODE:
 - SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) SHALL FULLY OPEN. D-2 (RETURN AIR) SHALL BE CLOSED.
 - THE SPACE TEMPERATURE, SENSED BY T1, SHALL THEN BE MAINTAINED BY MODULATING V-1 AS REQUIRED.
 - OCCUPIED VENTILATION MODE:
 - SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) SHALL FULLY OPEN. D-2 (RETURN AIR) SHALL BE CLOSED.
 - V-1 SHALL BE CLOSED.
 - UNOCCUPIED:
 - D-1 (OUTSIDE AIR) SHALL BE FULLY CLOSED. D-2 (RETURN AIR) SHALL BE OPEN.
 - CYCLE FAN AND MODULATE V-1 AS REQUIRED TO MAINTAIN UNOCCUPIED SETPOINT.
 - MORNING WARM UP MODE:
 - WHEN SYSTEM IS INDEXED TO "MORNING WARM-UP MODE", DAMPER D-1 SHALL REMAIN CLOSED AND D-2 SHALL REMAIN OPEN. FAN SHALL ENERGIZE AND HEATING VALVE SHALL OPEN TO 100% (ADJ.). WHEN RETURN AIR TEMPERATURE, AS SENSED BY T1, REACHES SETPOINT OF 70°F (ADJUSTABLE) OR WHEN OCCUPIED SCHEDULE BEGINS, THE SYSTEM SHALL TRANSITION FROM "MORNING WARM-UP" MODE TO "OCCUPIED" MODE.
- MISCELLANEOUS
 - ON A FAILURE OF SUPPLY FAN, DAMPER D-1 SHALL CLOSE AND D-2 SHALL BE OPEN. ALARM AT BAS.
 - SMOKE DETECTORS, SD, LOCATED IN THE SUPPLY, EXHAUST AND RETURN AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
 - THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.
 - FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)



HVU-5 & 7 CONTROL

- GENERAL
 - IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION D-1 SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, D-1 SHALL BE FULLY CLOSED.
 - OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
 - OUTSIDE AIR TEMPERATURE AND HUMIDITY VALUES SHALL BE PROVIDED BY THE ASSOCIATED GLOBAL OA SENSORS. REFER TO GLOBAL OUTSIDE AIR CONDITIONS CONTROLS FOR ADDITIONAL INFORMATION. EACH UNIT SHALL REFERENCE THE GLOBAL SENSORS IN THE SAME QUADRANT IN WHICH THE UNIT IS LOCATED (DEFAULT), UNLESS OVERRIDDEN BY THE BAS.
- TEMPERATURE CONTROL
 - OCCUPIED HEATING MODE:
 - SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) SHALL FULLY OPEN.
 - THE SPACE TEMPERATURE, SENSED BY T1, SHALL THEN BE MAINTAINED BY MODULATING V-1 AS REQUIRED.
 - OCCUPIED VENTILATION MODE:
 - SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) SHALL FULLY OPEN.
 - V-1 SHALL BE CLOSED.
 - UNOCCUPIED:
 - SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY. D-1 (OUTSIDE AIR) SHALL BE FULLY OPEN.
 - CYCLE FAN AND MODULATE V-1 AS REQUIRED TO MAINTAIN UNOCCUPIED SETPOINT.
 - MORNING WARM UP MODE:
 - WHEN SYSTEM IS INDEXED TO "MORNING WARM-UP MODE", DAMPER D-1 SHALL REMAIN CLOSED AND D-2 SHALL REMAIN OPEN. FAN SHALL ENERGIZE AND HEATING VALVE SHALL OPEN TO 100% (ADJ.). WHEN RETURN AIR TEMPERATURE, AS SENSED BY T1, REACHES SETPOINT OF 70°F (ADJUSTABLE) OR WHEN OCCUPIED SCHEDULE BEGINS, THE SYSTEM SHALL TRANSITION FROM "MORNING WARM-UP" MODE TO "OCCUPIED" MODE.
- MISCELLANEOUS
 - ON A FAILURE OF SUPPLY FAN, DAMPER D-1 SHALL CLOSE. ALARM AT BAS.
 - SMOKE DETECTORS, SD, LOCATED IN THE SUPPLY AND EXHAUST AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
 - THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.
 - FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)



HVU-3 CONTROL

- GENERAL
 - IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION D-1 SHALL BE FULLY CLOSED AND D-2 SHALL BE FULLY OPEN. WHEN FANS ARE DE-ENERGIZED, D-1 SHALL BE FULLY CLOSED AND D-2 SHALL BE FULLY OPEN.
 - OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
 - OUTSIDE AIR TEMPERATURE AND HUMIDITY VALUES SHALL BE PROVIDED BY THE ASSOCIATED GLOBAL OA SENSORS. REFER TO GLOBAL OUTSIDE AIR CONDITIONS CONTROLS FOR ADDITIONAL INFORMATION. EACH UNIT SHALL REFERENCE THE GLOBAL SENSORS IN THE SAME QUADRANT IN WHICH THE UNIT IS LOCATED (DEFAULT), UNLESS OVERRIDDEN BY THE BAS.
- TEMPERATURE CONTROL
 - OCCUPIED MODE:
 - SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) SHALL MODULATE TO MINIMUM OUTSIDE AIR POSITION IN RESPONSE TO AIRFLOW MONITOR, AFM-1.
 - THE SPACE TEMPERATURE, SENSED BY T1, SHALL THEN BE MAINTAINED BY MODULATING V-1 & V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED.
 - OCCUPIED VENTILATION MODE:
 - SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.
 - D-1 (OUTSIDE AIR) SHALL FULLY OPEN. D-2 (RETURN AIR) SHALL BE CLOSED.
 - V-1 & V-2 SHALL BE CLOSED.
 - UNOCCUPIED:
 - D-1 (OUTSIDE AIR) SHALL BE FULLY CLOSED. D-2 (RETURN AIR) SHALL BE OPEN.
 - CYCLE FAN AND MODULATE V-1 & V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED TO MAINTAIN UNOCCUPIED SETPOINT.
 - MORNING WARM UP MODE:
 - WHEN SYSTEM IS INDEXED TO "MORNING WARM-UP MODE", DAMPER D-1 SHALL REMAIN CLOSED AND D-2 SHALL REMAIN OPEN. FAN SHALL ENERGIZE AND HEATING VALVE SHALL OPEN TO 100% (ADJ.). WHEN RETURN AIR TEMPERATURE, AS SENSED BY T1, REACHES SETPOINT OF 70°F (ADJUSTABLE) OR WHEN OCCUPIED SCHEDULE BEGINS, THE SYSTEM SHALL TRANSITION FROM "MORNING WARM-UP" MODE TO "OCCUPIED" MODE.
- MISCELLANEOUS
 - ON A FAILURE OF SUPPLY FAN, DAMPER D-1 SHALL CLOSE AND D-2 SHALL BE OPEN. ALARM AT BAS.
 - SMOKE DETECTORS, SD, LOCATED IN THE SUPPLY, EXHAUST AND RETURN AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
 - THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.
 - FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)

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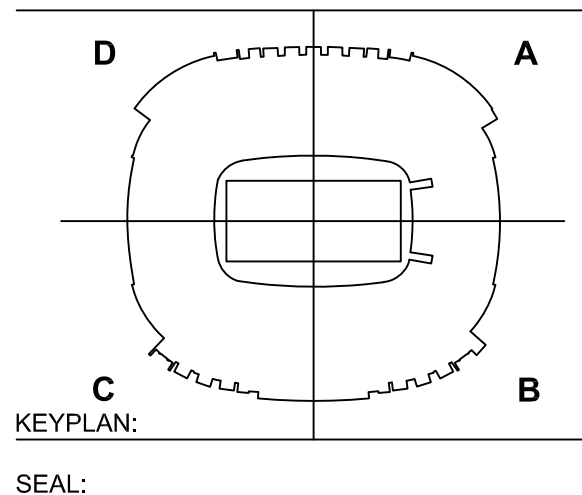
PROJECT NAME:

**M&T BANK STADIUM
HVAC CONTROLS,
LIGHTING CONTROLS
AND SUBMETERING
SYSTEMS
IMPROVEMENTS**

MSA PROJECT NO. 20-071

**THE MARYLAND STADIUM
AUTHORITY
333 WEST CAMDEN STREET, SUITE 500
BALTIMORE, MD 21201**

CONSULTANTS:
WET ENGINEERING, INC.
1801 RESEARCH BOULEVARD, SUITE 100
ROCKVILLE, MARYLAND 20850
P: 301-230-0811



PROFESSIONAL CERTIFICATION: I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND. LICENSE NO. _____ EXPIRATION DATE: _____.

ISSUED FOR:

DATE	DESCRIPTION
02/12/21	BID SET
04/02/21	ADDENDUM 01

PROJECT NO: 20092.01

SCALE: AS NOTED

DRAWN BY: MJG

CHECKED BY: CMP / MAF

DATE: FEBRUARY 12, 2021

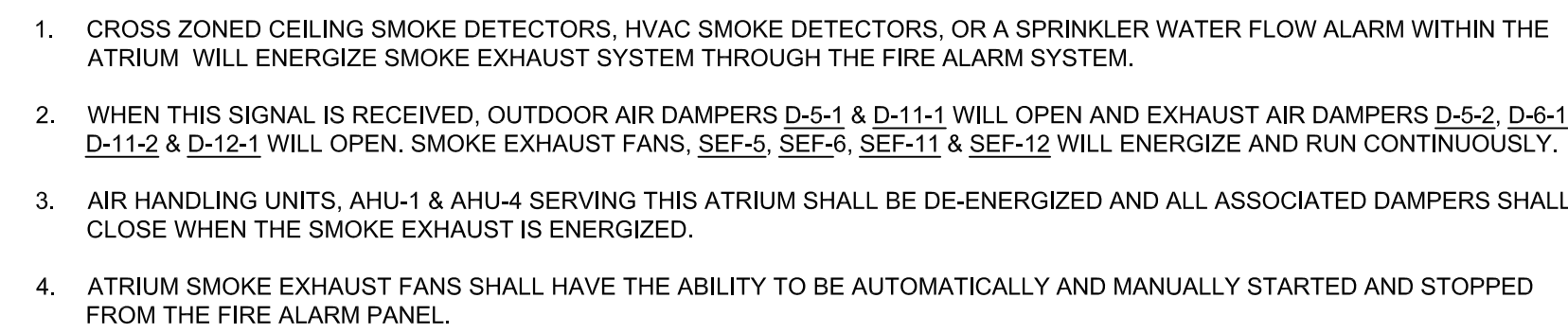
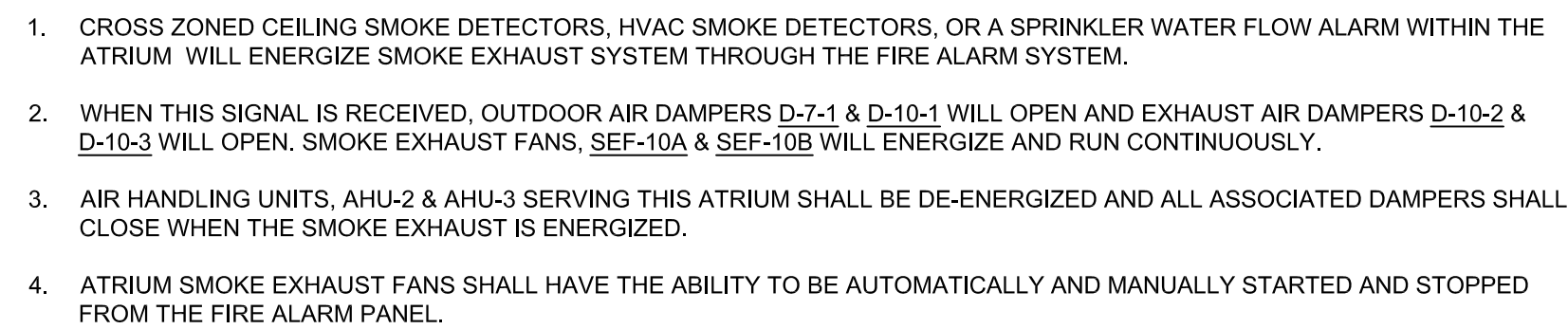
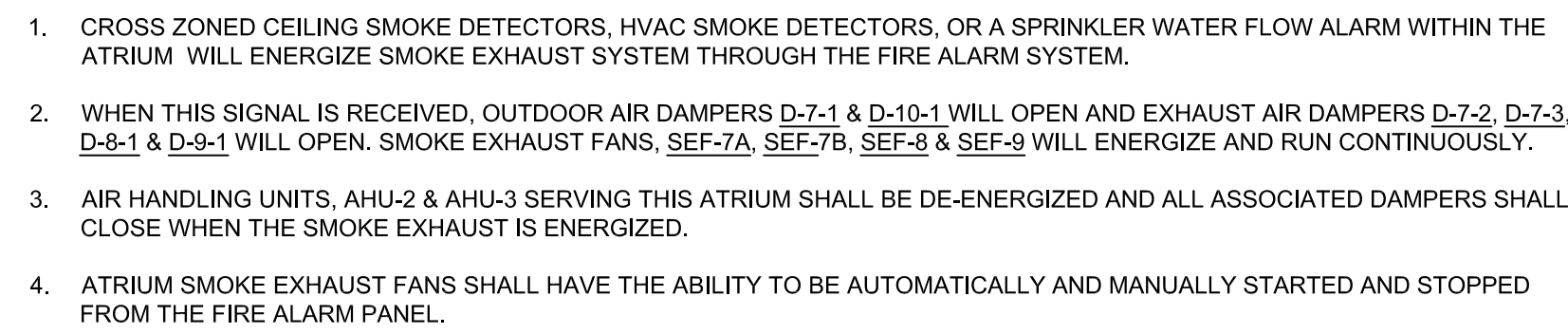
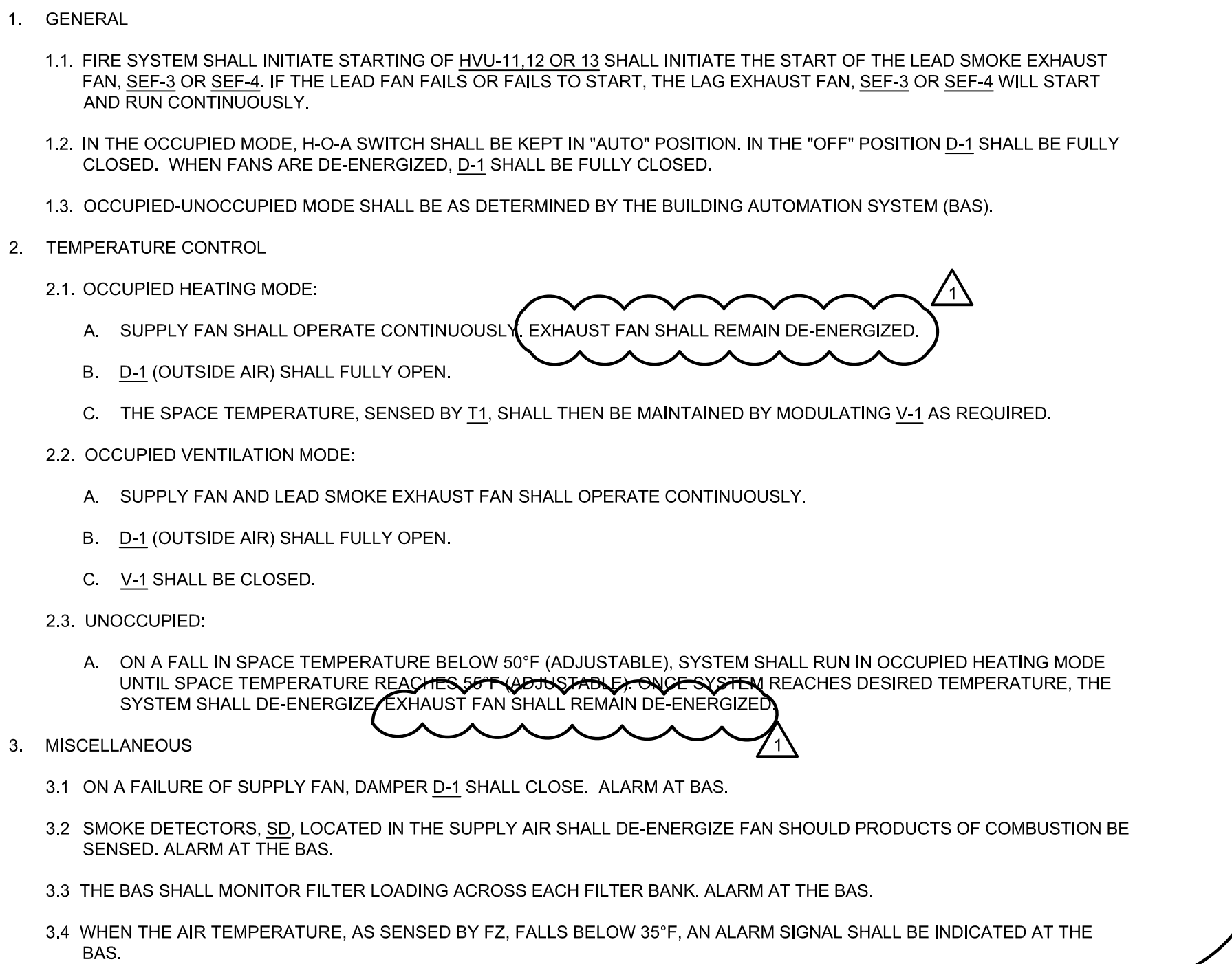
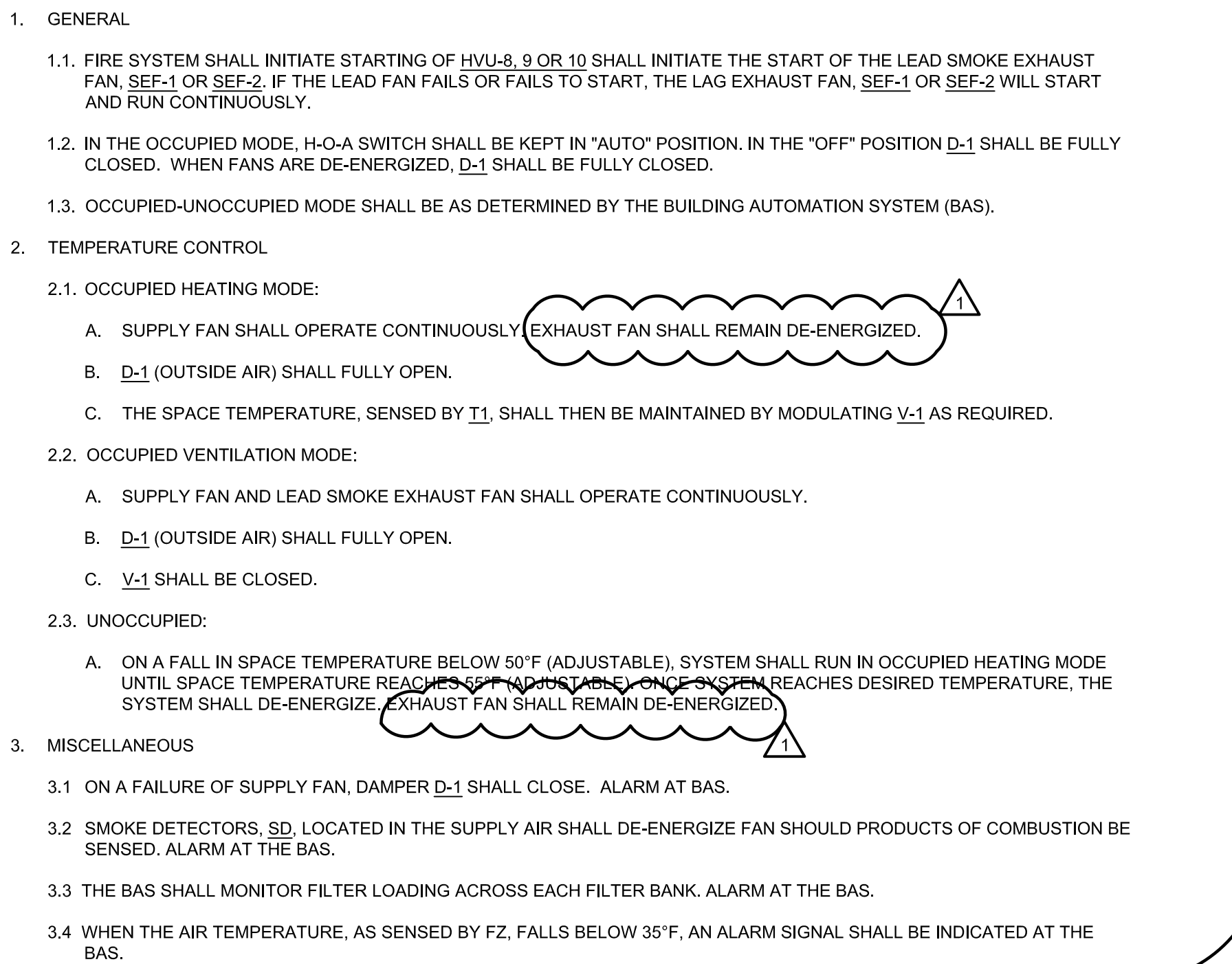
SHEET TITLE:

**AUTOMATIC TEMPERATURE
CONTROLS**

DRAWING NO:

M4.25

BKM# 20092.01



T-OA OUTSIDE AIR TEMPERATURE SENSOR

H-OA OUTSIDE AIR HUMIDITY SENSOR

1. PROTECT ALL INPUTS FROM LIGHTNING WITH EXTERNAL SURGE SUPPRESSION DEVICES.
2. FOLLOW ALL MANUFACTURER RECOMMENDED INSTALLATION INSTRUCTIONS.
3. ~~INSTALL DEVICES IN LOCATION WHERE READINGS ARE NOT EFFECTED BY DIRECT SUNLIGHT, ETC. SENSORS SHALL BE INSTALLED AT THE AND OUTDOOR (LOWERS IN AN ACCESSIBLE LOCATION)~~
4. PROVIDE MULTIPLE SENSORS AT VARIOUS LOCATIONS FOR ACCURATE MEASUREMENT OF OUTDOOR CONDITIONS (LOCATIONS ARE THE APPROX. AREAS. CONTRACTOR SHALL FIELD DETERMINE EXACT LOCATIONS);

OUTSIDE AIR CONDITIONS - SEQUENCE OF OPERATION

1. GENERAL
- 1.1. THE BAS SHALL MONITOR OUTSIDE CONDITIONS.
- 1.2. THE BAS SHALL DISPLAY OA DRY BULB TEMPERATURE, OA WET BULB TEMPERATURE, OA RELATIVE HUMIDITY, AND OA ENTHALPHY.
- 1.3. THE BAS SHALL HAVE A DEDICATED GRAPHICS SCREEN FOR OUTSIDE AIR CONDITIONS. ADDITIONALLY, THE BAS SHALL DISPLAY THE OUTSIDE CONDITIONS ON EACH ASSOCIATED MECHANICAL EQUIPMENT GRAPHIC SCREEN.
- 1.4. MULTIPLE SENSORS SHALL BE PROVIDED AT VARIOUS LOCATIONS FOR ACCURATE MEASUREMENT OF OUTSIDE AIR CONDITIONS. MECHANICAL EQUIPMENT SHALL REFERENCE THE ASSOCIATED OA SENSORS FOR THE AREA THEY SERVE (EQUADRANT).
- A. FOR MULTIPLE OA SENSORS SERVING THE SAME BUILDING, THE BAS SHALL ALSO PROVIDE A CALCULATED AVERAGE OA CONDITION BY POOLING ALL AVAILABLE SENSORS.
- B. THE BAS OPERATOR SHALL HAVE THE OPTION TO SELECT ONE (1) SET OF OA SENSOR AS A MASTER OVERRIDE FOR ALL EQUIPMENT. ADDITIONALLY, THE BAS OPERATOR SHALL BE ABLE TO RE-ASSIGN ASSOCIATED OA SENSORS FOR EQUIPMENT AS A PERMANENT RE-ASSIGNMENT OR TEMPORARY OVERRIDE.
- C. UPON FAILURE OF A SENSOR, ASSOCIATED EQUIPMENT FOLLOWING THAT SENSOR SHALL AUTOMATICALLY REFERENCE THE ASSOCIATED "FAIL TO" SENSOR.
2. CONTROL
- 2.1. MECHANICAL EQUIPMENT SHALL BE CONTROLLED BY THE ASSOCIATED OA SENSORS. THE BAS SHALL DISPLAY THE ASSOCIATED OA CONDITIONS ON THE EQUIPMENT GRAPHIC SCREEN.
3. ALARMS
- 3.1. AN ALARM SHALL BE ISSUED AT THE BAS WHENEVER THE CONTROLS SYSTEM SENSES ANY SENSOR IN A FAILED STATE.



DATE	DESCRIPTION
02/12/21	BID SET
04/02/21	ADDENDUM 01

PROJECT NO: **20092.01**

SCALE: AS NOTED

DRAWN BY: MJG

CHECKED BY: **CMP / MAF**

DATE: **FEBRUARY 12, 2021**

SHEET TITLE:

AUTOMATIC TEMPERATURE CONTROLS

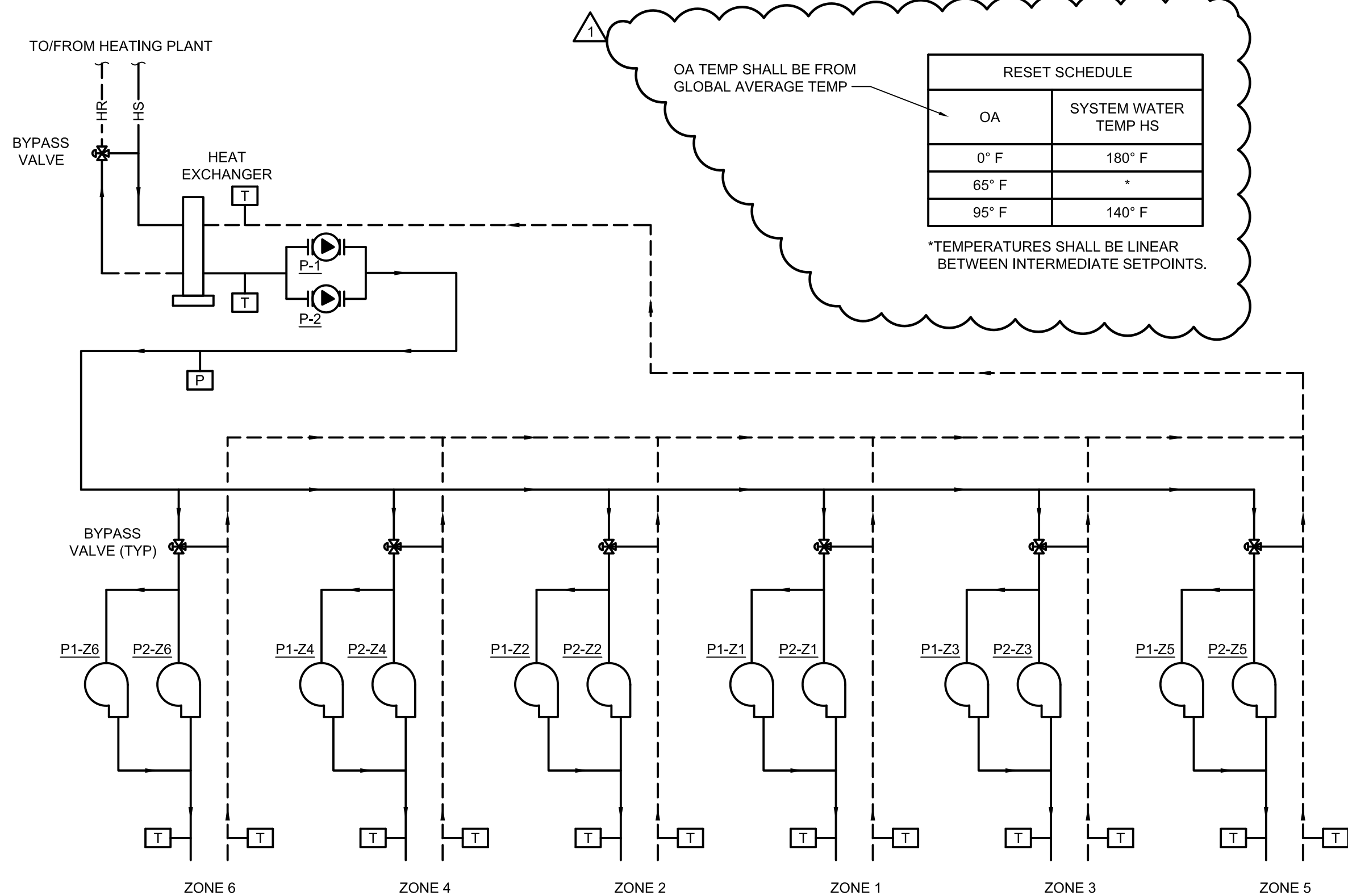
DRAWING NO:

M4.26

BKM# 20092.01

FIELD HEATING POINTS LIST

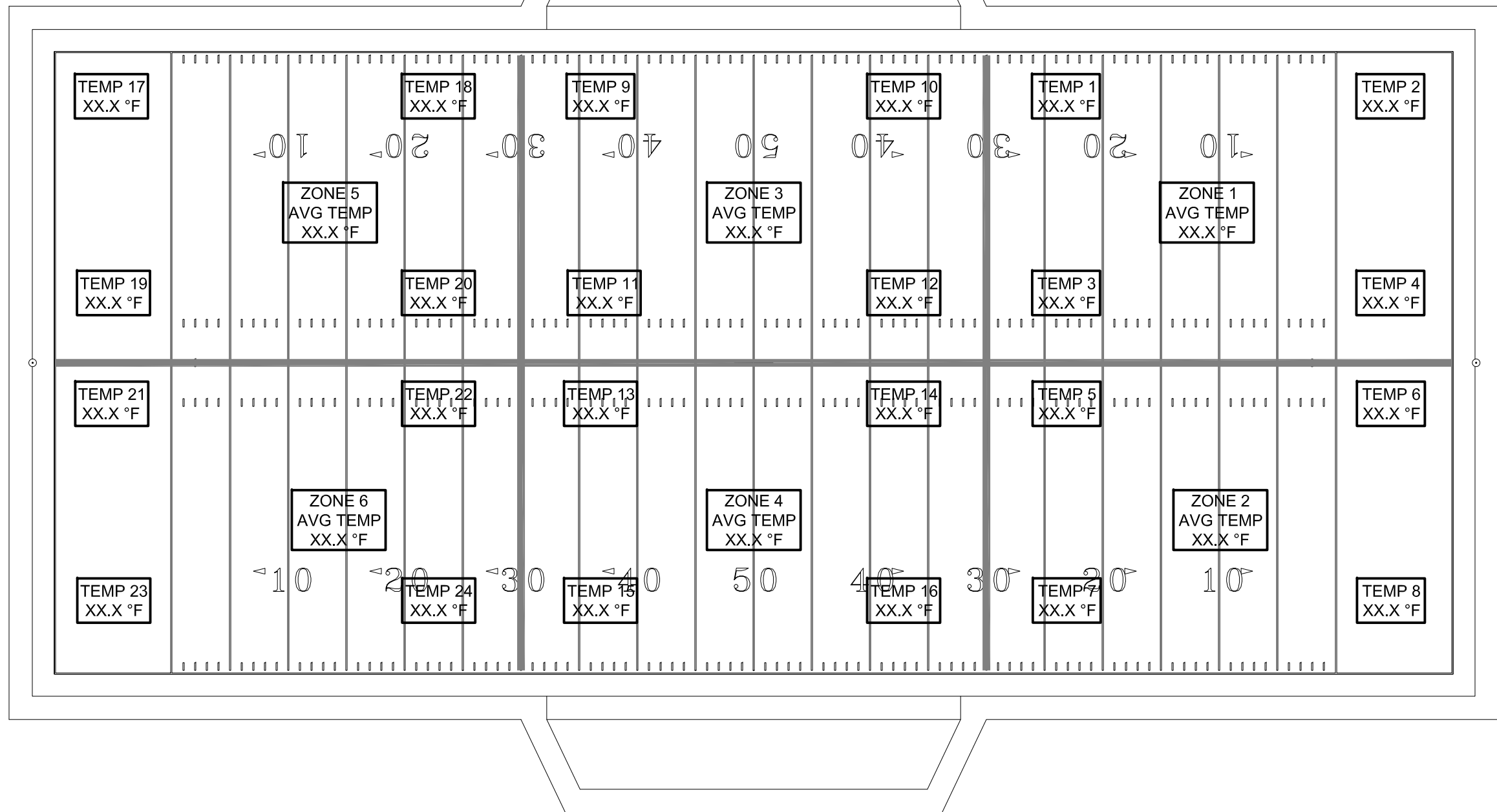
NAME	TYPE	VALUE
AC_PwrFail	BinaryValue	Normal / Failure
ElRtReturnTempSpt	AnalogValue	Deg F
FldkTemp	AnalogValue	Deg F
HeaderPmpRotate	BinaryValue	On/ Off
HeaderSupplySpt	AnalogValue	Deg F
HdByPassVvCmd	AnalogValue	%
MainHeaderPump1Command	BinaryValue	Start / Stop
MainHeaderPump1Status	BinaryValue	On/ Off
MainHeaderPump2Command	BinaryValue	Start / Stop
MainHeaderPump2Status	BinaryValue	On/ Off
MainHeaderReturnTemp	AnalogValue	Deg F
MainHeaderSupplyTemp	AnalogValue	Deg F
MainHeaderSysPress	AnalogValue	PSI
OaEnableDiffSpt	AnalogValue	Deg F
OaEnableSpt	BinaryValue	Deg F
Occupancy	BinaryValue	Enabled / Disabled
OutsideAirHghLimit	AnalogValue	Deg F
OutsideAirLowLimit	AnalogValue	Deg F
ReturnHghLimit	AnalogValue	Deg F
ReturnLowLimit	AnalogValue	Deg F
SystemStatus	BinaryValue	Enabled / Disabled
SystemSwitch	BinaryValue	Auto
Zn1AvgTemp	AnalogInput	Deg F
Zn1PmpRotate	BinaryValue	On/ Off
Zn2AvgTemp	AnalogInput	Deg F
Zn2PmpRotate	BinaryValue	On/ Off
Zn3AvgTemp	AnalogInput	Deg F
Zn3PmpRotate	BinaryValue	On/ Off
Zn4AvgTemp	AnalogInput	Deg F
Zn4PmpRotate	BinaryValue	On/ Off
Zn5AvgTemp	AnalogInput	Deg F
Zn5PmpRotate	BinaryValue	On/ Off
Zn6AvgTemp	AnalogInput	Deg F
Zn6PmpRotate	BinaryValue	On/ Off
Zone1_Temp1	AnalogInput	Deg F
Zone1_Temp2	AnalogInput	Deg F
Zone1_Temp3	AnalogInput	Deg F
Zone1HtgVvCmd	AnalogValue	Deg F
Zone1Pump1Cmd	BinaryValue	Start / Stop
Zone1Pump1Sts	BinaryValue	On/ Off
Zone1Pump2Cmd	BinaryValue	Start / Stop
Zone1Pump2Sts	BinaryValue	On/ Off
Zone1ReturnTemp	AnalogValue	Deg F
Zone1SupplyTemp	AnalogValue	Deg F
Zone2_Temp5	AnalogInput	Deg F
Zone2_Temp6	AnalogInput	Deg F
Zone2_Temp7	AnalogInput	Deg F
Zone2_Temp8	AnalogInput	Deg F
Zone2HtgVvCmd	AnalogValue	Deg F
Zone2Pump1Cmd	BinaryValue	Start / Stop
Zone2Pump1Sts	BinaryValue	On/ Off
Zone2Pump2Cmd	BinaryValue	Start / Stop
Zone2Pump2Sts	BinaryValue	On/ Off
Zone2ReturnTemp	AnalogValue	Deg F
Zone2SupplyTemp	AnalogValue	Deg F
Zone3_Temp9	AnalogInput	Deg F
Zone3_Temp10	AnalogInput	Deg F
Zone3_Temp11	AnalogInput	Deg F
Zone3_Temp12	AnalogInput	Deg F
Zone3HtgVvCmd	AnalogValue	Deg F
Zone3Pump1Cmd	BinaryValue	Start / Stop
Zone3Pump1Sts	BinaryValue	On/ Off
Zone3Pump2Cmd	BinaryValue	Start / Stop
Zone3Pump2Sts	BinaryValue	On/ Off
Zone3ReturnTemp	AnalogValue	Deg F
Zone3SupplyTemp	AnalogValue	Deg F
Zone4_Temp13	AnalogInput	Deg F
Zone4_Temp14	AnalogInput	Deg F
Zone4_Temp15	AnalogInput	Deg F
Zone4_Temp16	AnalogInput	Deg F
Zone4HtgVvCmd	AnalogValue	Deg F
Zone4Pump1Cmd	BinaryValue	Start / Stop
Zone4Pump1Sts	BinaryValue	On/ Off
Zone4Pump2Cmd	BinaryValue	Start / Stop
Zone4Pump2Sts	BinaryValue	On/ Off
Zone4ReturnTemp	AnalogValue	Deg F
Zone4SupplyTemp	AnalogValue	Deg F
Zone5_Temp17	AnalogInput	Deg F
Zone5_Temp18	AnalogInput	Deg F
Zone5_Temp19	AnalogInput	Deg F
Zone5_Temp20	AnalogInput	Deg F
Zone5HtgVvCmd	AnalogValue	Deg F
Zone5Pump1Cmd	BinaryValue	Start / Stop
Zone5Pump1Sts	BinaryValue	On/ Off
Zone5Pump2Cmd	BinaryValue	Start / Stop
Zone5Pump2Sts	BinaryValue	On/ Off
Zone5ReturnTemp	AnalogValue	Deg F
Zone5SupplyTemp	AnalogValue	Deg F



FIELD HEATING SYSTEM - SCHEMATIC DIAGRAM

FIELD HEATING SYSTEM CONTROL

- GENERAL:
- ALL EXISTING SENSORS AND VALVES IN SCHEMATIC SHALL BE REMOVED AND REPLACED.
 - EXISTING FIELD TEMPERATURE SENSORS (LOCATED APPROX. 10'-12" BELOW THE FIELD) SHALL BE REPLACED. ACCESS SHALL BE COORDINATED THRU THE OWNER. CONTRACTOR SHALL NOT TOUCH THE FIELD. ALL EXCAVATIONS AND FIELD WORK WILL BE BY THE OWNER'S GROUNDS CREW.
 - THIS IS A CRITICAL SYSTEM. ALL WORK RELATED TO THIS SYSTEM SHALL BE PROVIDED UNDER SEPARATE SUBMITTALS FOR APPROVAL.
 - SYSTEM SHALL BE OPERATED THROUGH THE BAS OPERATOR 'ENABLE'.
- SEQUENCE OF OPERATION:
- PER HEATING PLANT CONTROL SEQUENCE, PLANT BOILERS AND PUMPS SHALL BE OPERATIONAL AT ALL TIMES.
 - LEAD FIELD HEATING SYSTEM PRIMARY PUMP (P-1) SHALL BE ENERGIZED WHENEVER OUTSIDE AIR TEMPERATURE FALLS BELOW 50°F (ADJUSTABLE). UPON A FAILURE OF PRIMARY PUMP, P-1, LAG PUMP, P-2, SHALL ENERGIZE. LEAD / LAG PUMP SHALL ALTERNATE EVERY 300 HOURS OF RUN TIME.
 - ZONE PUMPS (TYP 6) SHALL ENERGIZE WHEN PRIMARY PUMP ENERGIZES.
 - 3-WAY CONTROL VALVE SHALL MODULATE TO MAINTAIN 120°F RETURN WATER TEMPERATURE (ADJ.) FROM FIELD.
 - PROVIDE TEMPERATURE SENSOR AT SUPPLY AND RETURN FOR EACH ZONE. EACH ZONE SHALL BE MONITORED AT THE BAS. MAINTAIN ZONE AVERAGE TEMPERATURE OF 50°F (ADJ.)
 - FIELD PRIMARY PUMP AND ZONE PUMPS SHALL DE-ENERGIZE WHEN OUTSIDE AIR TEMPERATURE RISES ABOVE 50°F (ADJUSTABLE).



FIELD HEATING SYSTEM - TEMPERATURE / ZONES

SCOREBOARD FANS CONTROL

- ALL SCOREBOARD FANS (I.E. SIX (6) WALL MOUNTED EXHAUST FANS AND EIGHT (8) INTERIOR PROP FANS PER SCOREBOARD) SHALL BE CONTROLLED VIA REVERSE ACTING THERMOSTAT.
- FANS SHALL ENERGIZE WHEN SPACE TEMPERATURE IS ABOVE 85°F (ADJUSTABLE) AND DE-ENERGIZE WHEN SPACE TEMPERATURE IS BELOW 80°F (ADJUSTABLE).
- ALARM AT BAS WHEN SPACE TEMPERATURE RISES ABOVE 105°F (ADJUSTABLE).

PIZZA OVEN EXHAUST FANS CONTROL

- EXHAUST FANS SHALL BE TIED INTO ASSOCIATED MAKE-UP AIR UNIT.
- FAN SHALL ENERGIZE WHEN ASSOCIATED MAKE-UP AIR UNIT IS ENERGIZED AND DE-ENERGIZE WHEN ASSOCIATED MAKE-UP AIR UNIT IS DE-ENERGIZED.
- ALARM AT BAS WHEN FAN IS NOT OPERATIONAL WHEN ASSOCIATED MAKE-UP AIR UNIT IS OPERATING.

RAVENS OFFICE RELIEF FANS

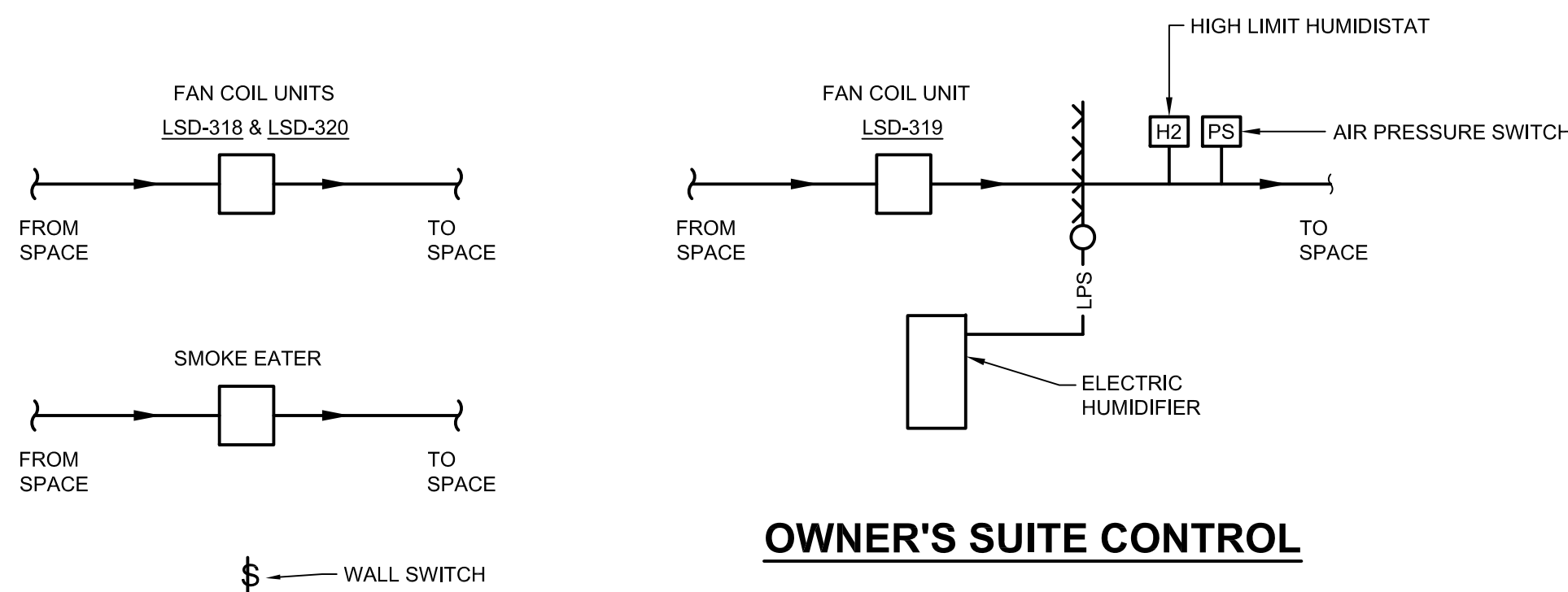
- RELIEF FANS (TYP 2) LOCATED IN HOUSEKEEPING RM 5-34-05.
- FANS SHALL ENERGIZE ONLY WHEN IN 'EXECUTIVE' AND 'FULL' SCHEDULED MODES.

TRANSFER FANS CONTROL

- ALL TRANSFER FANS SHALL BE CONTROLLED VIA REVERSE ACTING THERMOSTAT.
- FANS SHALL ENERGIZE WHEN SPACE TEMPERATURE IS ABOVE 85°F (ADJUSTABLE) AND DE-ENERGIZE WHEN SPACE TEMPERATURE IS BELOW 80°F (ADJUSTABLE). FAN SHALL BE INTERLOCKED WITH ALL ASSOCIATED INTAKE AND EXHAUST MODS.
- ALARM AT BAS WHEN SPACE TEMPERATURE RISES ABOVE 105°F (ADJUSTABLE).

LIQUOR STORAGE ROOM
CLC-VB06 TERMINAL UNIT CONTROL

- WHEN AHU-3 SYSTEM IS INDEXED TO 'OCCUPIED', THE SPACE THERMOSTAT SHALL MODULATE THE TERMINAL UNIT PRIMARY AIR DAMPER TO MAINTAIN OCCUPIED SPACE TEMPERATURE SETPOINT AND THE FAN SHALL BE DE-ENERGIZED.
- WHEN AHU-3 SYSTEM IS INDEXED TO 'UNOCCUPIED' AND/OR AHU-3 IS DE-ENERGIZED, THE TERMINAL UNIT PRIMARY AIR DAMPER SHALL GO TO MINIMUM SETTING. WHEN THE SPACE TEMPERATURE RISES ABOVE THE SPACE SETPOINT, THE UNIT FAN SHALL ENERGIZE AND THE COOLING COIL CONTROL VALVE SHALL OPEN AND MODULATE AS REQUIRED TO MAINTAIN SPACE SETPOINT.



OWNER'S SUITE CONTROL

1. GENERAL:
- OWNERS SUITE IS SERVED BY THREE (3) FAN COIL UNITS, A HUMIDIFIER AND A SMOKE EATER.
 - ALL UNITS SHALL BE CONNECTED TO THE BAS FOR MONITORING, CONTROL, AND ALARM.
2. FAN COIL UNITS CONTROL:
- REFER TO 4-PIPE FAN COIL UNIT CONTROL ON SHEET M4.23.
3. HUMIDIFIER CONTROL:
- SPACE HUMIDITY SENSOR, H1, SHALL MODULATE THE HUMIDIFIER TO MAINTAIN THE RELATIVE HUMIDITY SETPOINT (ADJUSTABLE). HIGH LIMIT HUMIDITY SENSOR, H2, SHALL OVERRIDE THIS CONTROL TO MAINTAIN A MAXIMUM HUMIDITY OF 85% (ADJUSTABLE).
 - HUMIDIFIER SHALL REMAIN DE-ENERGIZED UNTIL AIRFLOW IS SENSED AT AIR SENSE AIR PRESSURE SWITCH, PS.
4. SMOKE EATER CONTROL:
- CONNECT TO THE BAS FOR MONITORING, ON/OFF CONTROL, AND STATUS.
 - UNIT SHALL OPERATE VIA WALL FAN SWITCH.

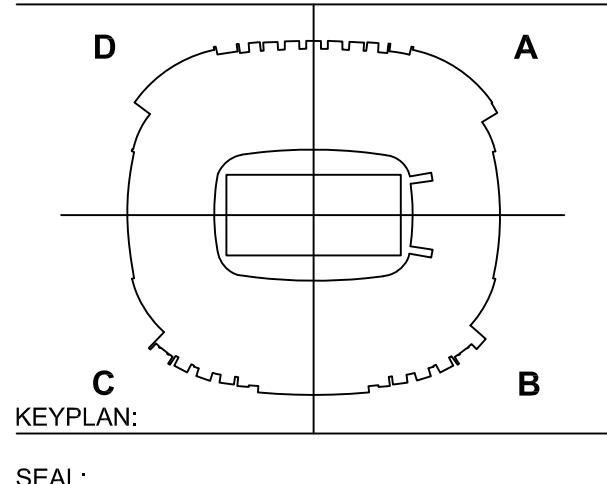
PROJECT NAME:

M&T BANK STADIUM
HVAC CONTROLS,
LIGHTING CONTROLS
AND SUBMETERING
SYSTEMS
IMPROVEMENTS

MSA PROJECT NO. 20-071

THE MARYLAND STADIUM
AUTHORITY
333 WEST CAMDEN STREET, SUITE 500
BALTIMORE, MD 21201

CONSULTANTS:
WFT ENGINEERING, INC.
1801 RESEARCH BOULEVARD, SUITE 100
ROCKVILLE, MARYLAND 20850
P: 301-230-0811



PROFESSIONAL CERTIFICATION:

PROFESSIONAL CERTIFICATION. I HEREBY
CERTIFY THAT THESE DOCUMENTS WERE
PREPARED OR APPROVED BY ME, AND
THAT I AM A DULY LICENSED
PROFESSIONAL ENGINEER UNDER THE
LAWS OF THE STATE OF MARYLAND.
LICENSE NO. _____
EXPIRATION DATE: _____.

ISSUED FOR:

DATE	DESCRIPTION
02/12/21	BID SET
04/02/21	ADDENDUM 01

PROJECT NO: 20092.01

SCALE: AS NOTED

DRAWN BY: MJG

CHECKED BY: CMP / MAF

DATE: FEBRUARY 12, 2021

SHEET TITLE:

AUTOMATIC TEMPERATURE
CONTROLS

DRAWING NO:

M4.27

HEAT TRACE PANELS CONTROL

- A. CONTRACTOR SHALL CONNECT EACH HEAT TRACE PANEL TO BE MONITORED AND CONTROLLED THRU THE BAS. PROVIDE ALL POINTS AND ALARMS IDENTIFIED. POINTS IDENTIFIED AS "GLOBAL" SHALL AFFECT ALL PANELS, AND "BY QUAD" SHALL BE SPECIFIC TO THE ZONE.
- B. HEAT TRACE SYSTEM IS ENERGIZED THRU THE GLOBAL OUTSIDE AIR TEMPERATURE. THE TEMPERATURE SENSORS LOCATED IN EACH QUAD ARE HARDWIRED TO ENERGIZE THE HEAT TRACE WHEN THE TEMPERATURE DROPS BELOW THE FAILURE SETPOINT (ADJ).
- C. HEAT TRACE ALARMS SHALL BE CATEGORIZED AS "CRITICAL".

POINTS SCHEDULE

PANEL	LOCATION	SERVICE
HT-CLA	CLUB LEVEL, QUAD A, ELECTRICAL ROOM 4.03.03	QUAD A
HT-CLB	CLUB LEVEL, QUAD B, ELECTRICAL ROOM 4.24.04	QUAD B
HT-CLC	CLUB LEVEL, QUAD C, ELECTRICAL ROOM 4.30.04	QUAD C
HT-CLD	CLUB LEVEL, QUAD D, ELECTRICAL ROOM 4.51.02	QUAD D

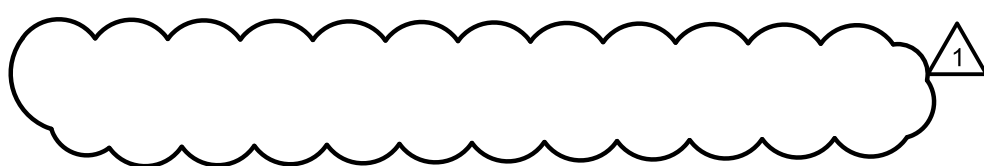
POINTS LIST

POINT	DEFAULT SETPOINT OR VALUE	NOTES
HEAT TRACE ENABLED SETPOINT	DEFAULT 40°F (ADJ)	GLOBAL & BY QUAD
HEAT TRACE SETPOINT DIFFERENTIAL DEADBAND	DEFAULT 2°F (ADJ)	GLOBAL & BY QUAD
HEAT TRACE FAILURE SETPOINT (ALARM)	DEFAULT 36°F (ADJ)	GLOBAL & BY QUAD
HEAT TRACE FAILURE ALARM	ON / OFF	BY QUAD
OA TEMPERATURE	°F	BY QUAD
OA TEMPERATURE AVERAGE	°F	GLOBAL
HEAT TRACE COMMAND	ON / OFF	BY QUAD

ELECTRICAL SUBSTATIONS

- A. SUBSTATION TRANSFORMER HIGH TEMPERATURE ALARMS SHALL BE MONITORED THROUGH THE BAS.

TMP-S HIGH TEMPERATURE ALARM IN SUBSTATION ENCLOSURE



SUBSTATION	LOCATION
SS1-PRA	PRESS LEVEL ELECTRICAL ROOM QUAD A
SS2-PRA	PRESS LEVEL ELECTRICAL ROOM QUAD A
SS1-PRB	PRESS LEVEL ELECTRICAL ROOM QUAD B
SS2-PRB	PRESS LEVEL ELECTRICAL ROOM QUAD B
SS1-PRC	PRESS LEVEL ELECTRICAL ROOM QUAD C
SS2-PRC	PRESS LEVEL ELECTRICAL ROOM QUAD C
SS1-PRD	PRESS LEVEL ELECTRICAL ROOM QUAD D
SS2-PRD	PRESS LEVEL ELECTRICAL ROOM QUAD D
SS1-SRB	SERVICE LEVEL ELECTRICAL ROOM QUAD B
SS2-SRB	SERVICE LEVEL ELECTRICAL ROOM QUAD B
SS3-SRB	SERVICE LEVEL ELECTRICAL ROOM QUAD B
SSFP-SRB	SERVICE LEVEL ELECTRICAL ROOM QUAD B
SSGE-SRB	SERVICE LEVEL ELECTRICAL ROOM QUAD B
SSGL-SRB	SERVICE LEVEL ELECTRICAL ROOM QUAD B

SWITCHGEAR AND GENERATOR BATTERY BANK MONITORING

- A. BATTERY BANKS IN THE FOLLOWING LOCATIONS NOTED BELOW SHALL BE MONITORED THROUGH THE BAS.

GENERATOR PLANT
GENERATOR PLANT
GENERATOR PLANT
MAIN ELECTRICAL ROOM
(SERVICE LEVEL, RM #1.24.03)

GENERATOR #1
GENERATOR #2
SWITCHGEAR
SWITCHGEAR

- B. THE FOLLOWING POINTS SHALL BE MONITORED:

AC FAILURE
CHARGER FAILURE
LOW DC VOLTS
HIGH DC VOLTS
GROUND FAULT

SUMP PUMP CONTROL

1. SUMP PUMP SHALL BE CONNECTED TO THE BAS FOR MONITORING AND ALARM. EXISTING METHOD OF CONTROL SHALL REMAIN.
2. PROVIDE A HI-LEVEL WATER SENSOR FOR THE SUMPS PUMPS THAT DO NOT HAVE ELECTRONIC CONTROLS.
3. SUMP PUMPS WITH FLOAT SWITCH
- 3.1. PUMPS SHALL BE ENERGIZED VIA A FLOAT ACTIVATED SWITCH.
- 3.2. INTEGRATE HIGH WATER (ALARM), AND STATUS (MONITOR) INTO BAS GRAPHICS.
4. SUMP PUMPS WITH ELECTRONIC CONTROLS:
- 4.1. PUMPS SHALL BE ENERGIZED BY THE ELECTRONIC WATER LEVEL DETECTOR.
- 4.2. INTEGRATE HIGH WATER (ALARM), WATER LEVEL (MONITOR) AND STATUS (MONITOR) INTO BAS GRAPHICS.

SUMP PUMP SCHEDULE

DESIG	SERVICE	# OF PUMPS	LOCATION	REMARKS
SP-1 (SWEP-1 & SWEP-2)	SEWAGE EJECTOR FOR QUAD B	2	QUAD B, MECH RM 1.26.03	ELECTRONIC CONTROLS
SP-2	FIELD ENTRANCE - SEWAGE EJECTOR	2	QUAD B, FIELD EQUIP STO RM 1.27.03	FLOAT SWITCH
SP-3	SUMP BOWL DRAINAGE	3	QUAD A	ELECTRONIC CONTROLS
SP-4	SUMP BOWL DRAINAGE	3	QUAD B	ELECTRONIC CONTROLS
SP-5	SUMP LOADING DOCK	2	QUAD B, TURCK DOCK	ELECTRONIC CONTROLS
SP-6	SUMP FIELD DRAINAGE EAST	2	QUAD B (NEAR EAST END ZONE)	ELECTRONIC CONTROLS
SP-7	SUMP FIELD DRAINAGE WEST	2	QUAD C (NEAR WEST END ZONE)	ELECTRONIC CONTROLS
SP-8 (NOTE 1)	FIELD ENTRANCE - STORM WATER	1	QUAD B, FIELD EQUIP STO RM 1.27.03	FLOAT SWITCH
SP-9 (NOTE 1)	STORM WATER GENERATOR PLANT - VESTIBULE	1	GENERATOR PLANT - VESTIBULE	FLOAT SWITCH
SP-10 (NOTE 1)	STORM WATER GENERATOR PLANT	2	GENERATOR PLANT	ELECTRONIC CONTROLS

NOTES:

1. SUMP PUMP DOES NOT CURRENTLY HAVE A DESIGNATION. USE THE PROVIDED DESIGNATION, UNLESS OTHERWISE DIRECTED BY OWNER.

bkm

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Mechanical / Electrical Engineers
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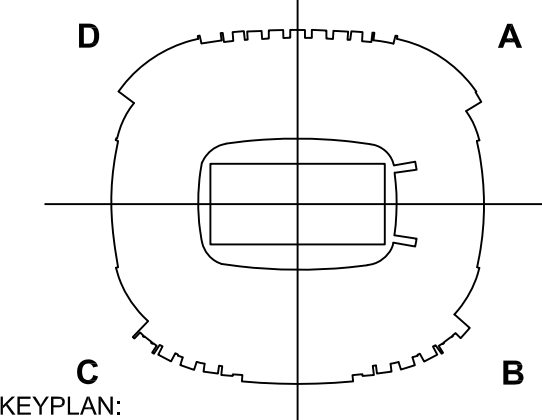
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