

WATER SYSTEM CONTROL FOR MORE INFORMATION.

21. BATTERY BANK FOR SWITCHGEAR SHALL BE MONITORED THRU THE BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION.

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

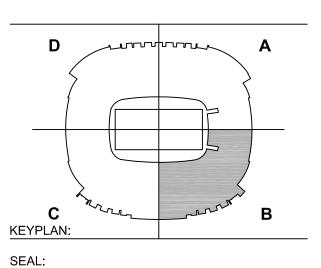
PROJECT NAME:

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



PROFESSIONAL CERTIFICATION:

PROFESSIONAL CERTIFICATION. I HEREB THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND. LICENSE NO. EXPIRATION DATE

ISSUED FOR:

DESCRIPTION 02/12/21 | BID SET

AS NOTED

DRAWN BY: BAS

PROJECT NO: **20092.01**

FEBRUARY 12, 2021

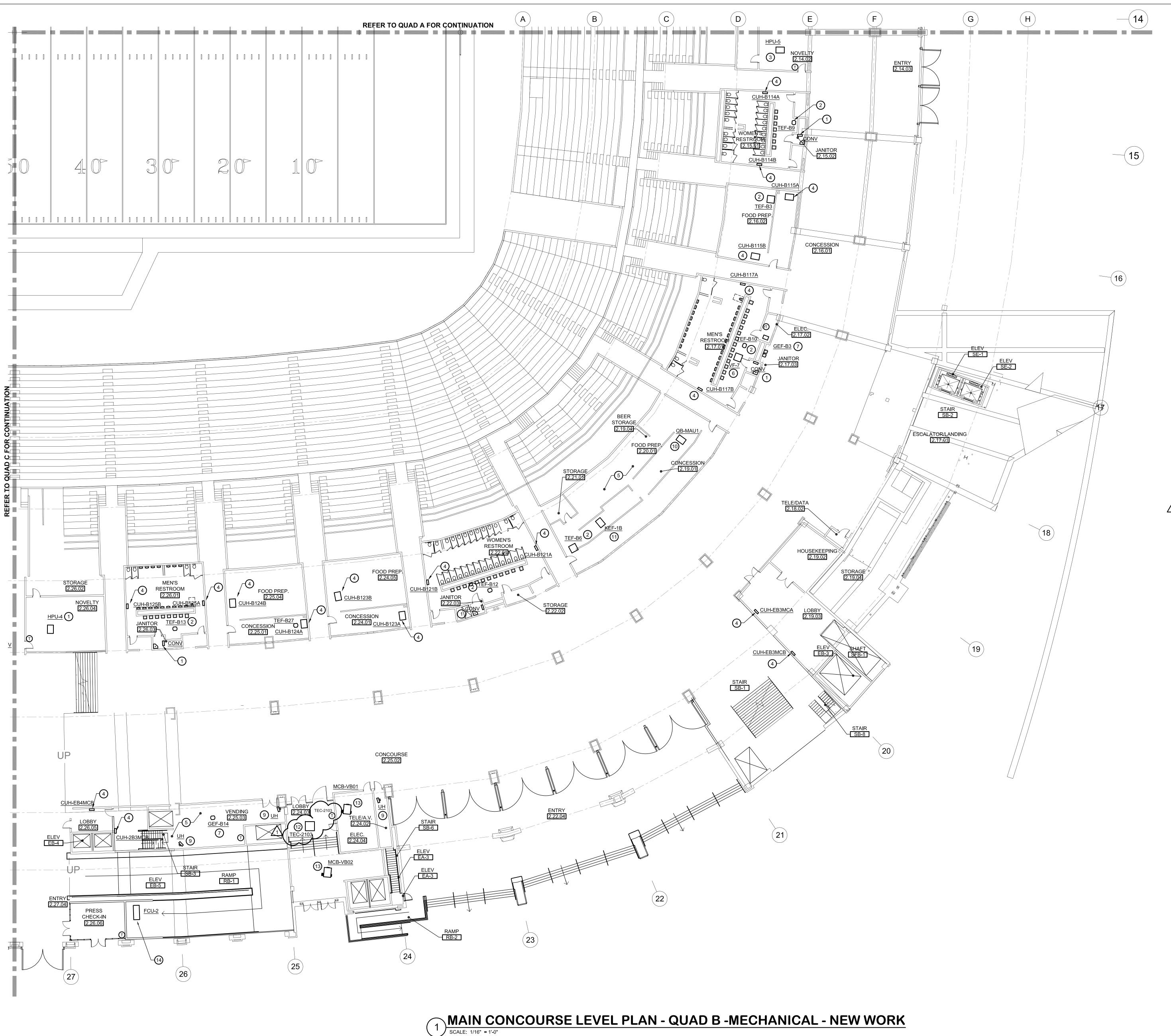
SHEET TITLE: **SERVICE LEVEL**

QUAD B MECHANICAL NEW WORK

DRAWING NO:

BKM# 20092.0⁻

SCALE: 1/16"=1'-0"



GENERAL NOTES:

- 1. REFER TO M001 FOR MECHANICAL LEGEND, ABBREVIATIONS AND
- GENERAL NOTES.

 2. 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

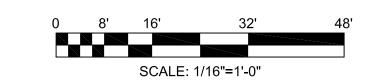
TO ATC CONTROLS DRAWINGS FOR ADDITIONAL INFORMATION.

3. ALL EXISTING THERMOSTATS SHALL BE REMOVED AND REPLACED.

O 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.
- 2. 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.
- 3. 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.
- 4. 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.
- 5. 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.
- 6. 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
- 7. 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.
- 8. 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.
- 9. 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.
- 10. 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.
- 11. 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.
- 12. EXISTING SPLIT-SYSTEM AIR CONDITIONING UNIT. PROVIDE NEW CONTROLS AND CONNECT TO BAS. REFER TO ATC DRAWINGS FOR MORE INFORMATION.
- 13. 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.
- 14. 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) THERMOSTAT (REMOVE AND REPLACE)	<u>DESIG</u>
ABBREVIATIONS AIR HANDLING UNIT CONVECTOR CABINET UNIT HEATER FAN COIL UNIT GENERAL EXHAUST FAN HEAT PUMP UNIT KITCHEN EXHAUST FAN MAKEUP AIR UNIT TOILET EXHAUST FAN UNIT HEATER VENTIL ATION FAN	AHU CONV CUH FCU GEF HPU KEF MAU TEF UH



bkm

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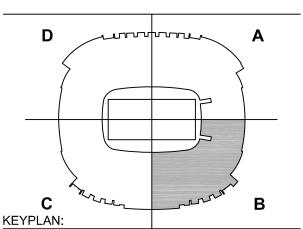
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M&T BANK STADIUM
HVAC CONTROLS,
LIGHTING CONTROLS
AND SUBMETERING
SYSTEMS
IMPROVEMENTS

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ISSUED FOR:

SEAL:

DATE DESCRIPTION

02/12/21 BID SET

04/02/21 ADDENDUM 01

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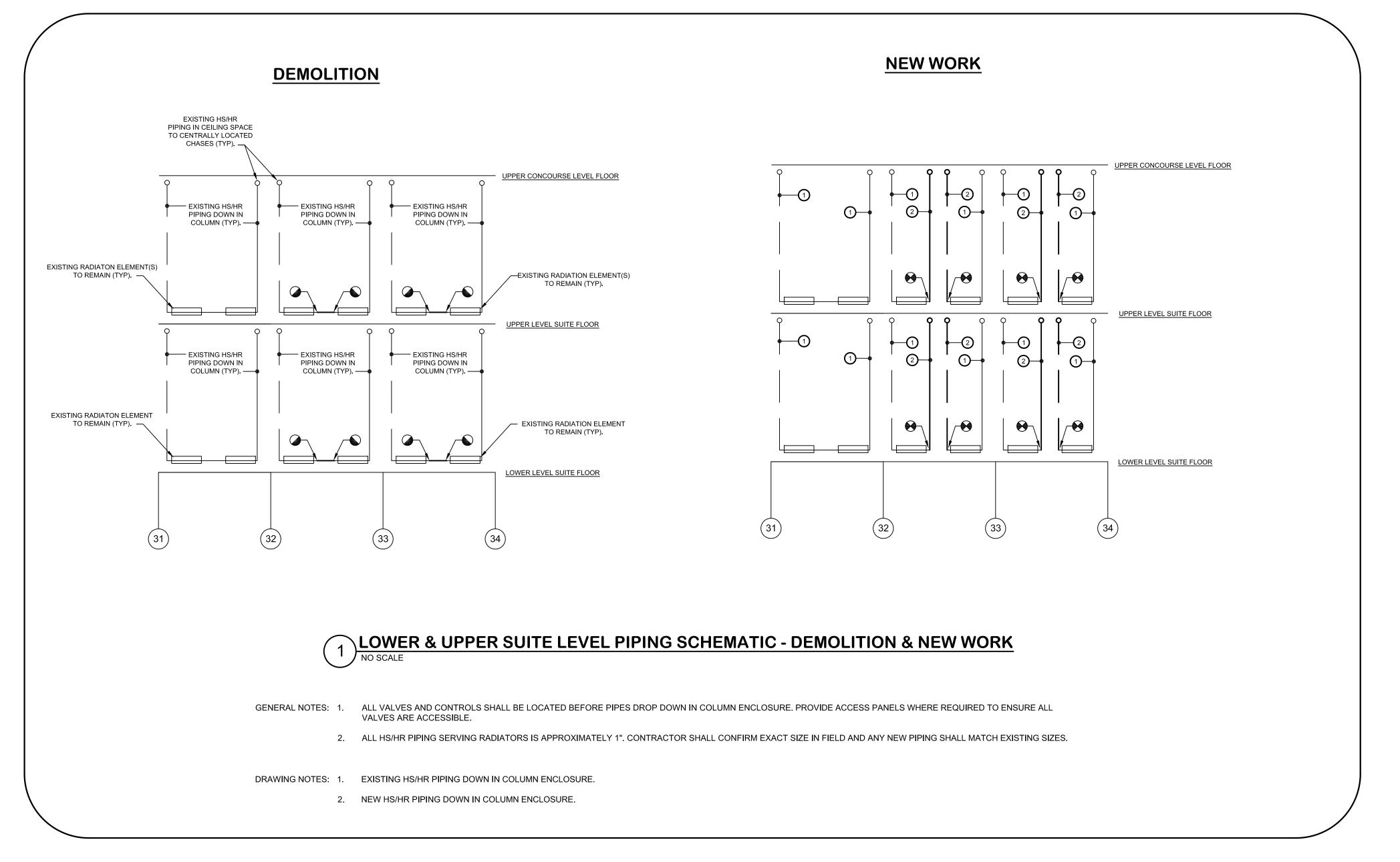
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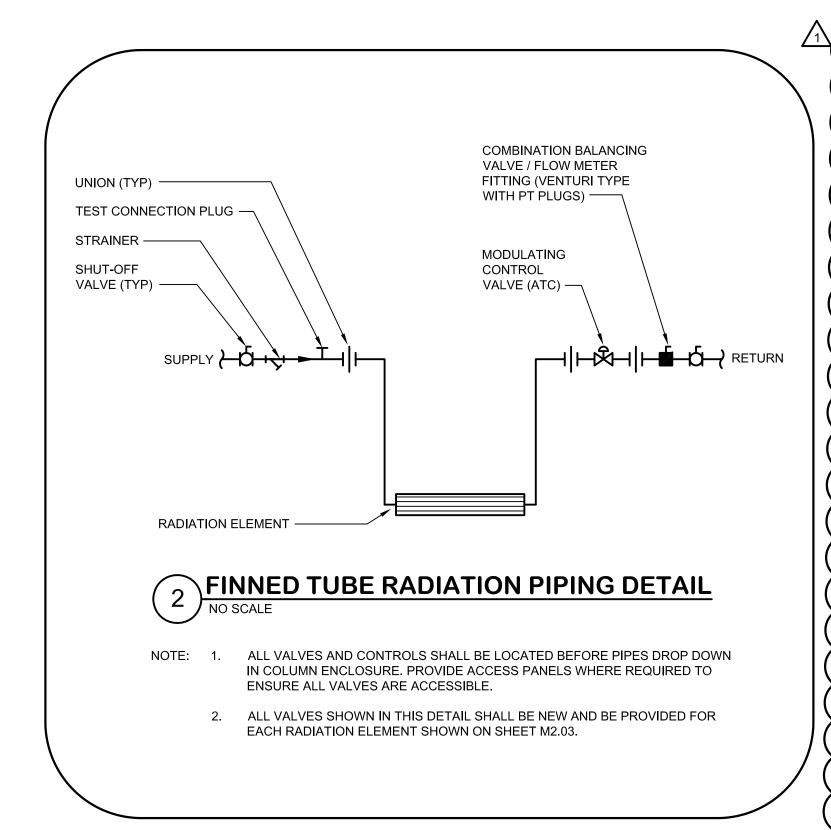
DATE: **FEBRUARY 12, 2021**

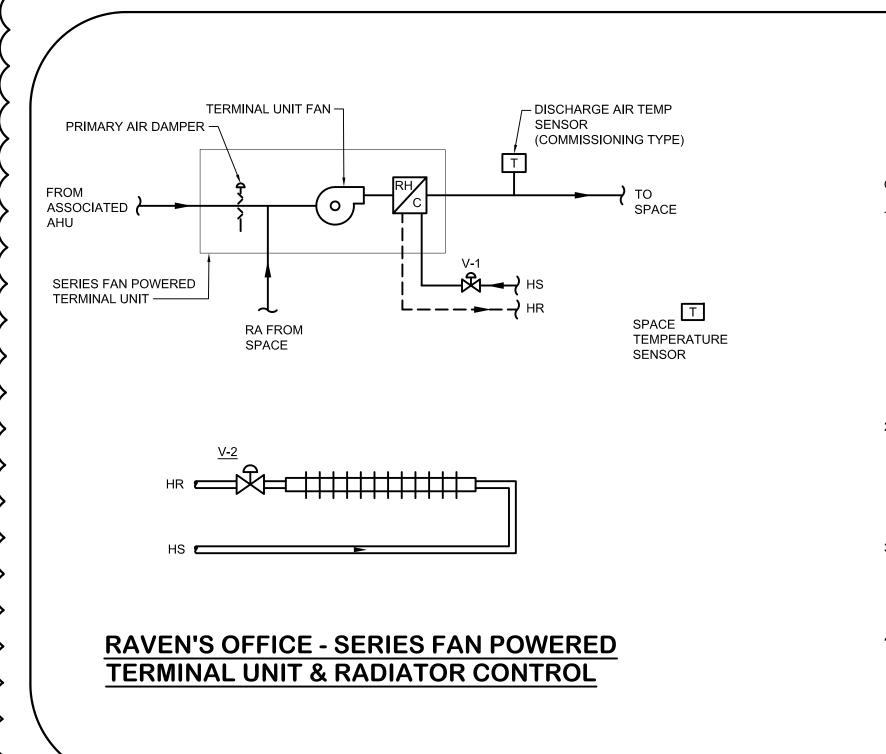
MAIN CONCOURSE LVL QUAD B MECHANICAL

NEW WORK

M1.12







CONTROL SEQUENCE (ASSOCIATED <u>AHU-3</u>):

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 VALVES, V-1 & V-2 TO MAINTAIN SPACE TEMPERATURE SETPOINT. ON A RISE IN SPACE TEMPERATURE, THE OPPOSITE SHALL

- 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, 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.
- 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 VALVES, V-1 & V-2, 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.

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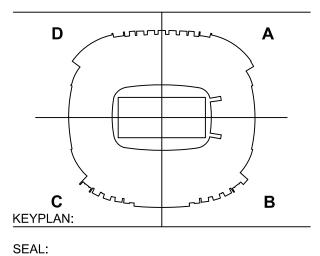
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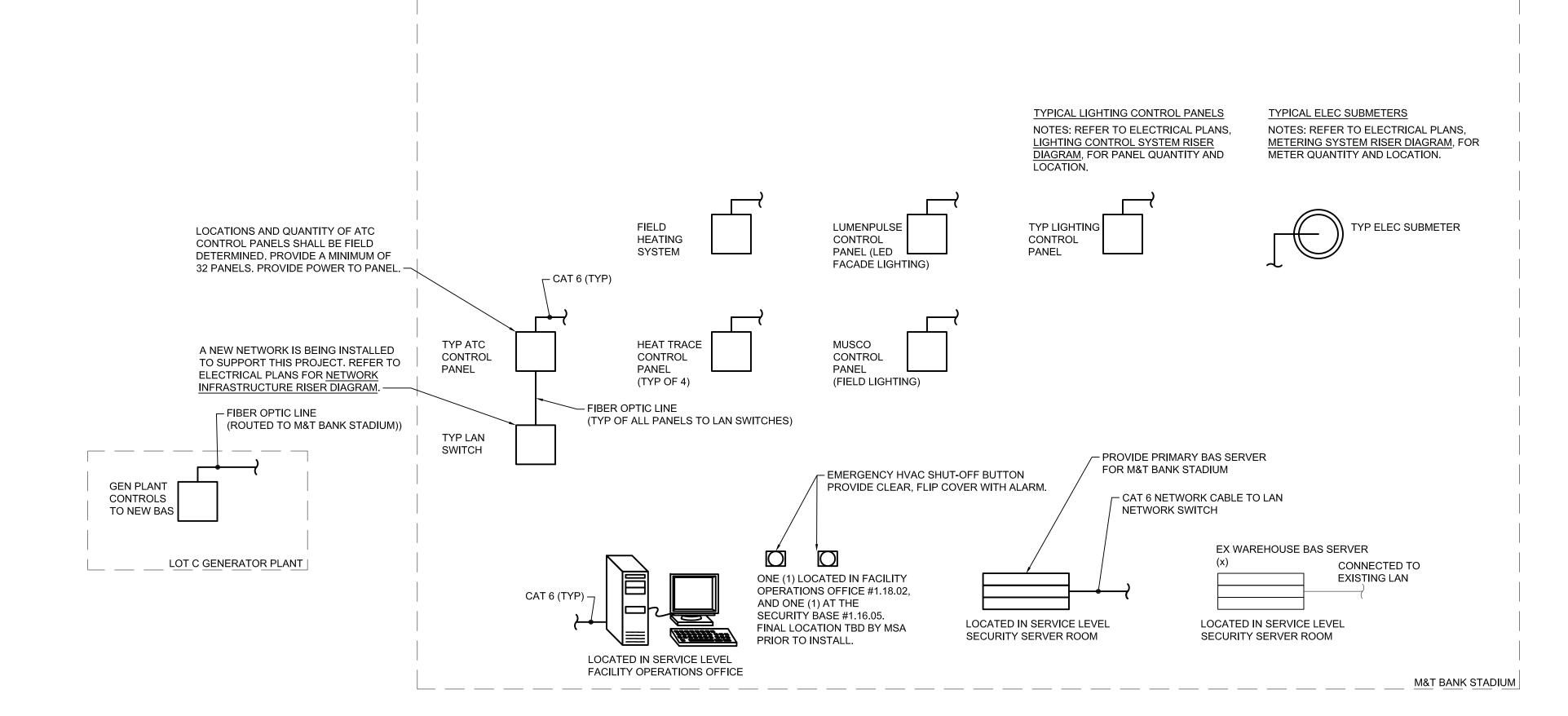
DATE: **FEBRUARY 12, 2021**

SHEET TITLE:

RAVENS OFFICE SCHEMATICS, DETAILS AND CONTROLS

DDAWING NO.

M2.02b



INTEGRATED BUILDING MANAGEMENT SYSTEM (iBMS) NETWORK ARCHITECTURE DIAGRAM

NOTE: REFER TO ELECRICAL DRAWINGS FOR IT NETWORK INFORMATION

iBMS NETWORK ARCHITECTURE GENERAL NOTES:

M&T BANK STADIUM SHALL BE PROVIDED WITH A NEW FULLY DIGITAL BUILDING AUTOMATION SYSTEM (BAS). THIS SYSTEM WILL REPLACE THE EXISTING JOHNSON DDC CONTROL SYSTEM & ANDOVER CONTINUUM CONTROL SYSTEM IN THEIR ENTIRETY, UNLESS OTHERWISE NOTED.

ALL SYSTEMS PROVIDED UNDER THIS PROJECT SHALL BE CONNECTED THRU THE NEW NETWORK INFRASTRUCTURE.

2. ELECTRIC SUBMETERING SHALL BE CONNECTED THRU THE NEW NETWORK INFRASTRUCTURE. THIS INCLUDES EXISTING AND NEW METERS. REFER TO ELECTRICAL PLANS, METERING SYSTEM RISER DIAGRAM, FOR ADDITIONAL INFORMATION.

3. BUILDING LIGHTING CONTROL SHALL BE CONNECTED THRU THE NEW NETWORK INFRASTRUCTURE. REFER TO ELECTRICAL PLANS ELECTRICAL PLANS, <u>LIGHTING CONTROL</u> SYSTEM RISER DIAGRAM, FOR ADDITIONAL INFORMATION.

4. ADDITIONAL EXISTING LIGHTING SYSTEMS SHALL BE CONTROLLED THROUGH THE NEW LIGHTING CONTROLS SYSTEM INCLUDING, BUT NOT LIMITED TO:

- LUMENPULSE LIGHTING SYSTEM (LED FACADE LIGHTING) - MUSCO LIGHTING SYSTEM (FIELD LIGHTING)

ETC LIGHTING SYSTEM

REFER TO ELECTRICAL PLANS FOR ADDITIONAL INFORMATION. WHERE EXISTING SYSTEMS ARE CONNECTED TO THE BAS, THE ATC CONTRACTOR SHALL PROVIDE THE ANY REQUIRED BACNET GATEWAYS, TRANSLATORS, RELAYS, ETC... FOR CONNECTION TO THE BAS.

EACH UNIQUE LIGHTING SYSTEM SHALL HAVE A DEDICATED BAS GRAPHICS PAGE.

AT A MINIMUM, THE BAS SHALL HAVE CONTROL OVER ALL LIGHTING SYSTEMS BY SENDING A SIGNAL TO MULTIPLE CONTACTS IN THE ASSOCIATED LIGHTING PANELS. THE BAS SHALL BE ABLE TO OVERRIDE ON/OFF MODE, SELECT PRE-PROGRAMMED LIGHTING MODES/SCENES, AND HAVE ALL SCHEDULING FUNCTIONS. THE LIGHTING SYSTEMS SHALL REPORT BACK TO INDICATE STATUS THRU THE BAS GRAPHICS.

5. ALL EXISTING HVAC / MECHANICAL EQUIPMENT WITHIN M&T BANK STADIUM SHALL BE CONNECTED TO THE NEW BAS, UNLESS OTHERWISE NOTED. INCLUDE EQUIPMENT LISTED BELOW

AND WITHIN THE DOCUMENTS: a. CHILLED WATER SECONDARY PUMPING PLANT

b. HEATING PLANT c. DOMESTIC COLD WATER BOOSTER PUMP SKIDS

d. DOMESTIC HOT WATER PLANT

e. FIELD HEATING SYSTEM f. AIR HANDLING UNITS

a. HEATING & VENTILATING UNITS

h. CONTROL ROOM LIEBERT UNITS i. PACKAGED HEAT PUMPS, SPLIT SYSTEMS AND PACKAGED WiFi ROOM A/C UNITS

j. VAV SINGLE-DUCT AIR TERMINAL UNITS

k. FAN-POWERED AIR TERMINAL UNITS I. FINNED TUBE RADIATORS & CONVECTORS

m. UNIT HEATERS & CABINET UNIT HEATERS n. EXHAUST, VENTILATION & SMOKE CONTROL FANS

o. TOILET EXHAUST FANS p. SCOREBOARD VENTILATION FANS

q. VENDOR COOLERS & FREEZERS (MONITORING ONLY) r. SUMP PUMPS (INCLUDING SEWAGE EJECTORS AND STORM WATER)

s. HEAT TRACE CONTROL PANELS t. ELECTRICAL ROOMS AND DATA ROOMS CLOSET - TEMPERATURE SENSORS

u. ELECTRICAL SUBSTATION ENCLOSURES - TEMPERATURE SENSORS v. BATTERY BANK STORAGE (WITHIN GENERATOR PLANT AND MAIN ELECTRICAL ROOM

SWITCHGEAR) w. GENERATOR PLANT

6. THE BAS GRAPHICAL USER INTERFACE (GUI) SHALL PROVIDE DYNAMIC GRAPHICS OF THE HVAC SYSTEM OPERATION (INCLUDING FLOOR PLANS). THE CONTROLS CONTRACTOR SHALL PROVIDE PROGRAMMING FOR ALL SYSTEM ADJUSTMENTS, SCHEDULING, TRENDING, AND ALARMING. THE CONTROLS CONTRACTOR SHALL INCLUDE IN THE NEW BAS, ALL OF THE EXISTING CUSTOM PROGRAMMING THAT THE MSA HAS SETUP IN THEIR CURRENT SYSTEMS, UNLESS OTHERWISE

7. THE CONTROLS CONTRACTOR SHALL COORDINATE PHASING AND INSTALLATION OF THE NEW BAS CONTROL PANELS WITH THE EXISTING CONTROL PANELS. WHERE REQUIRED, THE CONTROLS CONTRACTOR SHALL INCLUDE TEMPORARY SUPPORTS (I.E. UNSTRUCT, ETC...) FOR REMOVAL

BAS SERVICE COMMAND PRIORITIES

PRIORITY LEVEL	APPLICATION
1	GLOBAL HVAC SHUT-DOWN BUTTON
2	AVAILABLE - LIFE SAFETY
3	MANUAL LIFE SAFETY
4	AVAILABLE - LIFE SAFETY
5	AUTOMATIC LIFE SAFETY
6	AVAILABLE - LIFE SAFETY
7	RAVENS GAMEDAY
8	AVAILABLE
9	ESSENTIAL EQUIPMENT FAILURE
10	MINIMUM ON OFF
11	AVAILABLE
12	MAINTENANCE MANAGER
13	CORRECTIVE ACTION
14	AVAILABLE
15	SCHEDULING
16	AVAILABLE

1. SERVICE COMMAND PRIORITIES ARE FOR REFERENCE AND SHALL BE REVIEWED WITH OWNER PRIOR TO IMPLEMENTATION.

2. PROVIDE A "HEART BEAT" SYSTEM CHECK. SET AT 3PM EVERYDAY (ADJ.).

BAS SERVICE COMMAND PRIORITIES AND ALARMS

ATC GENERAL NOTES

1. M&T BANK STADIUM SHALL BE PROVIDED WITH A NEW FULLY DIGITAL BUILDING AUTOMATION SYSTEM (BAS). THIS SYSTEM WILL REPLACE THE EXISTING JOHNSON DDC CONTROL SYSTEM & ANDOVER CONTINUUM CONTROL SYSTEM IN THEIR ENTIRETY, UNLESS OTHERWISE NOTED.

ALL IDENTIFIED EQUIPMENT (SEE FLOOR PLANS) IS EXISTING TO REMAIN AND SHALL BE RETROFIT WITH NEW CONTROLS (I.E. SENSORS, DAMPERS, ETC...). ALL EQUIPMENT SHALL BE CONNECTED TO THE NEW BAS. REFER TO ATC CONTROLS DRAWINGS FOR ADDITIONAL INFORMATION.

ALL EXISTING THERMOSTATS RELATED TO WORK SHOWN ON PLANS OR IN SEQUENCES SHALL BE REMOVED AND REPLACED.

ALL EXISTING VALVES AND DAMPERS ARE PNEUMATICALLY ACTUATED. REPLACE ALL PNEUMATIC ACTUATORS WITH ELECTRONIC ACTUATORS.

- . THE ATC WORK SHALL INCLUDE PROVISIONS FOR A COMPLETE AND OPERABLE CONTROL SYSTEM, INCLUDING ALL DEVICES REQUIRED TO ACHIEVE THE SEQUENCES AND FUNCTIONS INDICATED THROUGHOUT THE CONTRACT DOCUMENTS. ATC CONTRACTOR SHALL HAVE A DEDICATED PERSON FOR BAS SYSTEMS INTEGRATION.
- 3. THE ATC CONTRACTOR SHALL FURNISH AND INSTALL ALL ELECTRICAL WIRING AND CONDUIT FROM POWER SOURCE, INCLUDING TERMINATION TO ALL REQUIRED ATC RELATED POWER CONNECTIONS INCLUDING, BUT NOT LIMITED TO, DDC CONTROLLERS (PROVIDE LOW VOLTAGE CONTROLLER FOR AIR TERMINAL UNITS INCLUDING TRANSFORMERS AND DISCONNECT SWITCHES AS REQUIRED), SENSORS, VALVE AND DAMPER ACTUATORS (INCLUDING SMOKE DAMPERS), AIR FLOW MONITORS, ATC PANELS, ETC. THE ATC CONTRACTOR SHALL BE WHOLLY RESPONSIBLE FOR ALL POWER REQUIREMENTS NECESSARY FOR A COMPLETE INSTALLATION FROM THE POWER SOURCE TO ALL ATC RELATED CONNECTIONS.
- 4. THE ATC CONTRACTOR SHALL COORDINATE AND VERIFY THAT ALL CONTROLLERS, DEVICES AND ACCESSORIES ARE PROVIDED AS REQUIRED TO ACCOMPLISH ALL CONTROL FUNCTIONS AND SEQUENCES INDICATED IN THE CONTRACT DOCUMENTS. WHERE CONTROL RELATED DEVICES ARE NOT PROVIDED BY AN EQUIPMENT MANUFACTURER, IT SHALL BE THE RESPONSIBILITY OF THE ATC CONTRACTOR TO PROVIDE THE CONTROL DEVICES REQUIRED TO ACCOMPLISH THE FUNCTIONS AND SEQUENCES INDICATED.
- 5. THE ATC CONTRACTOR SHALL PROVIDE NEW CONTROLLERS, DEVICES, POINTS, ETC REQUIRED TO ACCOMPLISH THE CONTROL SEQUENCES AND FUNCTIONS INDICATED ON THE DRAWINGS AND IN THE SPECIFICATIONS. EXISTING CONTROLLERS AND DEVICES SHALL BE DEMOLISHED AND NOT BE RE-USED FOR THIS PROJECT. ALL POINTS SHALL BE TIED INTO THE BUILDING AUTOMATION SYSTEM (BAS). IN ADDITION, THE ATC CONTRACTOR SHALL PROVIDE ALL CONTROLLERS, DEVICES, POINTS, ETC REQUIRED TO CONTROL, OPERATE AND MONITOR ALL EQUIPMENT INDICATED THROUGHOUT THE CONTRACT DOCUMENTS.

ALL CONTROLLERS SHALL BE PROVIDED WITH A MINIMUM 10% SPARE CAPACITY AND NO LESS THAN ONE (1) SPARE POINT.

- 6. PROVIDE EQUIPMENT STATUS FOR ALL MECHANICAL EQUIPMENT. EQUIPMENT FAILURES SHALL BE ALARMED AT THE BAS. PROVIDE END SWITCHES FOR ALL MOTOR OPERATED DAMPERS. END SWITCHES SHALL BE INTERFACED WITH THE BAS.
- 7. PROVIDE CURRENT SENSING RELAYS FOR ALL MECHANICAL EQUIPMENT AS REQUIRED TO PROVIDE EQUIPMENT STATUS. EQUIPMENT STATUS SHALL BE INDICATED AS THE BAS.
- 8. PROVIDE TEMPERATURE SENSOR IN SUPPLY DUCTWORK DOWNSTREAM OF ALL TERMINAL REHEAT UNITS, VAV TERMINALS WITH REHEAT COILS AND DUCT MOUNTED HEATING COILS.
- 9. WATER PRESSURE DROP THROUGH ATC CONTROL VALVES SHALL NOT EXCEED 10 FT. HEAD. TWO-POSITION ATC VALVES UTILIZED FOR ISOLATION, BY-PASS OR SHUT-OFF PURPOSES SHALL BE FULL LINE SIZE.
- 10. ALL ATC DEMOLITION SHALL BE PERFORMED BY THE ATC CONTRACTOR ONLY. REMOVAL OF EXISTING PNEUMATICALLY CONTROLLED EQUIPMENT SHALL BE SEQUENCED TO ENSURE CONTINUED OPERATION OF THE FACILITY, ALL PNEUMATIC PIPING, EQUIPMENT, ETC. LOCATED WITHIN MECHANICAL ROOMS, SERVICE LEVEL AND EXPOSED TO VIEW SHALL BE REMOVED AT THE COMPLETION OF THIS PROJECT. EXISTING PNEUMATIC TUBING ROUTED TO TERMINAL UNITS ON EACH FLOOR AND CONCEALED FROM VIEW SHALL BE ABANDONED IN PLACE. ANY ABANDONED TUBING SHALL BE SEALED AT EACH END AND LABELED "ABANDONED ATC TUBING".
- 11. ALL AIR HANDLING EQUIPMENT WITH A COOLING COIL THAT PRODUCE CONDENSATE SHALL BE EQUIPPED WITH A CONDENSATE WATER-LEVEL DETECTION DEVICE CONFORMING TO UL 508 WHICH SHALL SHUT OFF THE EQUIPMENT SERVED IN THE EVENT THAT THE PRIMARY DRAIN IS BLOCKED. THE DEVICE SHALL BE INSTALLED IN THE EQUIPMENT-SUPPLIED DRAIN PAN AT A POINT HIGHER THAN THE PRIMARY DRAIN LINE CONNECTION AND BELOW THE OVERFLOW RIM OF SUCH PAN. ALL CONDENSATE PUMP BASINS SHALL ALSO BE PROVIDED WITH A WATER-LEVEL DETECTION DEVICE THAT SHUTS OFF EQUIPMENT SERVED WHEN OVERFLOW IS SENSED. LEAK DETECTION FOR ALL UNITS SHALL ALSO ALARM AT THE
- 12. PROVIDE THERMOSTAT/SENSOR GUARDS IN ALL AREAS SUBJECT TO POTENTIAL DAMAGE. THERMOSTAT/SENSOR GUARDS SHALL BE CLEAR, IMPACT RESISTANT LOCKABLE PLASTIC OR APPROVED EQUIVALENT. LOCATIONS SHALL BE COORDINATED WITH THE OWNER. CONTRACTOR SHALL PROVIDE FIFTEEN (15) GUARDS.

BUILDING AUTOMATION SYSTEM (BAS).

- 13. ALL SETPOINTS INDICATED ON THE SEQUENCES SHALL BE ADJUSTABLE. OPERATOR SHALL BE ABLE TO EASILY ADJUST ALL POINTS THRU THE GRAPHICAL USER INTERFACE.
- 14. ALL ATC WIRING IN MECHANICAL ROOMS, SERVICE LEVEL AND WHERE EXPOSED TO VIEW SHALL BE INSTALLED IN CONDUIT. ALL ATC WIRING SHALL BE PLENUM RATED.
- 15. EXISTING CONDUIT MAY BE REUSED IF IN GOOD CONDITION AND WILL NOT CAUSE CONFLICT WITH PHASING OF WORK. 16. ATC CONTROL VALVES FOR HEATING SHALL FAIL FULL-OPEN. ATC CONTROL VALVES FOR
- 17. THE BAS SYSTEM SHALL HAVE THE ABILITY TO EMAIL AND TEXT MESSAGE ALARM SIGNALS. 18. THE BAS SHALL INCLUDE BACKUP CONFIGURATION WITH ONE (1) YEAR OF BACKUP
- 19. NETWORK CABLE SHALL BE CAT 6 AND "ORANGE". ON CLUB LEVEL, ALL EXPOSED CABLING SHALL BE PAINTED BLACK, EXCEPT CABLING WITHIN CABLE TRAY.

COOLING SHALL FAIL TO THE LAST POSITION. FAILURE SHALL BE ALARMED AT THE BAS.

- 20. PROVIDE TWO (2) GLOBAL HVAC SHUT DOWN BUTTON FOR ALL STADIUM AIR HANDLING EQUIPMENT. SHUT-DOWN BUTTON SHALL BE LOCATED IN THE SERVICE LEVEL AT THE FACILITY OPERATIONS OFFICE #1.18.02, AND AT THE SECURITY BASE #1.16.05. (FINAL LOCATIONS FOR INSTALLATION SHALL BE APPROVED BY MSA, COORDINATE PRIOR TO INSTALLATION). PROVIDE CLEAR COVER OVER BUTTON. GLOBAL SHUT-DOWN SHALL ALSO BE INCLUDED ON THE BAS GRAPHICAL USER INTERFACE.
- 21. NETWORK WIRING LAYOUT SHALL BE SUBMITTED FOR REVIEW AND APPROVAL.

- 22. THE FIRE ALARM SYSTEM SHALL OVERRIDE THE BAS SYSTEM FOR ALL LIFE-SAFETY OPERATIONS (I.E. SMOKE CONTROL, ETC...). COORDINATE WIRING AND CONTROLS WITH THE FIRE ALARM CONTRACTOR. ALL CONTROL DEVICES AND WIRING USED FOR THE SMOKE CONTROL SYSTEMS SHALL MEET THE UL 864, UUKL LISTING REQUIREMENTS.
- 23. THERE SHALL BE A BAS GRAPHICS PAGE DEDICATED TO THE FIRE ALARM SYSTEM. THIS PAGE SHALL DISPLAY THE THREE (3) FIRE ALARM INPUT POINTS (FIRE ALARM, TROUBLE, AND SUPERVISORY) AND THE SMOKE EXHAUST FAN STATUS.
- 24. ALL ASSOCIATED FIRE ALARM WORK SHALL BE COORDINATED WITH THE EXISTING FIRE ALARM SYSTEM VENDOR. ALL FIRE ALARM WORK SHALL BE TESTED AND COMMISSIONED. - ATRIUM SMOKE ZONE CONTROL - CLUB SMOKE ZONE CONTROL
- 25. THE EXISTING FIRE ALARM SYSTEM IS A SIEMENS FIRE ALARM SYSTEM.

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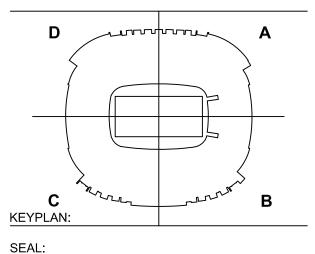
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DRAWN BY: CMP

FEBRUARY 12, 2021

BUILDING AUTOMATION SYSTEM - GENERAL NOTES & NETWORK ARCHITECTURE

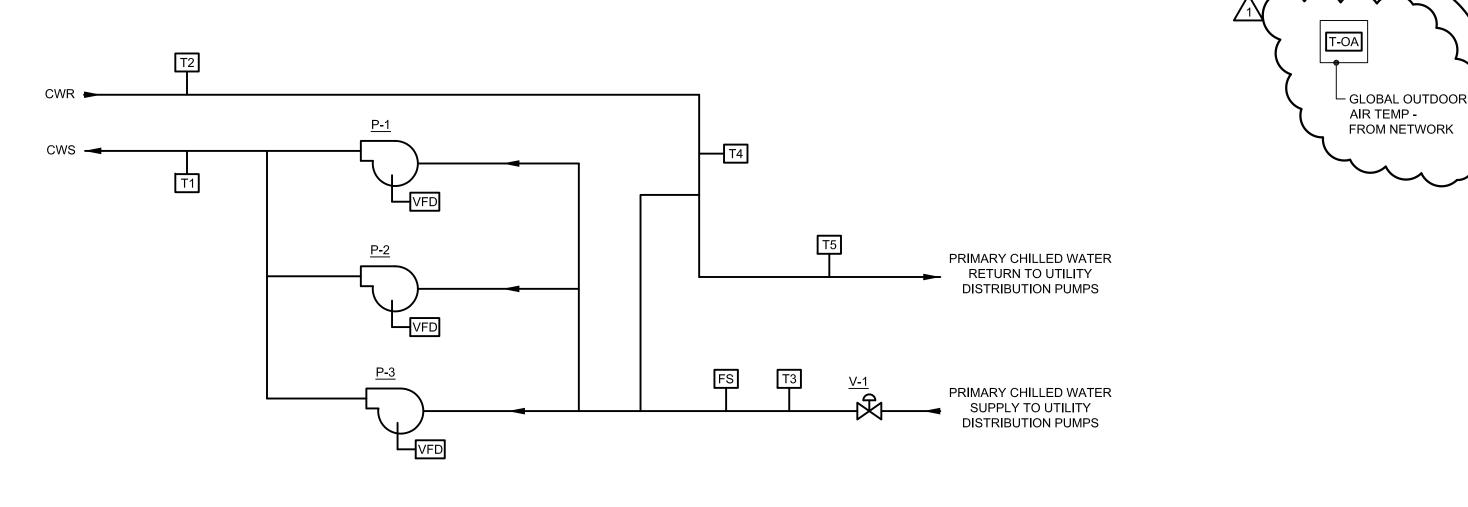
DRAWING NO:

- 2. DOMESTIC WATER HEATERS: 2.1. TANK MOUNTED SENSORS $\underline{\text{T1}}$, $\underline{\text{T-2}}$ & $\underline{\text{T-3}}$ SHALL MODULATE STEAM VALVES $\underline{\text{V-1}}$, $\underline{\text{V-2}}$ & $\underline{\text{V-3}}$ TO MAINTAIN ITS SETTING OF 140°F (ADJUSTABLE).
- 2.2. THREE (3) STORAGE WATER HEATERS ARE PIPED IN PARALLEL TO HANDLE THE DESIGN
- 2.3. EACH HEATER WILL HAVE SELF CONTAINED CONTROL OF ITS OWN TANK TEMPERATURE AND THAT TEMPERATURE SHALL BE MONITORED AT THE BAS.
- 2.4. 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
- 2.5. 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. 3. DOMESTIC WATER BOOSTER PUMPS:
- 2.6. FAILURE OF EITHER PUMP WILL BE ALARMED AT THE BAS.

- DOMESTIC WATER SUPPLY TEMPERATURE SENSOR **T5** WILL MONITOR LOOP TEMPERATURE AND TREND 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
- 2.10. 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 <u>HX-1</u> AND PREHEATING IS

WHEN TEMPERATURE RISES ABOVE 145°F (ADJUSTABLE).

- 3.1. TWO (2) PACKAGED DOMESTIC WATER BOOSTER PUMP SYSTEMS WITH FOUR (4) PUMPS EACH ARE PROVIDED FOR THE FACILITY.
- 3.2. 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:

- 1.1. 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 BEN CONFIRMED BY THE UTILITY FLOW METER AND SYSTEM FLOW SWITCH, <u>FS-1</u>.
- 1.2. 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.
- 1.3. 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
- LEAD/LAG PUMP OPERATION. LEAD PUMP SHALL BE ALTERNATED EVERY 300 HOURS (ADJ) OF RUN TIME. 1.4. 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.
- 1.5. A FAILURE OF ANY DISTRIBUTION PUMP WILL BE ALARMED AT THE BAS.
- 1.6. EACH DISTRIBUTION PUMP WILL BE STARTED AT REDUCED SPEED THROUGH INDIVIDUAL VARIABLE FREQUENCY PUMP DRIVES AND SEQUENCED WITH THE PROGRAMMED LEAD/LAG 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 SEED 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 <u>DPT-1</u>, <u>DPT-2</u> & <u>DPT-3</u> 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
- 1.8. 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.
- 1.9. BOTH PUMPS WILL THEN GRADUALLY MODULATE AT THE SAME SPEED TO MAINTAIN THE SETPOINTS OF THE OPT-1, DPT-2 & DRT-2 AS DETERMINED BY THE BAS PUMP SPEED SHALL INCREASE AS REQUIRED TO SATISFY DEMAND OF ALL DP TRANSMITTERS
- 1.10. 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
- 1.12. ON A RISE IN DIFFERENTIAL PRESSURE ABOVE THE SETPOINT, THE REVERSE SEQUENCE WILL OCCUR.
- 1.13. TEMPERATURE SENSOR <u>T-1</u> WILL MODULATE VALVE V-1 TO MAINTAIN ITS SETTING OF 36°F

SETPOINTS OF THE <u>DPT-1</u>, <u>DPT-2</u> & <u>DPT-3</u> AS DETERMINED BY THE BAS.

- 1.14. TEMPERATURE SENSORS <u>T-2</u>, <u>T-3</u>, <u>T-4</u> WILL MONITOR CHILLED WATER TEMPERATURE AT LOCATIONS
- 1.15. UTILITY FLOW METER SHALL MONITOR AND TREND CHILLED WATER CONSUMPTION AT THE FACILITY.

KEYPLAN: SEAL:

PROFESSIONAL CERTIFICATION:

THAT I AM A DULY LICENSED

LICENSE NO.

ISSUED FOR:

EXPIRATION DATE:

02/12/21 | BID SET

PROJECT NO: **20092.01**

DRAWN BY: **MJG**

SHEET TITLE:

SCALE:

PROFESSIONAL CERTIFICATION. I HEREBY

CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND

PROFESSIONAL ENGINEER UNDER THE

DESCRIPTION

LAWS OF THE STATE OF MARYLAND.

 ldash GLOBAL OUTDOOR

AIR TEMP -FROM NETWORK Burdette, Koehler, Murphy & Associates, Inc.

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

Mechanical / Electrical Engineers 6300 Blair Hill Lane, Suite 400

P: 410.323.0600 | www.bkma.com

Baltimore, Maryland 21209

PROJECT NAME:

CONSULTANTS:

P: 301-230-0811

WFT ENGINEERING, INC.

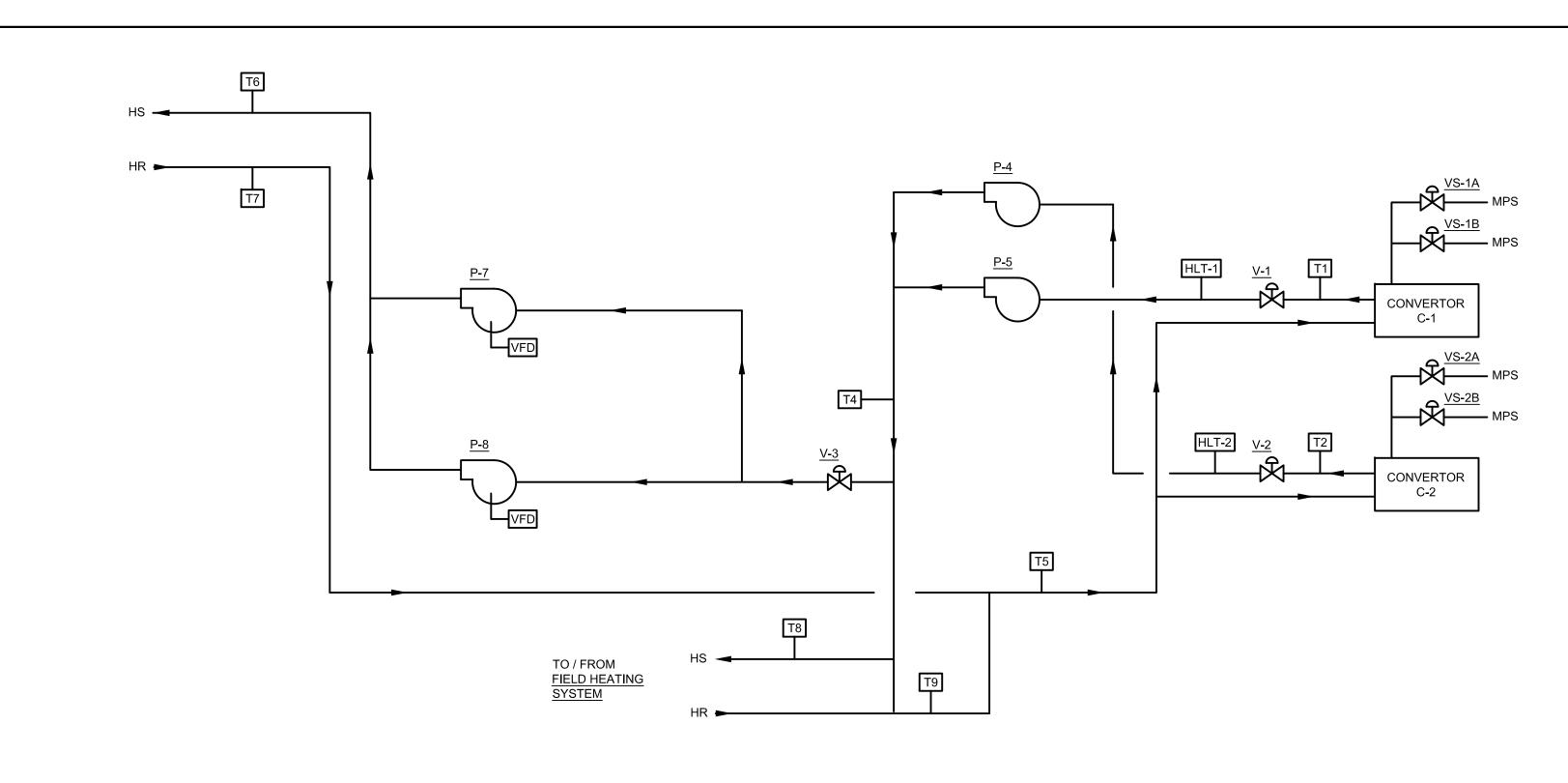
ROCKVILLE, MARYLAND 20850

1801 RESEARCH BOULEVARD, SUITE 100

SPACE CONTROL

A. GENERAL:

- 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 FOLLOWS, UNLESS OTHERWISE NOTED.
- HEATING OCCUPIED: 70°F (ADJUSTABLE) HEATING - UNOCCUPIED: 60°F (ADJUSTABLE) COOLING - OCCUPIED: 75°F (ADJUSTABLE) COOLING - UNOCCUPIED: 80°F (ADJUSTABLE)
- 2. EACH THERMOSTAT/SENSOR SHALL BE CAPABLE OF INDIVIDUAL TIME OF DAY SCHEDULING.
- B. CONSTANT VOLUME AHU'S WITH NO REHEAT COILS:
 - 1. EACH THERMOSTAT/SENSOR SHALL HAVE INDIVIDUAL OCCUPIED AND UNOCCUPIED HEATING AND COOLING SETPOINTS. ALL SETPOINTS SHALL BE ADJUSTABLE THROUGH THE BAS.
 - HEATING OCCUPIED: 72°F (ADJUSTABLE) HEATING - UNOCCUPIED: 60°F (ADJUSTABLE) COOLING - OCCUPIED: 75°F (ADJUSTABLE) COOLING - UNOCCUPIED: 80°F (ADJUSTABLE)
- C. DUCT MOUNTED REHEAT COILS:
- 1. UPON A FALL IN SPACE TEMPERATURE, TWO-WAY VALVE SHALL MODULATE TO MAINTAIN TEMPERATURE SETPOINT (ADJUSTABLE).
- D. VARIABLE VOLUME TERMINAL WITH ELECTRIC HEATING COIL:
 - 1. ON A FALL IN SPACE TEMPERATURE, SPACE THERMOSTAT/SENSOR SHALL MODULATE VAV DAMPER
 - 2. ON A CONTINUED FALL IN TEMPERATURE, THERMOSTAT/SENSOR SHALL ENERGIZE ELECTRIC HEATING COIL TO MAINTAIN SETPOINT.
 - 3. ON A RISE IN SPACE TEMPERATURE, THE OPPOSITE SHALL OCCUR.
- E. GENERAL EXHAUST FANS (GEF): 1. FAN OPERATION SHALL BE SCHEDULED THROUGH THE BAS.
 - WINTER MODE: FANS SHALL REMAIN DE-ENERGIZED NON-WINTER MODE: FANS SHALL OPERATE AS FOLLOWS:
 - 1.1. FANS SHALL BE ENERGIZED WHEN THE SYSTEM IS IN OCCUPIED MODE. FAN SHALL BE DE-ENERGIZED IN UNOCCUPIED MODE.
 - 1.2. OCCUPIED/UNOCCUPIED MODE SHALL BE DETERMINED BY BAS.



HEATING WATER SYSTEM CONTROL

GENERAL:

- 1.1. WHEN THE SYSTEM IS DE-ENERGIZED, THE STEAM / HEATING WATER CONVERTORS AND BUILDING HEAT PUMPS SHALL BE OFF.
- 1.2. HEATING SYSTEM SHALL RUN ALL YEAR WITH A REDUCED CAPACITY IN THE COOLING SEASON.
- 1.3. WHEN SYSTEM IS ENERGIZED, PRIMARY HEATING WATER PUMPS AND CONVERTORS WILL ENERGIZE IN STAGES TO MAINTAIN HEATING WATER TEMPERATURE DIFFERENCE. 1.4. OUTDOOR AIR TEMPERATURE SHALL BE BASED ON THE GLOBAL AVERAGE EMPERATURE.

- 2. PUMPS & CONVECTOR STARTER SEQUENCE: 2.1. 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 LEAD/LAG 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. 2.2. STEAM CONTROL VALVES VS-1A AND VS-1B SERVING C-1 CONVERTOR, V-1 WILL BE MODULATED IN
- SEQUENCE BY TEMPERATURE SENSOR T1 TO MAINTAIN HEATING WATER SUPPLY TEMPERATURE AS INDICATED ON HEATING WATER RESET SCHEDULE. CONTROL FOR CONVERTOR C-2 WILL BE SIMILAR TO <u>C-1</u> AND INDEPENDENT OF EACH OTHER.
- 2.3. 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 T4 & T5 EXCEEDS 24°F, THE LAG PUMP AND LAG CONVERTOR WILL BE ENERGIZED.

2.5. 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.

3. DIFFERENTIAL PRESSURE CONTROL:

- 3.1. 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.
- 3.2. THE LEAD PUMP WILL START AT A REDUCED SPEED RAMP UP AND DOWN AS REQUIRED. IF PUMP P-7 FAILS OR FAILS TO START AS SENSED BY THE VFD PANEL CONTACT, PUMP P-8 WILL AUTOMATICALLY START AND RUN CONTINUOUSLY.
- 3.3. 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

3.4. 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 REDUCED TO 50% FULL LOAD. BOTH PUMPS SHALL GRADUALLY MODULATE AT THE SAME SPEED TO MAINTAIN THE SETPOINTS OF DPT-1 DPT-2 & DPT-3. PUMP SPEED SHALL INCREASE AS REQUIRED TO SATISFY 1 DEMAND OF ALL DP TRANSMITTERS. $\overline{13}$ SHALL MODULATE $\underline{ extsf{V-4}}$ TO MAINTAIN SETPOINT (ADJUSTABLE), AS INDICATED ON RESET

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

BETWEEN INTERMEDIATE SETPOINTS.

*TEMPERATURES SHALL BE LINEAR

AUTOMATIC TEMPERATURE CONTROLS

FEBRUARY 12, 2021

AS NOTED

DRAWING NO:

CĽUB / ŠUIŤEŠ QŬAĎS A ŤHŘU Ď (AHU-1 THRU 4)

GENERAL

- 1.1. SUPPLY AIR FAN AND RETURN AIR FAN OPERATION SHALL BE INTERLOCKED. SUPPLY AND RETURN FANS SHALL OPERATE CONTINUOUSLY IN THE OCCUPIED MODE. H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN "OFF" POSITION, D-1A, D-1B AND $\underline{\text{D-3}}$ SHALL BE FULLY CLOSED AND $\underline{\text{D-2}}$ SHALL BE FULLY OPEN. WHEN FANS ARE DE-ENERGIZED, $\underline{\text{D-1A}}$, $\underline{\text{D-1B}}$ AND $\underline{\text{D-3}}$
- 1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE DETERMINED THE BUILDING AUTOMATION SYSTEM (BAS).
- 1.3. PROVIDE SEPARATE, INDEPENDENT LINKAGE CONTROL FOR EACH M.O.D. (D-1A, D-1B, D-2 & D-3).
- 1.4. 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
- 1.5. THE GLOBAL OUTDOOR AIR SENSORS SHALL BE INSTALLED AT THE OA LOUVERS FOR AIR HANDLING UNITS 1 THRU 4. INSTALL IN AN ACCESSIBLE LOCATION.
- 1.6. INDIVIDUAL AIR TERMINAL / VAV UNITS SHALL NOT BE PERMITTED TO DRIVE THE OPERATION OF THE SYSTEM (I.E TEMPERATURE OR FAN CONTROL). OPERATOR SHALL BE ABLE TO INDIVIDUALLY SELECT AIR TERMINAL UNITS TO REMOVE FROM THE CALCULATIONS DRIVING AHU OPERATIONS. ADDITIONALLY, AIR TERMINAL UNITS SERVING ELECTRICAL ROOMS WILL BE REMOVED BY DEFAULT. BAS GRAPHICS SHALL INDICATE IF A UNIT IS INCLUDED OR REMOVED FROM THE CALCULATIONS. SEE TEMPERATURE CONTROL AND FAN OPTIMIZATION CONTROL BELOW.

2. TEMPERATURE CONTROL

- A. WHEN THE OUTSIDE AIR ENTHALPY IS ABOVE THE RETURN AIR ENTHALPY, <u>D-1A</u>, <u>D-1B</u>, <u>D-2</u> & <u>D-3</u> SHALL MODULATE AS
- 1) $\underline{\text{D-}1A}$ (MIN OUTSIDE AIR) SHALL FULLY OPEN AND $\underline{\text{D-}1B}$ (MAX OUTSIDE AIR) SHALL BE FULLY CLOSED.

2) D-2 (RETURN AIR) SHALL FULLY OPEN.

INTERIOR UNIT TEMPERATURE OF 90°F (ADJUSTABLE).

- <u>-3</u> (RELIEF AIR) SHALL BE CLOSED WHEN <u>D-1B</u> (MAX OA) IS CLOSED. WHEN THE UNIT GOES TO ECONOMIZER, AND <u>D-1B</u> (MAX OA) BEGINS TO OPEN, THEN <u>D-3</u> (RELIEF AIR) SHALL MODULATE OPEN AND 'TRACK' WITH <u>D-1B</u> (MAX OA). B. WHEN THE OUTSIDE AIR ENTHALPY IS LESS THEN THE RETURN AIR ENTHALPY, <u>D-1A</u>, <u>D-1B</u>, <u>D-2</u> & <u>D-3</u> SHALL MODULATE TO MAXIMIZE ATMOSPHERIC (FREE) COOLING AND MAINTAIN A DISCHARGE AIR TEMPERATURE EQUAL TO THE SUPPLY AIR TEMPERATURE SETPOINT (45° ADJUSTABLE). 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)].
- C. THE SUPPLY AIR TEMPERATURE, SENSED BY T3, SHALL THEN BE MAINTAINED AT SETPOINT BY MODULATING V-1 OR V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED. THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE AS PER THE FOLLOWING SUPPLY AIR RESET SCHEDULE (ALL TEMPERATURES SHALL BE ADJUSTABLE).

RESET (SATR)

INDICATED.

ADJUSTABLE.

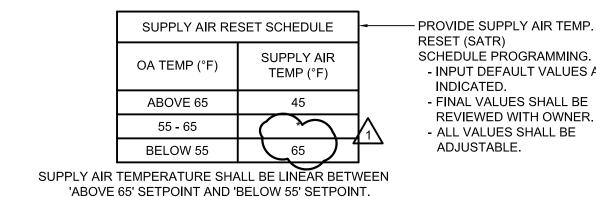
SCHEDULE PROGRAMMING

- FINAL VALUES SHALL BE

- ALL VALUES SHALL BE

REVIEWED WITH OWNER.

- INPUT DEFAULT VALUES AS



- 2.2 UNOCCUPIED (HEATING): CYCLE FANS AND OPEN HEATING VALVE, V-1, TO MAINTAIN ALL NIGHT SETBACK TEMPERATURES. <u>D-1A, D-1B</u> AND <u>D-3</u> SHALL BE FULLY CLOSED AND <u>D-2</u> FULLY OPEN. WHEN SUPPLY FAN CYCLES 'ON' THE ASSOCIATED VAV TERMINAL DAMPERS SHALL OPEN. BELOW 35°F OUTSIDE AIR TEMPERATURE, HEATING VALVE SHALL MODULATE TO MAINTAIN
- 2.3 UNOCCUPIED (COOLING): NIGHT THERMOSTAT/SENSOR AND HUMIDITY SENSOR SHALL CYCLE FAN(S) AND OPEN COOLING VALVE, V-2. TO MAINTAIN NIGHT SETBACK TEMPERATURE AND HUMIDITY SETPOINTS (ADJUSTABLE). D-1A, D-1B AND D-3 SHALL BE FULLY CLOSED AND D-2 FULLY OPEN.
- 2.4 MORNING WARM-UP: WHEN SYSTEM IS FIRST INDEXED TO "MORNING WARM UP" MODE, DAMPERS D-1A, D-1B & D-3 SHALL REMAIN CLOSED AND D-2 SHALL REMAIN OPEN. FANS SHALL ENERGIZE AND HEATING VALVE (V-1) SHALL MODULATE TO OPI 100% (PERCENTAGE OPEN SHALL BE ADJ). WHEN ALL SPACES REACH HEATING SETPOINT, OR WHEN OCCUPIED SCHEDULE
- 2.5 MORNING COOLING DOWN: WHEN SYSTEM IS FIRST INDEXED TO "MORNING COOL-DOWN" MODE, OCCUPIED AND NIGHT THERMOSTATS/SENSORS ARE ABOVE OCCUPIED COOLING SETPOINT, DAMPERS D-1A, D-1B, & 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.

BEGINS, THE SYSTEM SHALL TRANSITION FROM "MORNING WARM-UP" TO "OCCUPIED" MODE.

3. AIR FLOW / FAN CONTROL

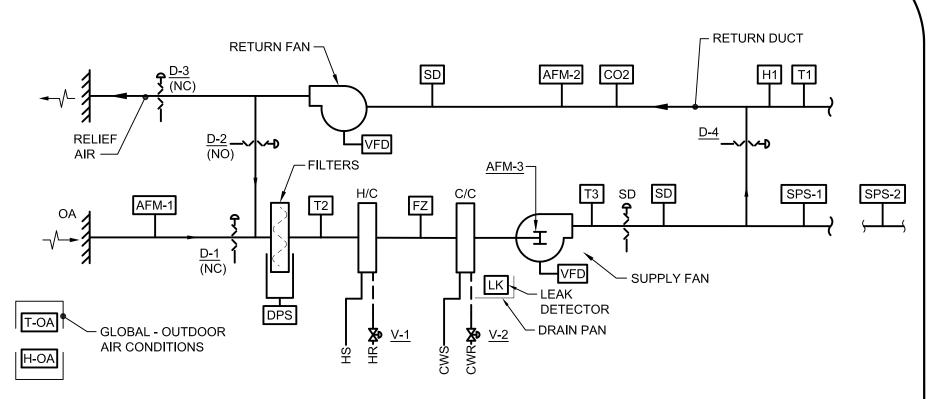
3.1. OCCUPIED:

- A. STATIC PRESSURE SENSOR, SPS-2, SHALL MODULATE THE SUPPLY FAN VARIABLE FREQUENCY DRIVE, VFD TO MAINTAIN THE SUPPLY DUCT STATIC PRESSURE SETPOINT.
- 1) FAN PRESSURE OPTIMIZATION (STATIC PRESSURE RESET): EVERY 10 MINUTES (ADJUSTABLE) DURING THE OCCUPIED MODE, THE DAMPER POSITIONS OF EACH VAV TERMINAL ASSOCIATED WITH THE AHU 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.
- B. AIR FLOW MONITORS, AFM-2 & AFM-3, LOCATED IN THE SUPPLY AND RETURN DUCT SHALL MODULATE THE RETURN AIR FAN VARIABLE FREQUENCY DRIVE, VFD TO MAINTAIN AN AIR FLOW OFFSET EQUAL TO THE OUTSIDE AIR.
- C. DAMPER D-1A LOCATED AT THE MINIMUM OUTSIDE AIR INTAKE SHALL ALWAYS BE OPEN DURING OCCUPIED MODE. MODULATE D-1B DURING ECONOMIZER MODE (ATMOSPHERIC COOLING).
- D. 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.
- 4. MISCELLANEOUS
- 4.1 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.
- 4.2 HIGH LIMIT STATIC PRESSURE SENSOR, <u>SPS-1</u> SHALL DE-ENERGIZE AHU 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 OR RETURN FAN, DAMPERS <u>D-1A</u>, <u>D-1B</u>, <u>D-2</u> AND <u>D-3</u> SHALL CLOSE. ALARM AT BAS.

4.5 MONITOR RETURN AIR CO2 SENSORS AT THE BAS.

- 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 CLOSED TO 50% (ADJ.) AND THE HEATING VALVE SHALL OPEN A MINIMUM OF 5% (ADJUSTABLE). A
- WARNING SHALL 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 (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 BEGINS TO RISE, OPERATION SHALL
- . 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.



LOW-TEMPERATURE, VAV AIR HANDLING UNIT CONTROL

GENERAL

- 1.1. SUPPLY AIR FAN AND RETURN AIR FAN OPERATION SHALL BE INTERLOCKED. SUPPLY AND RETURN 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 <u>D-2</u> SHALL BE FULLY OPEN. WHEN FANS ARE DE-ENERGIZED, <u>D-1</u> AND <u>D-3</u> SHALL BE FULLY CLOSED. <u>D-4</u> SHALL REMAIN CLOSED UNDER ALL CONDITIONS.
- 1.2. D-4 (BYPASS DAMPER) SHALL BE CLOSED UNDER OCCUPIED, UNOCCUPIED AND ALL OTHER MODES.
- 1.3. OCCUPIED-UNOCCUPIED MODE SHALL BE DETERMINED THE BUILDING AUTOMATION SYSTEM (BAS). ADDITIONALLY, MORNING WARM-UP AND MORNING COOL-DOWN MODES SHALL BE DETERMINED THROUGH THE BAS, VIA SCHEDULING OR OPERATOR
- 1.4. PROVIDE SEPARATE, INDEPENDENT LINKAGE CONTROL FOR EACH M.O.D. (D-1, D-2, D-3 & D-4).
- 1.5. 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
- LOBAL SENSORS IN THE SAME QUADRANT IN WHICH THE UNIT IS LOCATED (DEFAULT), UNLESS OVERRIDDEN BY THE BAS. 1.6. INDIVIDUAL AIR TERMINAL / VAV UNITS SHALL NOT BE PERMITTED TO DRIVE THE OPERATION OF THE SYSTEM (I.E. TEMPERATURE OR FAN CONTROL). OPERATOR SHALL BE ABLE TO INDIVIDUALLY SELECT AIR TERMINAL UNITS TO REMOVE FROM THE CALCULATIONS DRIVING AHU OPERATIONS. ADDITIONALLY, AIR TERMINAL UNITS SERVING ELECTRICAL ROOMS WILL BE REMOVED BY DEFAULT. BAS GRAPHICS SHALL INDICATE IF A UNIT IS INCLUDED OR REMOVED FROM THE CALCULATIONS. SEE TEMPERATURE CONTROL AND FAN OPTIMIZATION CONTROL BELOW.

2. TEMPERATURE CONTROL

- A. WHEN THE OUTSIDE AIR ENTHALPY IS ABOVE THE RETURN AIR ENTHALPY, <u>D-1</u>, <u>D-2</u> & <u>D-3</u> SHALL MODULATE AS FOLLOWS:
- 1) D-1 (OUTSIDE AIR) SHALL MODULATE TO MINIMUM OUTSIDE AIR POSITION IN RESPONSE TO AIRFLOW MONITOR, AFM-1. SEE AIR FLOW CONTROL BELOW.
- 2) 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.
- B. 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 (45° ADJUSTABLE). 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)].
- C. THE SUPPLY AIR TEMPERATURE, SENSED BY T3, SHALL THEN BE MAINTAINED AT SETPOINT BY MODULATING V-1 OR V-2, WITHOUT OVERLAPPING CONTROL, 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	45	
	55 - 65		Λ
	BELOW 55	65	<u> </u>
SUPPLY AIR	TEMPERATURE SHA	ALL BE LINEAR BETV	VEE

——— 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.

'ABOVE 65' SETPOINT AND 'BELOW 55' SETPOINT.

- 2.2 UNOCCUPIED (HEATING): CYCLE FANS AND OPEN HEATING VALVE, V-1, TO MAINTAIN ALL NIGHT SETBACK TEMPERATURES. D-1 AND <u>D-3</u> SHALL BE FULLY CLOSED AND <u>D-2</u> FULLY OPEN. WHEN SUPPLY FAN CYCLES 'ON' THE ASSOCIATED VAV TERMINAL DAMPERS SHALL OPEN. BELOW 35°F OUTSIDE AIR TEMPERATURE, HEATING VALVE SHALL MODULATE TO MAINTAIN INTERIOR UNIT TEMPERATURE OF 90°F (ADJUSTABLE).
- 2.3 UNOCCUPIED (COOLING): NIGHT THERMOSTAT/SENSOR AND HUMIDITY SENSOR SHALL CYCLE FAN(S) AND OPEN COOLING VALVE, V-2. TO MAINTAIN NIGHT SETBACK TEMPERATURE AND HUMIDITY SETPOINTS (ADJUSTABLE). D-1 AND D-3 SHALL BE FULLY CLOSED AND D-2 FULLY OPEN.
- 2.4 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 HEATING VALVE (V-1) SHALL MODULATE TO OPEN 100% (PERCENTAGE OPEN SHALL BE ADJ). WHEN ALL SPACES REACH HEATING SETPOINT, OR WHEN OCCUPIED SCHEDULE BEGINS, THE SYSTEM SHALL TRANSITION FROM "MORNING WARM-UP" TO "OCCUPIED" MODE.
- 2.5 MORNING COOLING DOWN: WHEN SYSTEM IS FIRST INDEXED TO "MORNING COOL-DOWN" MODE, OCCUPIED AND NIGHT THERMOSTATS/SENSORS ARE ABOVE OCCUPIED COOLING SETPOINT, 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.

3.1. OCCUPIED:

- A. STATIC PRESSURE SENSOR, SPS-2, SHALL MODULATE THE SUPPLY FAN VARIABLE FREQUENCY DRIVE, VFD TO MAINTAIN THE SUPPLY DUCT STATIC PRESSURE SETPOINT.
- 1) FAN PRESSURE OPTIMIZATION (STATIC PRESSURE RESET): EVERY 10 MINUTES (ADJUSTABLE) DURING THE OCCUPIED MODE, THE DAMPER POSITIONS OF EACH VAV TERMINAL ASSOCIATED WITH THE AHU 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.
- B. AIR FLOW MONITORS, AFM-2 & AFM-3, LOCATED IN THE SUPPLY AND RETURN DUCT SHALL MODULATE THE RETURN AIR FAN VARIABLE FREQUENCY DRIVE, VFD TO MAINTAIN AN AIR FLOW OFFSET EQUAL TO THE OUTSIDE AIR.
- C. 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).
- D. 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.

4. MISCELLANEOUS

- 4.1 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.
- 4.2 HIGH LIMIT STATIC PRESSURE SENSOR, <u>SPS-1</u> SHALL DE-ENERGIZE AHU 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 OR RETURN FAN, DAMPERS D-1, D-2 AND D-3 SHALL CLOSE. ALARM AT BAS.

4.5 MONITOR RETURN AIR CO2 SENSORS AT THE BAS.

SHUT-DOWN, AND A CRITICAL ALARM SHALL BE INDICATED AT THE BAS.

- 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 CLOSED TO 50% (ADJ.) AND THE HEATING VALVE SHALL OPEN A MINIMUM OF 5% (ADJUSTABLE). A WARNING SHALL 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 (ADJ.) TO ALLOW TEMPERATURE TO RISE, IF THIS TEMPERATURE FALLS TO 36 °F (ADJ.) OR BELOW, THE OA DAMPÉR A
- SHALL REMAIN CLOSED AND HEATING VALVE SHALL FULL OPEN. IF TEMPERATURE BEGINS TO RISE, OPERATION SHALL . WHEN THE AIR TEMPERATURE, AS SENSED BY FREEZE STAT, FZ, FALLS BELOW 35°F (ADJ), THE SUPPLY FAN SHALL

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 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 & D2 SHALL CLOSE. ALARM AT BAS. 4.5 FREEZE PROTECTION: WHEN THE MIXED AIR TEMPERATURE, AS SENSED BY T3, FALLS BELOW "FREEZE WARNING" SETPOINT OF 40°F (ADJ), MODULATE OA DAMPER CLOSED TO 50% (ADJ.) AND THE HEATING VALVE SHALL OPEN A MINIMUM OF 5% (ADJUSTABLE). A WARNING SHALL 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 (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 BEGINS TO RISE, OPERATION SHALL REVERSE. 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.

TOILET EXHAUST FANS

1. TOILET EXHAUST FANS (TEF): 1.1. FAN OPERATION SHALL BE SCHEDULED THROUGH THE BAS. \ WINTER MODE: FANS SHALL REMAIN DE-ENERGIZED. NON-WINTER MODE: FANS SHALL OPERATE AS FOLLOWS:

- GLOBAL - OUTDOOR

AIR CONDITIONS

GENERAL

2. TEMPERATURE CONTROL

2.2. UNOCCUPIED:

4. MISCELLANEOUS

A. WHEN THE ASSOCIATED AHU OR HVU SUPPLY FANS ARE ENERGIZED AND THE SYSTEM IS IN OCCUPIED MODE, THE FOLLOWING EXHAUST FANS SHALL BE ENERGIZED. FAN SHALL BE DE-ENERGIZED IN UNOCCUPIED MODE. REFER TO TABLE BELOW FOR ASSOCIATED AHU'S & HVU'S

B. ALL OTHER TOILET EXHAUST FANS NOT ASSOCIATED WITH AN AHU OR HVU, SHALL BE ENERGIZED IN OCCUPIED MODE AND DE-ENERGIZED IN UNOCCUPIED MODE.

C. OCCUPIED/UNOCCUPIED MODE SHALL BE DETERMINED BY 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

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

PROJECT NAME:

RETURN DUCT

SMOKE DAMPER

TEMPERATURE

SENSOR -

DETECTOR

– DRAIN PAN

CONSTANT VOLUME AIR HANDLING UNIT CONTROL

(AHU-10,14,19, & 27)

1.1. SUPPLY FAN SHALL OPERATE CONTINUOUSLY IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF"

1.4. OUTSIDE AIR TEMPERATURE AND HUMIDITY VALUES SHALL BE PROVIDED BY THE ASSOCIATED GLOBAL OA SENSORS. REFER TO GLOBAL

B. NIGHT THERMOSTAT/SENSOR SHALL CYCLE FAN AND OPEN VALVES $\underline{V-1}$ AND $\underline{V-2}$ AS REQUIRED, TO MAINTAIN NIGHT SETBACK

.3. MORNING WARM-UP: WHEN SYSTEM IS FIRST INDEXED TO "MORNING WARM UP" MODE, DAMPER D-1 SHALL REMAIN CLOSED AND D-2 SHAI REMAIN OPEN. FAN SHALL ENERGIZE AND HEATING VALVE (V-1) SHALL OPEN TO 100% (ADJ). WHEN RETURN AIR TEMPERATURE SETPOINT,

AS SENSED BY T1, REACHES 70°F (ADJ.), OR WHEN OCCUPIED SCHEDULE BEGINS, THE SYSTEM SHALL TRANSITION FROM "MORNING

MORNING COOL DOWN: WHEN SYSTEM IS FIRST INDEXED TO "MORNING COOL-DOWN" MODE, DAMPER D-1 SHALL REMAIN CLOSED AND D-2

3.1 OCCUPIED: AIR FLOW MONITOR, AFM-1, LOCATED IN OUTSIDE AIR DUCT SHALL MODULATE D-1 TO MAINTAIN VENTILATION AIR QUANTITY AS

SHALL REMAIN OPEN. FAN SHALL OPERATE WITH COOLING VALVE OPEN UNTIL OCCUPIED SETPOINT IS MET OR WHEN OCCUPIED SCHEDULE

B. THE SPACE TEMPERATURE, SENSED BY $\underline{\mathsf{T4}}$, SHALL THEN BE MAINTAINED AT SETPOINT BY MODULATING $\underline{\mathsf{V-1}}$ OR

BEGINS, THE SYSTEM SHALL TRANSITION FROM "MORNING COOL-DOWN" MODE TO "OCCUPIED" MODE.

OUTSIDE AIR CONDITIONS CONTROLS FOR ADDITIONAL INFORMATION. EACH UNIT SHALL REFERENCE THE GLOBAL SENSORS IN THE SAME

1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS)

1.3. PROVIDE SEPARATE, INDEPENDENT LINKAGE CONTROL FOR EACH M.O.D. (D-1 & D-2).

QUADRANT IN WHICH THE UNIT IS LOCATED (DEFAULT), UNLESS OVERRIDDEN BY THE BAS

A. <u>D-1</u> (OUTSIDE AIR) SHALL FULLY OPEN & <u>D-2</u> (RETURN AIR) SHALL FULLY CLOSE.

A. <u>D-1</u> (OUTSIDE AIR) SHALL FULLY CLOSE & <u>D-2</u> (RETURN AIR) SHALL FULLY OPEN.

<u>V-2</u>, WITHOUT OVERLAPPING CONTROL, AS REQUIRED.

WARM-UP" MODE TO "OCCUPIED" MODE.

INDICATED ON AIR HANDLING UNIT SCHEDULE.

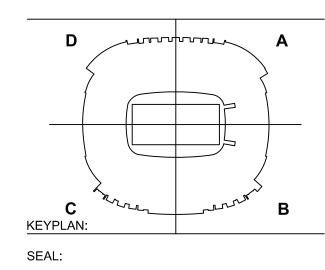
POSITION <u>D-1</u> SHALL BE FULLY CLOSED AND <u>D-2</u> SHALL BE FULLY OPEN. WHEN FAN(S) ARE DE-ENERGIZED, <u>D-1</u> SHALL BE FULLY CLOSED.

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:

02/12/21 | BID SET **、04/02/21 │ ADDENDUM 0**1

DESCRIPTION

PROJECT NO: 20092.01

AS NOTED SCALE:

DRAWN BY: **MJG**

SHEET TITLE:

CONTROLS

CHECKED BY: CMP / MAF

FEBRUARY 12. 2021

AUTOMATIC TEMPERATURE

DRAWING NO:

CONSTANT VOLUME AIR HANDLING UNIT CONTROL (AHU-11,12,13,18)

GENERAL

- 1.1. SUPPLY FAN SHALL OPERATE CONTINUOUSLY IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION <u>D-1</u> SHALL BE FULLY CLOSED AND <u>D-2</u> SHALL BE FULLY OPEN. WHEN FAN(S) ARE DE-ENERGIZED, <u>D-1</u>
- 1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
- 1.3. PROVIDE SEPARATE, INDEPENDENT LINKAGE CONTROL FOR EACH M.O.D. (D-1 & D-2).
- 1.4. 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
- 2. TEMPERATURE CONTROL

2.1. OCCUPIED (COOLING):

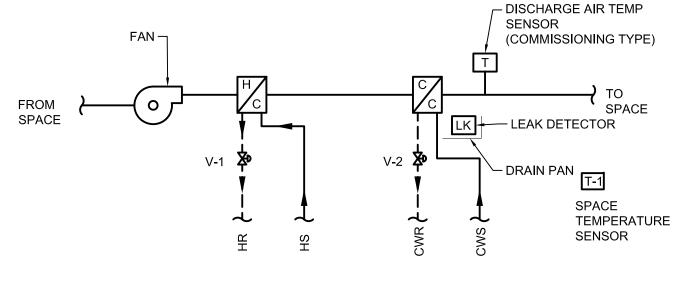
- A. WHEN THE OUTSIDE AIR ENTHALPY IS ABOVE THE RETURN AIR ENTHALPY, <u>D-1</u>,& <u>D-2</u> SHALL MODULATE AS FOLLOWS:
- 1) D-1 (OUTSIDE AIR) SHALL MODULATE TO MINIMUM OUTSIDE AIR POSITION IN RESPONSE TO AIRFLOW MONITOR, AFM-1. SEE AIRFLOW CONTROL BELOW.
- 2) <u>D-2</u> (RETURN AIR) SHALL FULLY OPEN.
- B. WHEN THE OUTSIDE AIR ENTHALPY IS LESS THAN THE RETURN AIR ENTHALPY, AND ALSO WHENEVER THE OA IS LESS THAN 55°F, DAMPERS <u>D-1</u> & <u>D-2</u> SHALL MODULATE TO MAXIMIZE ATMOSPHERIC (FREE) COOLING AND MAINTAIN A MINIMUM MIXED AIR TEMPERATURE AS REQUIRED TO SATISFY THE SPACE SETPOINT.
- C. THE SPACE TEMPERATURE, SENSED BY T5, SHALL THEN BE MAINTAINED AT SETPOINT BY MODULATING V-1 OR V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED.

2.2. OCCUPIED (HEATING):

- A. D-1 (OUTSIDE AIR) SHALL MODULATE TO MINIMUM OUTSIDE AIR POSITION IN REPSONSE TO AIRFLOW MONITOR, AFM-1. <u>D-2</u> (RETURN AIR) SHALL FULLY OPEN.
- B. THE SPACE TEMPERATURE, SENSED BY $\underline{15}$, SHALL THEN BE MAINTAINED AT SETPOINT BY MODULATING $\underline{V-1}$ AS
- C. ON A RISE IN SPACE TEMPERATURE, V-1 SHALL SHALL CLOSE.
- D. ON A FURTHER RISE IN SPACE TEMPERATURE, <u>D-1</u> (OUTSIDE AIR) & <u>D-2</u> (RETURN AIR) WILL MODULATE TO MAINTAIN
- 2.3. UNOCCUPIED: NIGHT THERMOSTAT/SENSOR SHALL CYCLE FAN AND OPEN VALVES V-1 AND V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED, TO MAINTAIN NIGHT SETBACK TEMPERATURE (ADJUSTABLE). D-1 SHALL BE FULLY CLOSED AND
- 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, <u>SPS-1</u>. 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 <u>D-1</u> & <u>D2</u> SHALL CLOSE. ALARM AT BAS.
- 4.5 MONITOR RETURN AIR CO2 SENSORS AT THE BAS



4 PIPE FAN COIL UNIT CONTROL

$\underbrace{\hspace{1cm}}$

- 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.

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 $\underline{V\text{-}1}$ AND $\underline{V\text{-}2}$, 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 <u>V-1</u>, 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 <u>V-2</u>, TO MAINTAIN UNOCCUPIED HIGH LIMIT TEMPERATURE SETPOINT, 85°F (ADJUSTABLE).

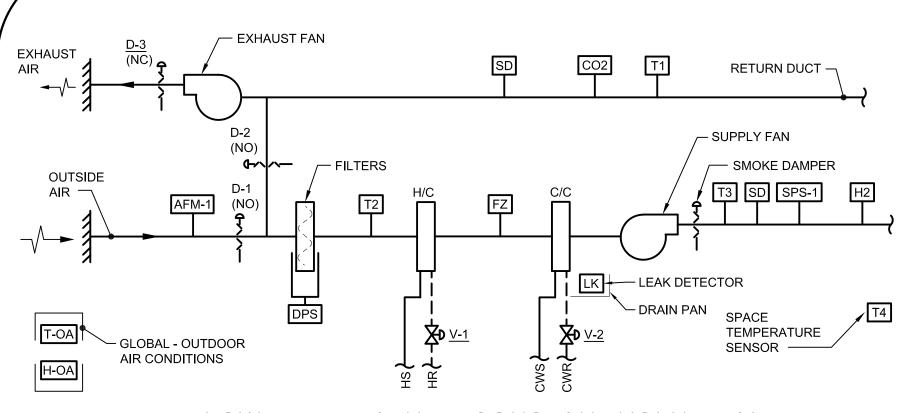
2.1. WARM UP / COOL DOWN MODES:

CONTROL, AS REQUIRED.

- A. WARM UP MODE: FAN SHALL BE ENERGIZED TO RUN CONTINUOUSLY AND HEATING VALVE SHALL BE FULL OPEN UNTIL
- 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

3. MISCELLANEOUS

3.1. IN THE EVENT OF AN OVERFLOW, WATER LEAK DETECTOR, LK, SHALL SHUT-OFF UNIT AND ALARM AT THE BAS.



LOW TEMPERATURE, CONSTANT VOLUME AIR **HANDLING UNIT CONTROL (AHU 15,16,17)**

GENERAL

- 1.1. SUPPLY AIR FAN ANDEXHAUST AIR FAN OPERATION SHALL BE INTERLOCKED. SUPPLY AND EXHAUST FANS SHALL OPERATE CONTINUOUSLY IN THE OCCUPIED MODE. H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. D-1 AND D-3 SHALL BE FULLY CLOSED AND <u>D-2</u> SHALL BE FULLY OPEN. WHEN FAN(S) ARE DE-ENERGIZED, <u>D-1</u> AND <u>D-3</u> SHALL BE FULLY CLOSED.
- 1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
- 1.3. PROVIDE SEPARATE, INDEPENDENT LINKAGE CONTROL FOR EACH M.O.D. (<u>D-1</u>, <u>D-2</u> & <u>D-3</u>).
- 1.4. 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

2. TEMPERATURE CONTROL

2.1. OCCUPIED:

- A. <u>D-1</u> (OUTSIDE AIR) & <u>D-3</u> (EXHAUST AIR) SHALL FULLY OPEN. <u>D-2</u> (RETURN AIR) SHALL FULLY CLOSE.
- B. THE SUPPLY AIR TEMPERATURE, SENSED BY T3, SHALL THEN BE MAINTAINED AT SETPOINT BY MODULATING V-1 OR V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED. THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE AS PER THE FOLLOWING SUPPLY AIR RESET SCHEDULE (ALL TEMPERATURES SHALL BE ADJUSTABLE).

SUPPLY AIR RE	SET SCHEDULE	PROVIDE SUPPLY AIR TEMP RESET (SATR)
OA TEMP (°F)	SUPPLY AIR TEMP (°F)	SCHEDULE PROGRAMMING INPUT DEFAULT VALUES INDICATED.
ABOVE 65	45	- FINAL VALUES SHALL
55 - 65	*	REVIEWED WITH OWNER - ALL VALUES SHALL BE
BELOW 55	85	ADJUSTABLE.
_		-

SUPPLY AIR TEMPERATURE SHALL BE LINEAR BETWEEN

2.2 UNOCCUPIED:

A. <u>D-1</u> (OUTSIDE AIR) & <u>D-3</u> (EXHAUST AIR) SHALL FULLY CLOSE. <u>D-2</u> (RETURN AIR) SHALL FULLY OPEN.

B. NIGHT THERMOSTAT/SENSOR SHALL CYCLE FAN AND OPEN VALVES V-1 AND V-2, WITHOUT OVERLAPPING CONTROL, 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 <u>D-2</u> 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.
- 3.1 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.

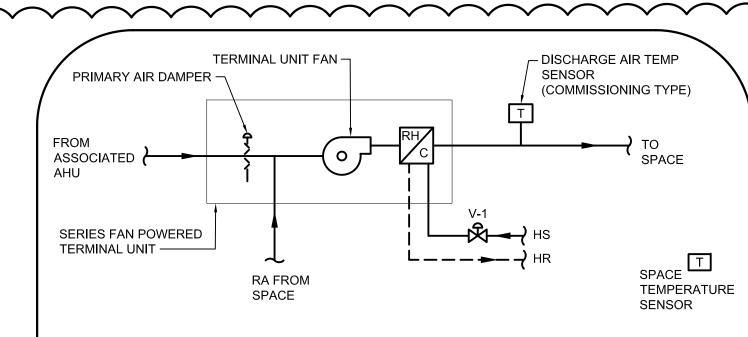
4. MISCELLANEOUS

3. AIR FLOW CONTROL

- 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.

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

- 4.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.
- 4.4 ON FAILURE OF SUPPLY FAN, DAMPERS <u>D-1</u>, <u>D-2</u> & <u>D-3</u> SHALL CLOSE. ALARM AT BAS.

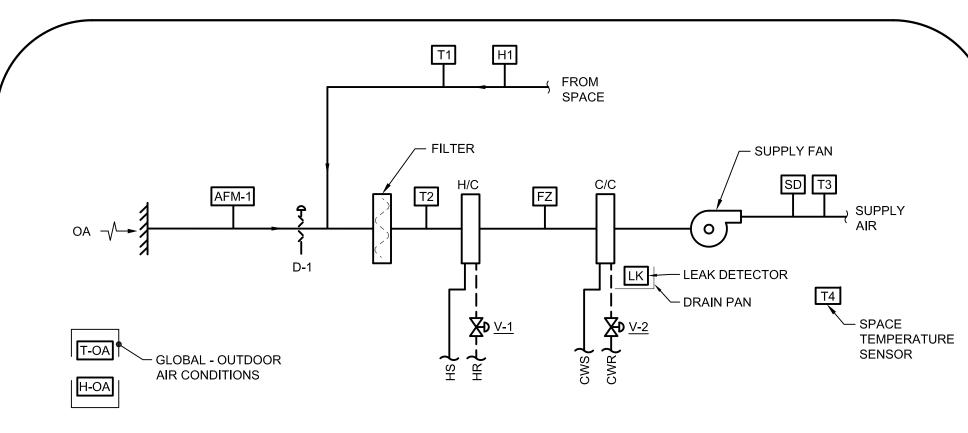


SERIES FAN POWERED TERMINAL UNIT CONTROL

- 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.

- 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 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.
- 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.
- 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.



CONSTANT VOLUME AIR HANDLING UNIT CONTROL (AHU-24 THRU 26)

GENERAL

- 1.1. SUPPLY FAN SHALL OPERATE CONTINUOUSLY IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION <u>D-1</u> SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, <u>D-1</u> SHALL BE FULLY CLOSED.
- 1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
- 1.3. 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.

2. TEMPERATURE CONTROL

2.1. OCCUPIED:

- A. D-1 (OUTSIDE AIR) SHALL MODULATE TO MINIMUM OUTSIDE AIR POSITION IN RESPONSE TO AIR FLOW MONITOR, AFM-1
- B. THE SPACE TEMPERATURE, SENSED BY T4, SHALL THEN BE MAINTAINED BY MODULATING V-1 & V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED.

2.2. UNOCCUPIED:

- A. <u>D-1</u> (OUTSIDE AIR) SHALL BE FULLY CLOSED.
- B. MODULATE $\underline{ ext{V-1}}$ & $\underline{ ext{V-2}}$, WITHOUT OVERLAPPING CONTROL, AS REQUIRED TO MAINTAIN UNOCCUPIED SETPOINT.

3. MISCELLANEOUS

- 3.1 ON A FAILURE OF SUPPLY FAN, DAMPER <u>D-1</u> SHALL CLOSE. ALARM AT BAS.
- 3.2 SMOKE DETECTORS, <u>SD</u>, LOCATED IN THE SUPPLY AND RETURN AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.

3.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS 3.4 FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27

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MISC. HEATERS CONTROL

A. HOT WATER UNIT HEATERS (UH):

- 1. PROVIDE NEW CONTROLS AND CONNECT TO BAS. EXISTING THERMOSTAT SHALL BE REMOVED AND
- 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"
- 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
- 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
- 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
- 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
- 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
- 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 FOLLOWED, 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 FOLLOWED, 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 FOLLOWED, UNLESS OTHERWISE NOTED.

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

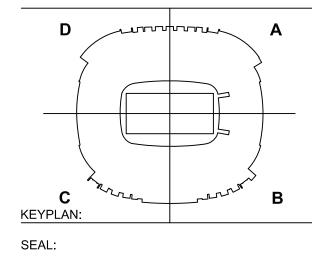
PROJECT NAME:

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



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.

ISSUED FOR:

DATE

EXPIRATION DATE:

DESCRIPTION 02/12/21 | BID SET

、04/02/21 │ ADDENDUM 01

PROJECT NO: **20092.01**

DRAWN BY: **MJG**

SCALE:

CHECKED BY: CMP / MAF

AS NOTED

FEBRUARY 12, 2021

SHEET TITLE: AUTOMATIC TEMPERATURE

DRAWING NO:

CONTROLS

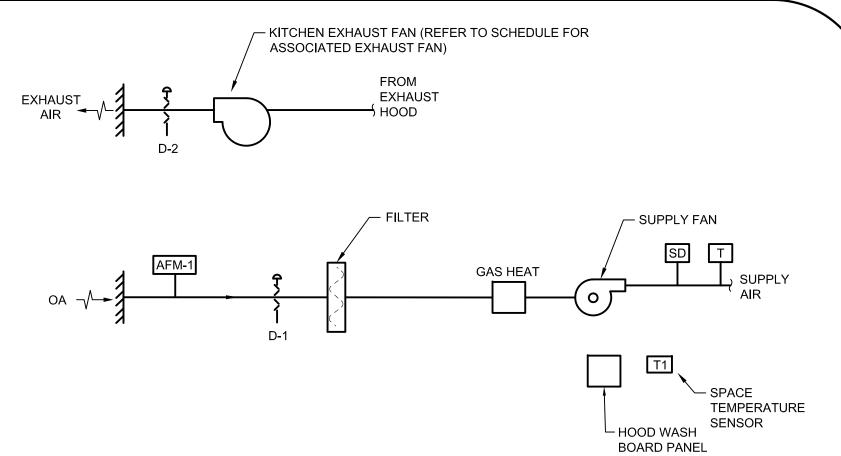
BKM# 20092.0

BOARD PANEL MAKEUP AIR UNIT & KITCHEN EXHAUST WITH COOLING COIL CONTROL

- GENERAL
- 1.1. IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION $\underline{D-1}$ SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, <u>D-1</u> SHALL BE FULLY CLOSED.
- 1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
- 1.3 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.
- 2. TEMPERATURE CONTROL
- 2.1. OCCUPIED HEATING MODE:
- A. SUPPLY FAN AND EXHAUST FAN SHALL OPERATE CONTINUOUSLY.
- B. <u>D-1</u> (OUTSIDE AIR) & <u>D-2</u> (EXHAUST AIR) SHALL FULLY OPEN.
- C. THE SPACE TEMPERATURE SHALL THEN BE MAINTAINED AT 50° (ADJUSTABLE) BY MODULATING GAS FIRED HEAT AS REQUIRED.
- 2.2. OCCUPIED COOLING MODE:
- A. SUPPLY FAN AND EXHAUST FAN SHALL OPERATE CONTINUOUSLY
- B. <u>D-1</u> (OUTSIDE AIR) & <u>D-2</u> (EXHAUST AIR) SHALL FULLY OPEN.
- C. THE SPACE TEMPERATURE SHALL THEN BE MAINTAINED AT 80° (ADJUSTABLE) BY MODULATING VALVE V-1 AS
- 2.3. UNOCCUPIED HEATING:
 - A. EXHAUST FANS WILL BE DE-ENERGIZED AND ASSOCIATED DAMPER <u>D-2</u> 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.).
 - 2.4 UNOCCUPIED COOLING:
 - A. MAKEUP AIR UNIT AND ASSOCIATED EXHAUST FANS WILL BE DE-ENERGZIED AND DAMPERS <u>D-1</u> & <u>D-2</u>, AND VALVE <u>V-1</u> SHALL BE CLOSED.
- MISCELLANEOUS
- 3.1 ON A FAILURE OF SUPPLY FAN, DAMPER <u>D-1</u> SHALL CLOSE. ALARM AT BAS.
- 3.2 SMOKE DETECTORS, <u>SD</u>, SHALL DE-ENERGIZE FANS SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE
- 3.3 THE SYSTEM SHALL ALARM WHEN ROOM SENSOR T-1 DROPS BELOW 50°F (ADJUSTABLE).
- 3.4 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.
- 3.5 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

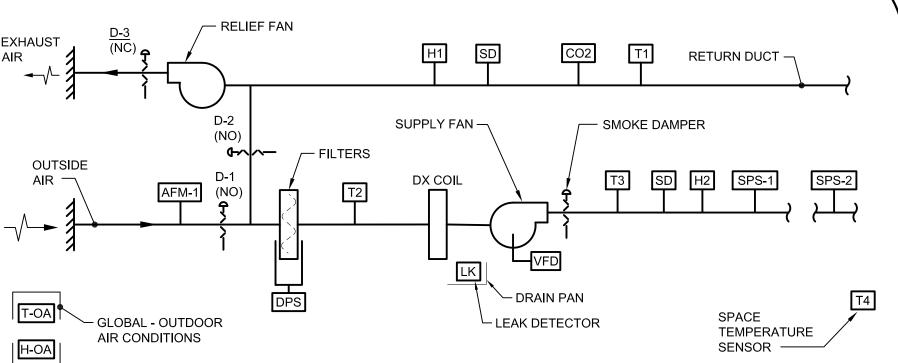
- A. EACH CONCESSION STAND EXHAUST FAN SHALL BE CONTROLLED BY A THERMOSTAT. UPON A RISE IN SPACE TEMPERATURE ABOVE 85°F (ADJUSTABLE), THE FAN SHALL ENERGIZE. UPON A FALL IN SPACE TEMPERATURE BELOW 80°F (ADJUSTABLE).
- B. ALL SETPOINTS LISTED ABOVE SHALL BE ADJUSTABLE.
- C. EACH FAN (TYP. 24) SHALL HAVE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



MAKEUP AIR UNIT & KITCHEN EXHAUST CONTROL

- GENERAL
- 1.1. IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION <u>D-1</u> SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, <u>D-1</u> SHALL BE FULLY CLOSED.
- 1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
- 1.3 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
- 2. TEMPERATURE CONTROL
- 2.1. OCCUPIED HEATING MODE:
- A. SUPPLY FAN AND EXHAUST FAN SHALL OPERATE CONTINUOUSLY
- B. <u>D-1</u> (OUTSIDE AIR) & <u>D-2</u> (EXHAUST AIR) SHALL FULLY OPEN.
- C. THE SPACE TEMPERATURE SHALL THEN BE MAINTAINED AT 50° (ADJUSTABLE) BY MODULATING GAS FIRED HEAT AS
- - A. EXHAUST FANS WILL BE DE-ENERGIZED AND ASSOCIATED DAMPER <u>D-2</u> SHALL BE CLOSED. B. FOR CONCESSION STANDS WITH ELECTRIC HEATERS (STANDS 129 & 152): MAKEUP AIR UNIT WILL BE DE-ENERGIZED AND ASSOCIATED DAMPERS <u>D-1</u> 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
- 3. MISCELLANEOUS
- 3.1 ON A FAILURE OF SUPPLY FAN, DAMPER D-1 SHALL CLOSE. ALARM AT BAS.
- 3.2 SMOKE DETECTORS, SD, SHALL DE-ENERGIZE FANS SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE
- 3.3 THE SYSTEM SHALL ALARM WHEN ROOM SENSOR T-1 DROPS BELOW 50°F (ADJUSTABLE).
- 3.4 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 **RTU 1 THRU 4 POINTS LIST OBJECT NAME** READ/WRITE **OBJECT NAME** READ/WRITE **ANALOG INPUT BINARY INPUT** DISCHARGE AIR TEMPERATURE READ OCCUPANCY SWITCH LOCAL READ SPACE TEMPERATURE LOCAL READ DAYTIME WARMUP ALLOW LOCAL READ SPACE TEMPERATURE SETPOINT LOCAL READ FROSTAT READ READ FAN PROVING SWITCH READ DUCT STATIC PRESSURE ANALOG OUTPUT **BINARY OUTPUT** READ READ SUPPLY FAN VFD FAN S/S **ANALOG VALUE** COMPRESSOR 1 S/S READ READ DISCHARGE AIR COOLING SETPOINT READ / WRITE COMPRESSOR 2 S/S READ DISCHARGE AIR HEATING SETPOINT READ / WRITE REVERSING VALVE DUCT STATIC PRESSURE SETPOINT READ / WRITE **AUXILIARY HEAT** READ READ SPACE TEMPERATURE BAS READ / WRITE **BINARY VALUE** SPACE TEMPERATURE SETPOINT BAS READ / WRITE READ / WRITE SPACE TEMPERATURE ACTIVE READ UNIT CONTROL OCCUPANCY SWITCH BAS SPACE TEMPERATURE SETPOINT ACTIVE READ READ / WRITE UNOCCUPIED COOLING SETPOINT READ / WRITE DAYTIME WARMUP ALLOW BAS READ / WRITE READ UNOCCUPIED HEATING SETPOINT READ / WRITE OCCUPANCY STATUS COOLING MODE READ **HEATING CALC** READ **HEATING COIL** READ COOLING CALC P-GAIN READ / WRITE **HEATING MODE** READ UNOCCUPIED COOLING MODE READ HEATING CALC P-GAIN READ / WRITE READ VFD CALC P-GAIN READ / WRITE UNOCCUPIED HEATING MODE LOW TEMPERATURE SAFETY READ READ CHANGEOVER DELAY



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

- GENERAL
- 1.1. 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, <u>D-1</u> AND <u>D-3</u> SHALL BE FULLY CLOSED.
- 1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE DETERMINED THE BUILDING AUTOMATION SYSTEM (BAS).
- 1.3. PROVIDE SEPARATE, INDEPENDENT LINKAGE CONTROL FOR EACH M.O.D. (<u>D-1, D-2</u> & <u>D-3</u>).
- 1.4. 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.
- 2. TEMPERATURE CONTROL
- A. WHEN THE OUTSIDE AIR ENTHALPY IS ABOVE THE RETURN AIR ENTHALPY, <u>D-1</u>, <u>D-2</u> & <u>D-3</u> SHALL MODULATE AS
- 1) D-1 (OUTSIDE AIR) SHALL MODULATE TO MINIMUM OUTSIDE AIR POSITION IN RESPONSE TO AIRFLOW MONITOR, AFM-1. SEE AIR FLOW CONTROL BELOW.
- 2) D-2 (RETURN AIR) SHALL FULLY OPEN.
- 3) 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 (PI VERSUS Po) EXCEEDS 0.05" W.C.
- B. WHEN THE OUTSIDE AIR ENTHALPY IS LESS THEN THE RETURN AIR ENTHALPY, <u>D-1,</u> <u>D-2</u> & <u>D-3</u> 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)].
- C. 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	1
55 - 65	*	
BELOW 55	60	

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.

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

- 2.2 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).
- 2.3 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 <u>D-2</u> FULLY OPEN.
- AND D-3 SHALL BE FULL I OLUGED AND D-2 I OLL I OI EIG. 2.4 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
 - $_{5}$ MORNING COOLING DOWN: WHEN SYSTEM IS FIRST INDEXED TO "MORNING COOL-DOWN" MODE, DAMPERS <u>D-1</u> &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

MAINTAIN THE SUPPLY DUCT STATIC PRESSURE SETPOINT.

- 3.1. OCCUPIED:
- A. STATIC PRESSURE SENSOR, SPS-2, SHALL MODULATE THE SUPPLY FAN VARIABLE FREQUENCY DRIVE, VFD TO
- 1) 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.
- B. 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).
- C. 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.
- 4. MISCELLANEOUS

4.5 MONITOR RETURN AIR CO2 SENSORS AT THE BAS.

- 4.1 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.
- 4.2 HIGH LIMIT STATIC PRESSURE SENSOR, <u>SPS-1</u> SHALL DE-ENERGIZE AHU 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 OR RETURN FAN, DAMPERS <u>D-1</u>, <u>D-2</u> AND <u>D-3</u> SHALL CLOSE. ALARM AT BAS.
- 4.6 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.

M&T BANK STADIUM

PROJECT NAME:

HVAC CONTROLS, LIGHTING CONTROLS AND SUBMETERING SYSTEMS

Burdette, Koehler, Murphy & Associates, Inc.

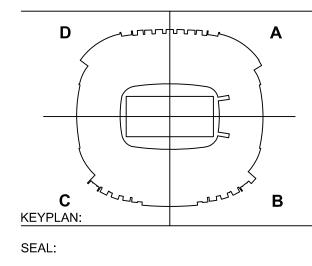
Mechanical / Electrical Engineers 6300 Blair Hill Lane, Suite 400 Baltimore, Maryland 21209 P: 410.323.0600 | www.bkma.com

MSA PROJECT NO. 20-071

IMPROVEMENTS

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**

AS NOTED SCALE:

DRAWN BY: **MJG**

FEBRUARY 12, 2021

SHEET TITLE: AUTOMATIC TEMPERATURE

DRAWING NO:

CONTROLS

1.2. EACH MOD SHALL BE PROVIDED WITH AN END-SWITCH AND MONITORED THROUGH THE BAS.

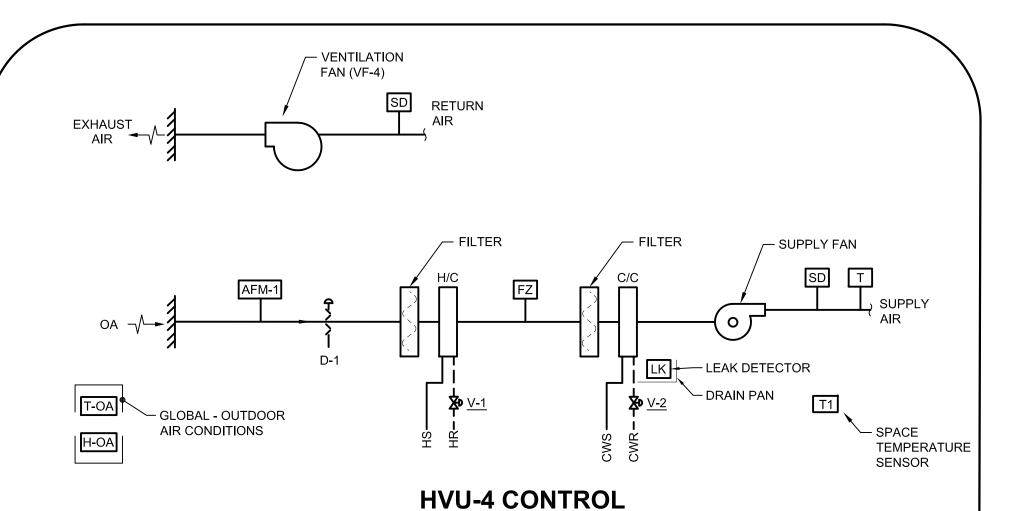
1.3. PROVIDE SEPERATE BAS GRAPHICS PAGE FOR VENTILATION FANS.

2.1. VF-8 & VF-9: VENTILATION FANS SHALL BE CONTROLLED BY THE SAME THERMOSTAT. UPON A RISE IN SPACE TEMPERATURE, ABOVE 85°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.

2.2. 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.

2.3. VF-10,24,26,27,28,29 & 31: VENTILATION FANS SHALL BE CONTROLLED BY INDIVIDUAL HERMOSTATS. 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

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 (O 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



GENERAL

1.1. IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION $\underline{D-1}$ SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, <u>D-1</u> SHALL BE FULLY CLOSED.

1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).

1.3 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

2. TEMPERATURE CONTROL

2.1. OCCUPIED MODE:

A. SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY

B. D-1 (OUTSIDE AIR) SHALL FULLY OPEN.

C. THE SPACE TEMPERATURE, SENSED BY T1, SHALL THEN BE MAINTAINED BY MODULATING V-1 & V-2, WITHOUT OVERLAPPING CONTROL. AS REQUIRED.

2.2. UNOCCUPIED:

A. 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.

2.3 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.

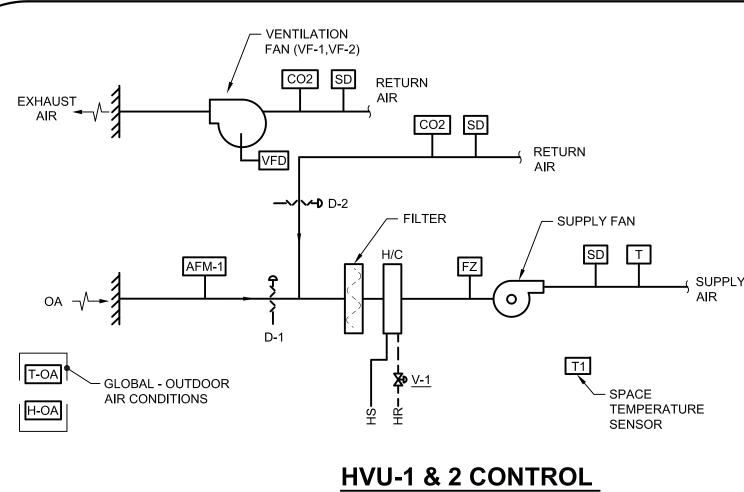
3. MISCELLANEOUS

3.1 ON A FAILURE OF SUPPLY FAN, DAMPER <u>D-1</u> SHALL CLOSE. ALARM AT BAS.

COMBUSTION BE SENSED. ALARM AT THE BAS.

3.2 SMOKE DETECTORS, SD, LOCATED IN THE SUPPLY AND EXHAUST AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF

3.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS. 3.4 FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)



GENERAL

1.1. IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION <u>D-1</u> 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.

1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).

1.3 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.

2. TEMPERATURE CONTROL

2.1. OCCUPIED HEATING MODE:

A. SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY

B. <u>D-1</u> (OUTSIDE AIR) SHALL FULLY OPEN. <u>D-2</u> (RETURN AIR) SHALL BE CLOSED.

C. THE SPACE TEMPERATURE, SENSED BY $\underline{\mathsf{T1}}$, SHALL THEN BE MAINTAINED BY MODULATING $\underline{\mathsf{V-1}}$ AS REQUIRED.

2.2. OCCUPIED VENTILATION MODE: A. SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.

B. <u>D-1</u> (OUTSIDE AIR) SHALL FULLY OPEN. <u>D-2</u> (RETURN AIR) SHALL BE CLOSED.

C. <u>V-1</u> SHALL BE CLOSED.

2.3. UNOCCUPIED:

A. <u>D-1</u> (OUTSIDE AIR) SHALL BE FULLY CLOSED. <u>D-2</u> (RETURN AIR) SHALL BE OPEN.

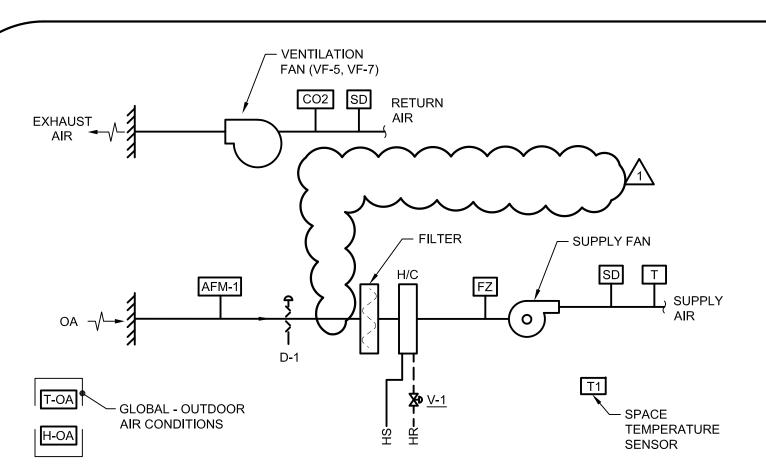
B. CYCLE FAN AND MODULATE V-1 AS REQUIRED TO MAINTAIN UNOCCUPIED SETPOINT 2.4 MORNING WARM UP MODE:

A. 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.

3.1 ON A FAILURE OF SUPPLY FAN, DAMPER <u>D-1</u> SHALL CLOSE AND <u>D-2</u> SHALL BE OPEN. ALARM AT BAS.

3.2 SMOKE DETECTORS, <u>SD</u>, LOCATED IN THE SUPPLY, EXHAUST AND RETURN AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.

3.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS. 3.4 FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)



HVU-5 & 7 CONTROL

GENERAL

1.1. IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION <u>D-1</u> SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, <u>D-1</u> SHALL BE FULLY CLOSED.

1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).

1.3 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.

2. TEMPERATURE CONTROL

2.1. OCCUPIED HEATING MODE:

A. SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINU

B. D-1 (OUTSIDE AIR) SHALL FULLY OPEN

C. THE SPACE TEMPERATURE, SENSED BY T1, SHALL THEN BE MAINTAINED BY MODULATING V-1 AS REQUIRED.

2.2. OCCUPIED VENTILATION MODE:

A. SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.

B. D-1 (OUTSIDE AIR) SHALL FULLY OPEN C. <u>V-1</u> SHALL BE CLOSED.

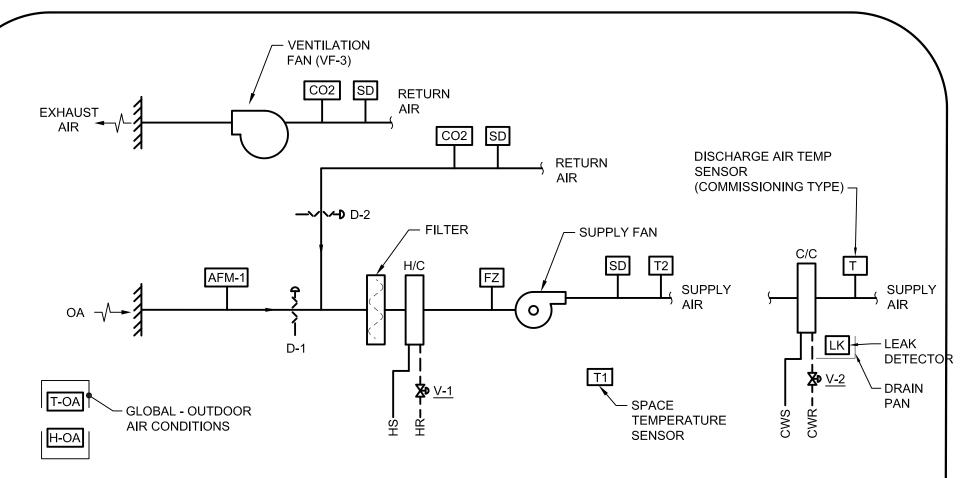
2.3. UNOCCUPIED: SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY. D-1 (OUTSIDE AIR) SHALL BE FULLY OPEN. $\sqrt{1}$ B. CYCLE FAN AND MODULATE <u>V-1</u> AS REQUIRED TO MAINTAIN UNOCCUPIED SETPOINT.

2.4 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.

3. MISCELLANEOUS 3.1 ON A FAILURE OF SUPPLY FAN, DAMPER <u>D-1</u> SHALL CLOSE. ALARM AT BAS.

3.2 SMOKE DETECTORS, SD, LOCATED IN THE SUPPLY AND EXHAUST AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.

3.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS. 3.4 FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)



HVU-3 CONTROL

GENERAL

1.1. 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.

1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).

1.3 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.

2. TEMPERATURE CONTROL

2.1 OCCUPIED MODE:

A. SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.

B. D-1 (OUTSIDE AIR) SHALL MODULATE TO MINIMUM OUTSIDE AIR POSITION IN RESPONSE TO AIRFLOW MONITOR, AFM-1.

C. THE SPACE TEMPERATURE, SENSED BY $\underline{T1}$, SHALL THEN BE MAINTAINED BY MODULATING $\underline{V-1}$ & $\underline{V-2}$, WITHOUT OVERLAPPING CONTROL, AS REQUIRED.

2.2. OCCUPIED VENTILATION MODE:

A. SUPPLY FAN AND VENTILATION FAN SHALL OPERATE CONTINUOUSLY.

B. <u>D-1</u> (OUTSIDE AIR) SHALL FULLY OPEN. <u>D-2</u> (RETURN AIR) SHALL BE CLOSED.

C. <u>V-1</u> & <u>V-2</u> SHALL BE CLOSED.

2.3. UNOCCUPIED:

A. <u>D-1</u> (OUTSIDE AIR) SHALL BE FULLY CLOSED. <u>D-2</u> (RETURN AIR) SHALL BE OPEN.

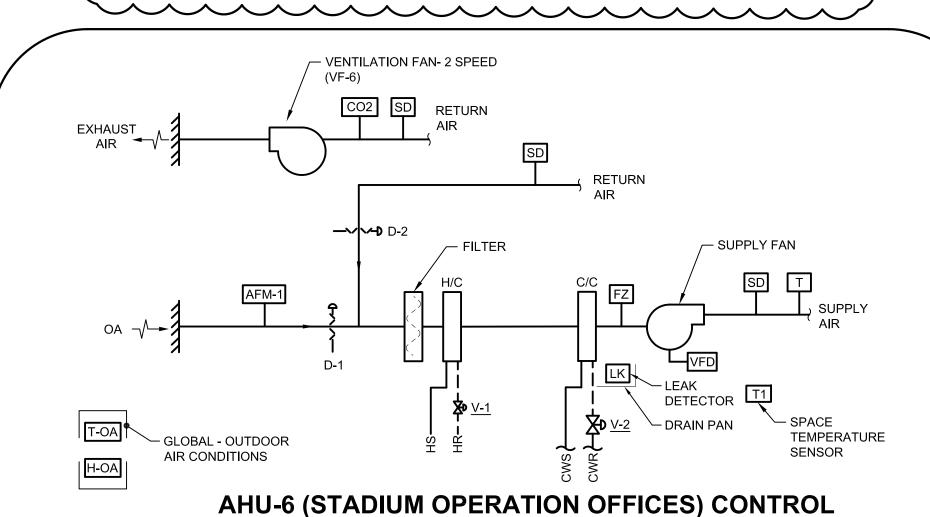
B. CYCLE FAN AND MODULATE V-1 & V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED TO MAINTAIN UNOCCUPIED SETPOINT.

A. 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.

3. MISCELLANEOUS 3.1 ON A FAILURE OF SUPPLY FAN, DAMPER <u>D-1</u> SHALL CLOSE AND <u>D-2</u> SHALL BE OPEN. ALARM AT BAS.

3.2 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.

3.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS. 3.4 FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27



GENERAL

1.1. IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION <u>D-1</u> SHALL BE FULLY CLOSED.

WHEN FANS ARE DE-ENERGIZED, <u>D-1</u> SHALL BE FULLY CLOSED. 1.2. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).

1.3 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.

2. TEMPERATURE CONTROL

2.1. OCCUPIED MODE:

D-1 (OUTSIDE AIR) SHALL MODULATE TO MINIMUM OUTSIDE AIR POSITION IN RESPONSE TO AIRFLOW MONITOR, AFM-1 & D-2 (RETURN AIR) SHALL BE FULLY OPEN.

2.2. ECONOMIZER MODE:

A. WHENEVER THE OUTDOOR AIR TEMPERATURE, AS SENSED BY THE GLOBAL OUTDOOR AIR SENSOR, FALLS BELOW ITS HIGH-LIMIT SHUTOFF SETPOINT OF 63°F (ADJUSTABLE) AND THE SPACE THERMOSTAT REQUIRED COOLING, THE UNIT SHALL 2.3. UNOCCUPIED:

A. D-1 (OUTSIDE AIR) SHALL BE FULLY CLOSED. D-2 (RETURN AIR) SHALL BE OPEN.

B. CYCLE FAN AND MODULATE V-1 OR V-2, WITHOUT OVERLAPPING CONTROL, AS REQUIRED TO MAINTAIN UNOCCUPIED SETPOINT. 2.4 MORNING WARM UP MODE:

A. WHEN SYSTEM IS INDEXED TO "MORNING WARM-UP MODE", DAMPER <u>D-1</u> SHALL REMAIN CLOSED AND <u>D-2</u> 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.

3. MISCELLANEOUS 3.1 ON A FAILURE OF SUPPLY FAN, DAMPER <u>D-1</u> SHALL CLOSE. ALARM AT BAS.

3.2 SMOKE DETECTORS, <u>SD</u>, 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. 3.4 FREEZE PROTECTION: (SEE SHEET M4.22. SAME SEQUENCE AS CONSTANT VOLUME AHU CONTROL AHU-10, 14, 19, & 27)

Burdette, Koehler, Murphy & Associates, Inc. Mechanical / Electrical Engineers 6300 Blair 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

~~~~ KEYPLAN:

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:

SEAL

DESCRIPTION

02/12/21 | BID SET ı∖ 04/02/21 │ ADDENDUM 0

**AS NOTED** 

PROJECT NO: 20092.01

SCALE:

DRAWN BY: **MJG** 

**FEBRUARY 12, 2021** 

**AUTOMATIC TEMPERATURE** 

DRAWING NO:

CONTROLS

SHEET TITLE:

#### HVU-8, 9, & 10 AND SEF-1 & 2 CONTROL

#### GENERAL

- 1.1. FIRE SYSTEM SHALL INITIATE STARTING OF <u>HVU-8</u>, <u>9 OR 10</u> SHALL INITIATE THE START OF THE LEAD SMOKE EXHAUST FAN, <u>SEF-1</u> OR <u>SEF-2</u>. IF THE LEAD FAN FAILS OR FAILS TO START, THE LAG EXHAUST FAN, <u>SEF-1</u> OR <u>SEF-2</u> WILL START
- 1.2. IN THE OCCUPIED MODE, H-O-A SWITCH SHALL BE KEPT IN "AUTO" POSITION. IN THE "OFF" POSITION <u>D-1</u> SHALL BE FULLY CLOSED. WHEN FANS ARE DE-ENERGIZED, <u>D-1</u> SHALL BE FULLY CLOSED.
- 1.3. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).
- 2. TEMPERATURE CONTROL

#### 2.1. OCCUPIED HEATING MODE:

- A. SUPPLY FAN SHALL OPERATE CONTINUOUSLY EXHAUST FAN SHALL REMAIN DE-ENERGIZED.
- B. <u>D-1</u> (OUTSIDE AIR) SHALL FULLY OPEN.
- C. THE SPACE TEMPERATURE, SENSED BY  $\underline{\mathsf{T1}}$ , SHALL THEN BE MAINTAINED BY MODULATING  $\underline{\mathsf{V-1}}$  AS REQUIRED.

#### 2.2. OCCUPIED VENTILATION MODE:

- A. SUPPLY FAN AND LEAD SMOKE EXHAUST FAN SHALL OPERATE CONTINUOUSLY.
- B. <u>D-1</u> (OUTSIDE AIR) SHALL FULLY OPEN.
- C. <u>V-1</u> SHALL BE CLOSED.

#### 2.3. UNOCCUPIED:

A. 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. EXHAUST FAN SHALL REMAIN DE-ENERGIZED.

#### 3. MISCELLANEOUS

- 3.1 ON A FAILURE OF SUPPLY FAN, DAMPER <u>D-1</u> SHALL CLOSE. ALARM AT BAS.
- 3.2 SMOKE DETECTORS, <u>SD</u>, LOCATED IN THE SUPPLY AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.
- 3.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.
- 3.4 WHEN THE AIR TEMPERATURE, AS SENSED BY FZ, FALLS BELOW 35°F, AN ALARM SIGNAL SHALL BE INDICATED AT THE

# **GLOBAL OUTSIDE AIR CONDITIONS CONTROLS** (MULTIPLE SENSORS)

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.

4. PROVIDE MULTIPLE SENSORS AT VARIOUS LOCATIONS FOR ACCURATE MEASUREMENT OF OUTDOOR CONDITIONS (LOCATIONS ARE THE APPROX. AREAS. CONTRACTOR SHALL FIELD DETERMINE EXACT LOCATIONS):

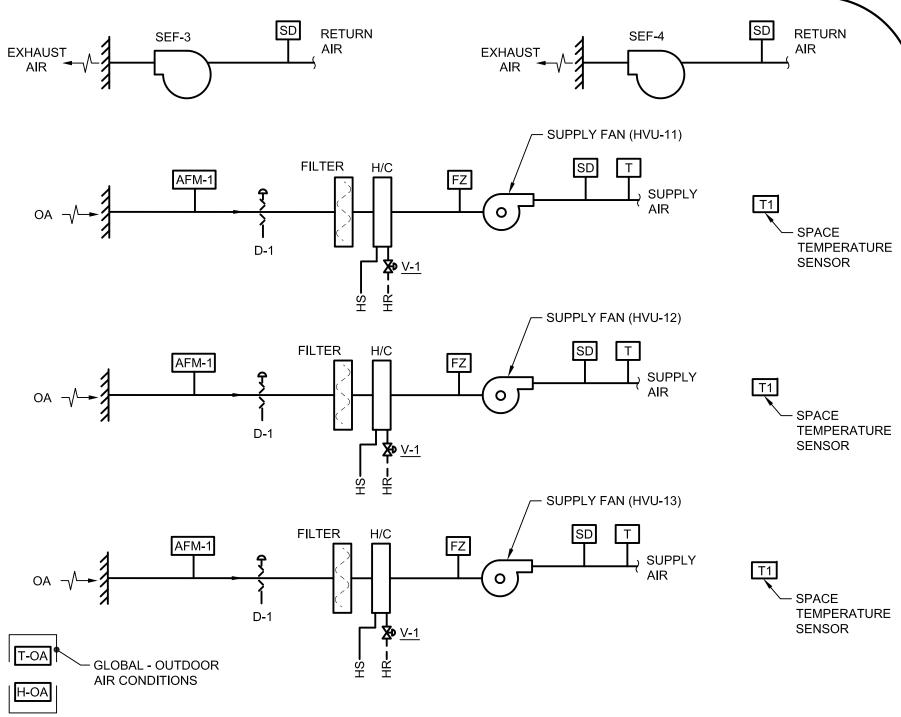
|     | DESIGNATION | LOCATION                                    | FAIL TO SENSOR |
|-----|-------------|---------------------------------------------|----------------|
|     |             |                                             |                |
|     | OA-A        | PRESS LEVEL, MECHANICAL ROOM QUAD A (AHU-1) | FAIL TO OA-D   |
|     | ОА-В        | PRESS LEVEL, MECHANICAL ROOM QUAD B (AHU-2) | FAIL TO OA-C   |
|     | OA-C        | PRESS LEVEL, MECHANICAL ROOM QUAD C (AHU-3) | FAIL TO OA-D   |
| Λ _ | OA-D        | PRESS LEVEL, MECHANICAL ROOM QUAD D (AHU-4) | FAIL TO OA-A   |
|     |             |                                             |                |

# OUTSIDE AIR CONDITIONS - SEQUENCE OF OPERATION

# 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
- 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
- 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. 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.

3.1. AN ALARM SHALL BE ISSUED AT THE BAS WHENEVER THE CONTROLS SYSTEM SENSES ANY SENSOR IN A FAILED STATE.



#### HVU-11, 12, & 13 AND SEF-3 & 4 CONTROL

#### GENERAL

- 1.1. FIRE SYSTEM SHALL INITIATE STARTING OF <u>HVU-11,12 OR 13</u> SHALL INITIATE THE START OF THE LEAD SMOKE EXHAUST FAN, SEF-3 OR SEF-4. IF THE LEAD FAN FAILS OR FAILS TO START, THE LAG EXHAUST FAN, SEF-3 OR SEF-4 WILL START
- 1.2. 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, <u>D-1</u> SHALL BE FULLY CLOSED.
- 1.3. OCCUPIED-UNOCCUPIED MODE SHALL BE AS DETERMINED BY THE BUILDING AUTOMATION SYSTEM (BAS).

#### 2. TEMPERATURE CONTROL

2.1. OCCUPIED HEATING MODE:

- EXHAUST FAN SHALL REMAIN DE-ENERGIZED. A. SUPPLY FAN SHALL OPERATE CONTINUOUSLY
- B. <u>D-1</u> (OUTSIDE AIR) SHALL FULLY OPEN.
- C. THE SPACE TEMPERATURE, SENSED BY  $\underline{\mathsf{T1}}$ , SHALL THEN BE MAINTAINED BY MODULATING  $\underline{\mathsf{V-1}}$  AS REQUIRED.

#### 2.2. OCCUPIED VENTILATION MODE:

A. SUPPLY FAN AND LEAD SMOKE EXHAUST FAN SHALL OPERATE CONTINUOUSLY.

B. <u>D-1</u> (OUTSIDE AIR) SHALL FULLY OPEN.

#### C. <u>V-1</u> SHALL BE CLOSED. 2.3. UNOCCUPIED:

A. ON A FALL IN SPACE TEMPERATURE BELOW 50°F (ADJUSTABLE), SYSTEM SHALL RUN IN OCCUPIED HEATING MODE UNTIL SPACE TEMPERATURE REACHES 56°F (ADJUSTABLE). ONCE SYSTEM REACHES DESIRED TEMPERATURE, THE SYSTEM SHALL DE-ENERGIZE EXHAUST FAN SHALL REMAIN DE-ENERGIZED

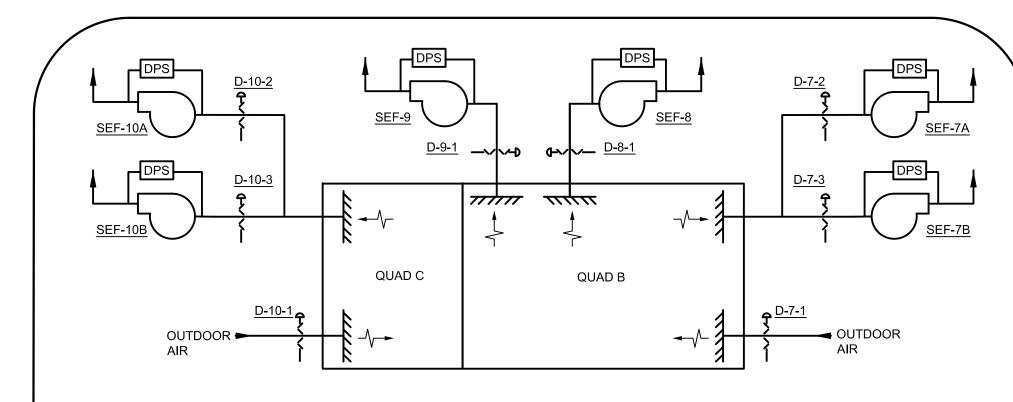
#### 3. MISCELLANEOUS

3.1 ON A FAILURE OF SUPPLY FAN, DAMPER <u>D-1</u> SHALL CLOSE. ALARM AT BAS.

3.2 SMOKE DETECTORS, SD, LOCATED IN THE SUPPLY AIR SHALL DE-ENERGIZE FAN SHOULD PRODUCTS OF COMBUSTION BE SENSED. ALARM AT THE BAS.

# 3.3 THE BAS SHALL MONITOR FILTER LOADING ACROSS EACH FILTER BANK. ALARM AT THE BAS.

3.4 WHEN THE AIR TEMPERATURE, AS SENSED BY FZ, FALLS BELOW 35°F, AN ALARM SIGNAL SHALL BE INDICATED AT THE



#### SOUTHEAST ATRIUM SMOKE ZONE CONTROL (QUAD B)

1. CROSS ZONED CEILING SMOKE DETECTORS, HVAC SMOKE DETECTORS, OR A SPRINKLER WATER FLOW ALARM WITHIN THE ATRIUM WILL ENERGIZE SMOKE EXHAUST SYSTEM THROUGH THE FIRE ALARM SYSTEM.

- 2. WHEN THIS SIGNAL IS RECEIVED, OUTDOOR AIR DAMPERS <u>D-7-1</u> & <u>D-10-1</u> WILL OPEN AND EXHAUST AIR DAMPERS <u>D-7-2</u>, <u>D-7-3</u>,
- D-8-1 & D-9-1 WILL OPEN. SMOKE EXHAUST FANS, SEF-7A, SEF-7B, SEF-8 & SEF-9 WILL ENERGIZE AND RUN CONTINUOUSLY. 3. AIR HANDLING UNITS, AHU-2 & AHU-3 SERVING THIS ATRIUM SHALL BE DE-ENERGIZED AND ALL ASSOCIATED DAMPERS SHALL
- 4. ATRIUM SMOKE EXHAUST FANS SHALL HAVE THE ABILITY TO BE AUTOMATICALLY AND MANUALLY STARTED AND STOPPED

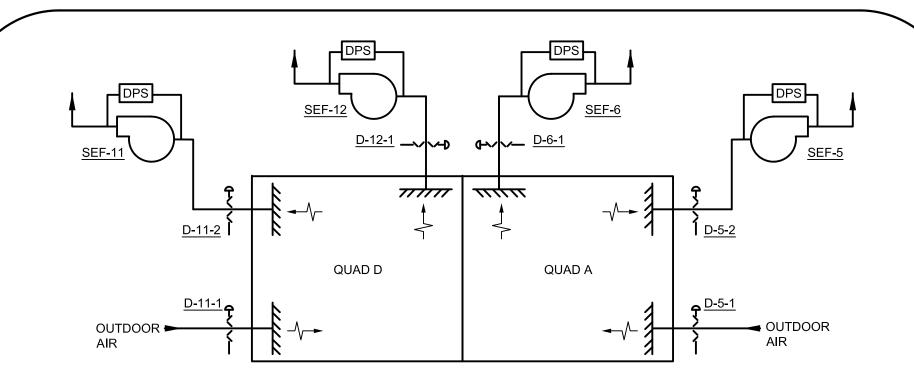
CLOSE WHEN THE SMOKE EXHAUST IS ENERGIZED.

# SOUTHWEST CLUB SMOKE ZONE CONTROL (QUAD C)

1. CROSS ZONED CEILING SMOKE DETECTORS, HVAC SMOKE DETECTORS, OR A SPRINKLER WATER FLOW ALARM WITHIN THE

ATRIUM WILL ENERGIZE SMOKE EXHAUST SYSTEM THROUGH THE FIRE ALARM SYSTEM.

- 2. WHEN THIS SIGNAL IS RECEIVED, OUTDOOR AIR DAMPERS <u>D-7-1</u> & <u>D-10-1</u> WILL OPEN AND EXHAUST AIR DAMPERS <u>D-10-2</u> & <u>D-10-3</u> WILL OPEN. SMOKE EXHAUST FANS, <u>SEF-10A</u> & <u>SEF-10B</u> WILL ENERGIZE AND RUN CONTINUOUSLY.
- 3. AIR HANDLING UNITS, AHU-2 & AHU-3 SERVING THIS ATRIUM SHALL BE DE-ENERGIZED AND ALL ASSOCIATED DAMPERS SHALL CLOSE WHEN THE SMOKE EXHAUST IS ENERGIZED.
- 4. ATRIUM SMOKE EXHAUST FANS SHALL HAVE THE ABILITY TO BE AUTOMATICALLY AND MANUALLY STARTED AND STOPPED FROM THE FIRE ALARM PANEL.



# NORTH ATRIUM SMOKE ZONE CONTROL (QUAD A & D)

1. CROSS ZONED CEILING SMOKE DETECTORS, HVAC SMOKE DETECTORS, OR A SPRINKLER WATER FLOW ALARM WITHIN THE ATRIUM WILL ENERGIZE SMOKE EXHAUST SYSTEM THROUGH THE FIRE ALARM SYSTEM.

- 2. WHEN THIS SIGNAL IS RECEIVED, OUTDOOR AIR DAMPERS <u>D-5-1</u> & <u>D-11-1</u> WILL OPEN AND EXHAUST AIR DAMPERS <u>D-5-2</u>, <u>D-6-1</u> D-11-2 & D-12-1 WILL OPEN. SMOKE EXHAUST FANS, SEF-5, SEF-6, SEF-11 & SEF-12 WILL ENERGIZE AND RUN CONTINUOUSLY.
- 3. AIR HANDLING UNITS, AHU-1 & AHU-4 SERVING THIS ATRIUM SHALL BE DE-ENERGIZED AND ALL ASSOCIATED DAMPERS SHALL CLOSE WHEN THE SMOKE EXHAUST IS ENERGIZED.
- 4. ATRIUM SMOKE EXHAUST FANS SHALL HAVE THE ABILITY TO BE AUTOMATICALLY AND MANUALLY STARTED AND STOPPED FROM THE FIRE ALARM PANEL.

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

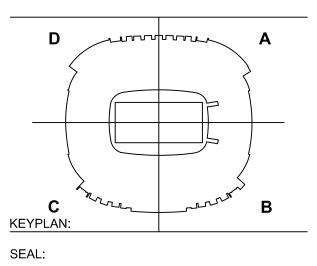
PROJECT NAME:

**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



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.

ISSUED FOR:

EXPIRATION DATE:

DESCRIPTION

02/12/21 | BID SET

PROJECT NO: **20092.01** 

**AS NOTED** SCALE:

DRAWN BY: **MJG** 

**FEBRUARY 12, 2021** 

SHEET TITLE:

AUTOMATIC TEMPERATURE CONTROLS

DRAWING NO:

#### FIELD HEATING POINTS LIST

VALUE AC PwrFail BinaryValue Normal / Failure EffReturnTempSpt AnalogValue Deg F FieldTemp AnalogValue HeaderPmpRotate BinaryValue On/ Off HeaderSupplySpt AnalogValue HxBypassVIvCmd AnalogValue MainHeaderPump1Command BinaryValue MainHeaderPump1Status BinaryValue MainHeaderPump2Command BinaryValue MainHeaderPump2Status BinaryValue MainHeaderReturnTemp AnalogValue MainHeaderSupplyTemp AnalogValue MainHeaderSysPress AnalogValue OaEnableDiffSpt AnalogValue OaEnableSpt AnalogValue Occupancy BinaryValue Enabled / Disabled OutsideAirHighLimit AnalogValue OutsideAirLowLimit AnalogValue ReturnHighLimit AnalogValue ReturnLowLimit AnalogValue SystemStatus BinaryValue Enabled / Disabled SystemSwitch BinaryValue 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 AnalogInput Deg F Zn6PmpRotate BinaryValue On/ Off AnalogInput Deg F AnalogInput Zone1\_Temp2 AnalogInput Zone1 Temp4 AnalogInput Zone1HtgVIvCmd AnalogValue Zone1Pump1Cmd BinaryValue Start / Stop Zone1Pump1Sts BinaryValue On/ Off Zone1Pump2Cmd BinaryValue Start / Stop Zone1Pump2Sts On/ Off BinaryValue Zone1ReturnTemp AnalogValue Zone1SupplyTemp AnalogValue AnalogInput Zone2 Temp6 AnalogInput Zone2 Temp7 AnalogInput Deg F Zone2 Temp8 AnalogInput Zone2HtgVIvCmd AnalogValue Zone2Pump1Cmd BinaryValue Zone2Pump1Sts BinaryValue On/ Off Zone2Pump2Cmd BinaryValue Start / Stop Zone2Pump2Sts BinaryValue On/ Off Zone2ReturnTemp AnalogValue Zone2SupplyTemp AnalogValue Zone3 Temp9 AnalogInput Zone3 Temp10 Zone3\_Temp11 AnalogInput Zone3\_Temp12 AnalogInput Zone3HtgVIvCmd AnalogValue Zone3Pump1Cmd BinaryValue Start / Stop Zone3Pump1Sts BinaryValue On/ Off Zone3Pump2Cmd BinaryValue On/ Off Zone3Pump2Sts BinaryValue Zone3ReturnTemp AnalogValue Deg F Zone3SupplyTemp AnalogValue Zone4 Temp13 AnalogInput Zone4\_Temp14 AnalogInput Zone4\_Temp15 AnalogInput AnalogInput Zone4 Temp16 Zone4HtgVIvCmd AnalogValue Zone4Pump1Cmd BinaryValue Zone4Pump1Sts BinaryValue On/ Off Zone4Pump2Cmd BinaryValue Start / Stop Zone4Pump2Sts BinaryValue On/ Off Zone4ReturnTemp AnalogValue Zone4SupplyTemp AnalogValue Zone5\_Temp17 AnalogInput Zone5 Temp18 AnalogInput Zone5 Temp19 AnalogInput Zone5\_Temp20 AnalogInput Zone5HtgVIvCmd AnalogValue Zone5Pump1Cmd BinaryValue Start / Stop BinaryValue Zone5Pump1Sts On/ Off Zone5Pump2Cmd BinaryValue Start / Stop Zone5Pump2Sts BinaryValue On/ Off Zone5ReturnTemp AnalogValue Zone5SupplyTemp AnalogValue Zone6 Temp17 AnalogInput Zone6\_Temp18 AnalogInput Zone6\_Temp19 AnalogInput

AnalogInput

BinaryValue

BinaryValue

BinaryValue

BinaryValue

AnalogValue

AnalogValue

AnalogValue

On/ Off

On/ Off

Deg F

Start / Stop

Zone6 Temp20

Zone6HtgVIvCmd

Zone6Pump1Cmd

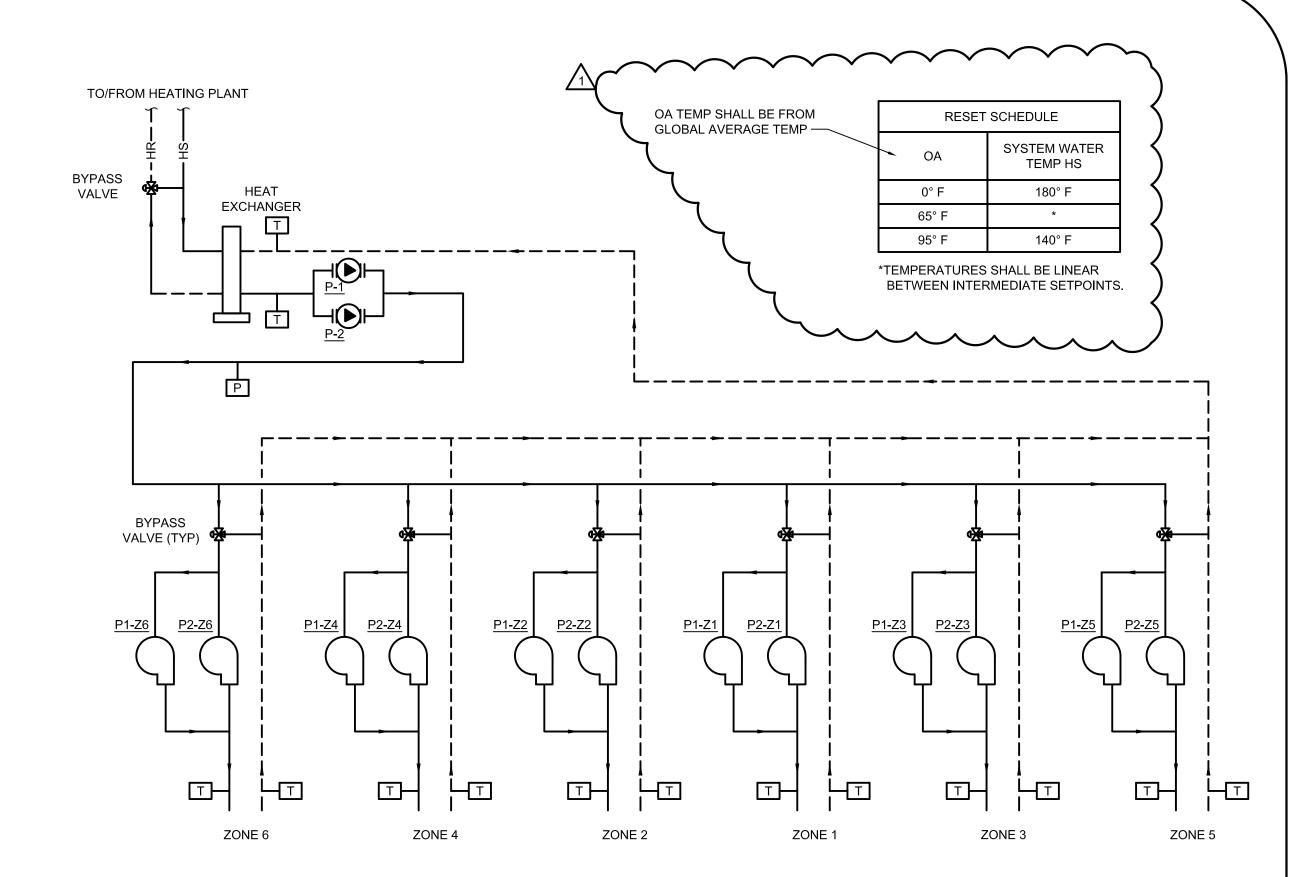
Zone6Pump2Cmd

Zone6ReturnTemp

Zone6SupplyTemp

Zone6Pump1Sts

Zone6Pump2Sts



### FIELD HEATING SYSTEM - SCHEMATIC DIAGRAM

#### FIELD HEATING SYSTEM CONTROL

1. ALL EXISTING SENSORS AND VALVES IN SCHEMATIC SHALL BE REMOVED AND REPLACED.

2. EXISTING FIELD TEMPERATURE SENSORS (LOCATED APPROX. 10 -12" BELOW THE FIELD) SHALL BE REPLACE. 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.

3. THIS IS A CRITICAL SYSTEM. ALL WORK RELATED TO THIS SYSTEM SHALL BE PROVIDED UNDER

SEPARATE SUBMITTALS FOR APPROVAL.

4. SYSTEM SHALL BE OPERATED THROUGH THE BAS OPERATOR "ENABLE".

5. SYSTEM SHALL UTILIZE THE RESET SCHEDULE.

SEQUENCE OF OPERATION:

RISES ABOVE 50°F (ADJUSTABLE).

1. PER HEATING PLANT CONTROL SEQUENCE, PLANT BOILERS AND PUMPS SHALL BE OPERATIONAL AT

2. 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.

3. ZONE PUMPS (TYP 6) SHALL ENERGIZE WHEN PRIMARY PUMP ENERGIZES.

4. 3-WAY CONTROL VALVE SHALL MODULATE TO MAINTAIN 120°F RETURN WATER TEMPERATURE (ADJ.)

5. 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) 6. FIELD PRIMARY PUMP AND ZONE PUMPS SHALL DE-ENERGIZE WHEN OUTSIDE AIR TEMPERATURE

XX.X °F **■** XX.X °**# ■** XX.X°F **∥**XX.X ° **† |** XX.X °F XX.X °F TEMP 19 TEMP 1 TEMP 4 XX.X °F **I** kx.x °F XX.X °F ∥xx.x°#∥ XX.X °F TEMP<sub>1</sub>22 XX.X°F XX.X °F XX.X °F TAVG TEMPI AVG TEMP XX.k °F TEMP 23 XX.X °F

FIELD HEATING SYSTEM - TEMPERATURE / ZONES

#### SCOREBOARD FANS CONTROL

- 1. 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.
- 2. FANS SHALL ENERGIZE WHEN SPACE TEMPERATURE IS ABOVE 85°F (ADJUSTABLE) AND DE-ENERGIZE WHEN SPACE TEMPERATURE IS BELOW 80°F (ADJUSTABLE).
- 3. ALARM AT BAS WHEN SPACE TEMPERATURE RISES ABOVE 105°F

#### TRANSFER FANS CONTROL

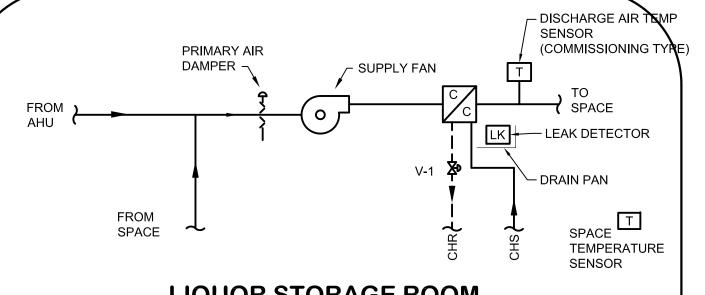
- 1. ALL TRANSFER FANS SHALL BE CONTROLLED VIA REVERSE
- 2. FANS SHALL ENERGIZE WHEN SPACE TEMPERATURE IS ABOVE 85°F (ADJUSTABLE) AND DE-ENERGIZE WHEN SPACE
- 3. ALARM AT BAS WHEN SPACE TEMPERATURE RISES ABOVE 105°F (ADJUSTABLE).

# PIZZA OVEN EXHAUST FANS CONTROL

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

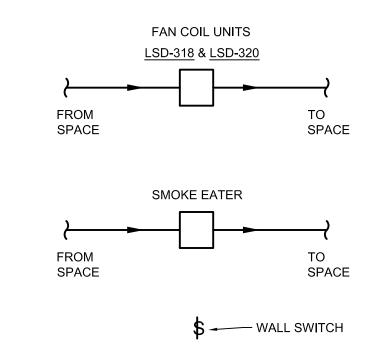
2. FANS SHALL ENERGIZE ONLY WHEN IN "EXECUTIVE" AND "FULL" SCHEDULED MODES. 

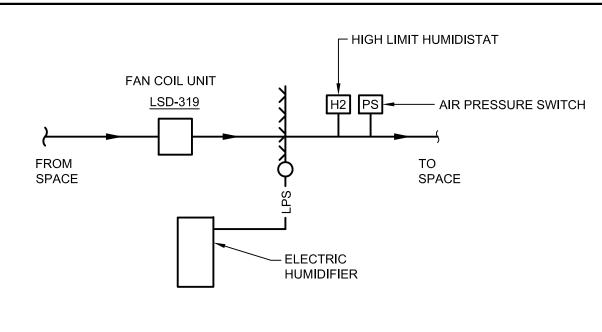
**RAVENS OFFICE RELIEF FANS** 



#### LIQUOR STORAGE ROOM **CLC-VB06 TERMINAL UNIT CONTROL**

- 1. 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.
- 2. 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





T SPACE TEMPERATURE SENSOR 1 PER FAN COIL UNIT) H1 SPACE HUMIDISTAT SENSOR

# **OWNER'S SUITE CONTROL**

- 1.1. OWNERS SUITE IS SERVED BY THREE (3) FAN COIL UNITS, A HUMIDIFIER AND A SMOKE EATER.
- 1.2. ALL UNITS SHALL BE CONNECTED TO THE BAS FOR MONITORING, CONTROL, AND ALARM.
- FAN COIL UNITS CONTROL:
- 2.1. REFER TO <u>4-PIPE FAN COIL UNIT CONTROL</u> ON SHEET M4.23.
- 3. HUMIDIFIER CONTROL:
- 3.1. 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).
  - A. HUMIDIFIER SHALL REMAIN DE-ENERGIZED UNTIL AIRFLOW IS SENSED AT AIR SENSE AIR PRESSURE SWITCH, PS.
- 4. SMOKE EATER CONTROL:
- 4.1 CONNECT TO THE BAS FOR MONITORING, ON/OFF CONTROL, AND

4.2 UNIT SHALL OPERATE VIA WALL FAN SWITCH.

- ACTING THERMOSTAT.
- TEMPERATURE IS BELOW 80°F (ADJUSTABLE). FAN SHALL BE INTERLOCKED WITH ALL ASSOCIATED INTAKE AND EXHAUST

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

Burdette, Koehler, Murphy & Associates, Inc.

**M&T BANK STADIUM** 

HVAC CONTROLS,

LIGHTING CONTROLS

AND SUBMETERING

**SYSTEMS** 

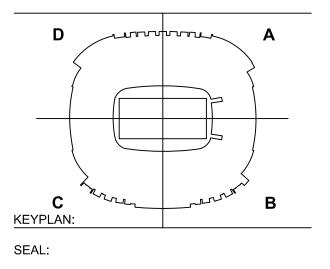
**IMPROVEMENTS** 

MSA PROJECT NO. 20-071

THE MARYLAND STADIUM

Mechanical / Electrical Engineers 6300 Blair Hill Lane, Suite 400 Baltimore, Maryland 21209 P: 410.323.0600 | www.bkma.com

PROJECT NAME:



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:

02/12/21 | BID SET

DESCRIPTION

PROJECT NO: **20092.01** 

**AS NOTED** SCALE:

DRAWN BY: MJG

**FEBRUARY 12, 2021** 

SHEET TITLE:

**AUTOMATIC TEMPERATURE** CONTROLS

DRAWING NO:

#### **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
- C. HEAT TRACE ALARMS SHALL BE CATEGORIZED AS "CRITICAL".

| POINTS SCHEDULE |                                                   |         |
|-----------------|---------------------------------------------------|---------|
| PANEL           | LOCATION                                          | SERVICE |
|                 |                                                   |         |
| HT-CLA          | CLUB LEVEL, QUAD A,<br>ELECTRICAL ROOM<br>4.03.03 | QUAD A  |
| HT-CLB          | CLUB LEVEL, QUAD B,<br>ELECTRICAL ROOM<br>4.24.04 | QUAD B  |
| HT-CLC          | CLUB LEVEL, QUAD C,<br>ELECTRICAL ROOM<br>4.30.04 | QUAD C  |
| HT-CLD          | CLUB LEVEL, QUAD D,<br>ELECTRICAL ROOM<br>4.51.02 | QUAD D  |
|                 |                                                   |         |

| CAL".                                           |                              |                     |
|-------------------------------------------------|------------------------------|---------------------|
| OINTS LIST                                      |                              |                     |
| POINT                                           | DEFAULT SETPOINT OR<br>VALUE | NOTES               |
|                                                 |                              |                     |
| HEAT TRACE ENABLED<br>SETPOINT                  | DEFAULT 40°F (ADJ)           | GLOBAL & BY<br>QUAD |
| HEAT TRACE SETPOINT<br>DIFFERENTIAL<br>DEADBAND | DEFAULT 2°F (ADJ)            | GLOBAL & BY<br>QUAD |
| HEAT TRACE FAILURE<br>SETPOINT (ALARM)          | DEFAULT 36°F (ADJ)           | GLOBAL & BY<br>QUAD |
| HEAT TRACE FAILURE<br>ALARM                     | ON / OFF                     | BY QUAD             |
| OA TEMPERATURE                                  | °F                           | BY QUAD             |
| OA TEMPERATURE<br>AVERAGE                       | °F                           | GLOBAL              |
| HEAT TRACE COMMAND                              | ON / OFF                     | BY QUAD             |
|                                                 |                              |                     |

### **ELECTRICAL SUBSTATIONS**

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



| 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 #1** GENERATOR PLANT **GENERATOR #2** GENERATOR PLANT SWITCHGEAR MAIN ELECTRICAL ROOM SWITCHGEAR (SERVICE LEVEL, RM #1.24.03)

B. THE FOLLOWING POINTS SHALL BE MONITORED:

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

#### **SUMP PUMP CONTROL**

- 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
- 3. SUMP PUMPS WITH FLOAT SWITCH

4. SUMP PUMPS WITH ELECTRONIC CONTROLS:

- 3.1. PUMPS SHALL BE ENERGIZED VIA A FLOAT ACTIVATED SWITCH.
- 3.2. INTEGRATE HIGH WATER (ALARM), AND STATUS (MONITOR) INTO BAS GRAPHICS.
- 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 F                                        | PUMP SC    | HEDULE                                |                        |
|---|------------------------------|-----------------------------------------------|------------|---------------------------------------|------------------------|
|   | DESIG                        | SERVICE                                       | # OF PUMPS | LOCATION                              | REMARKS                |
|   | ~~                           |                                               | ~~~        | ~~~                                   | ~~~                    |
| > | SP-1<br>(SWEP-1 &<br>SWEP-2) | SEWAGE EJECTOR<br>FOR QUAD B                  | 2          | QUAD B, MECH RM<br>1.26.03            | ELECTRONIC<br>CONTROLS |
| ( | SP-2                         | FIELD ENTRANCE -<br>SEWAGE EJECTOR            | 2          | QUAD B, FIELD EQUIP<br>STO RM 1.27.03 | FLOAT SWITCH           |
|   | SP-3                         | SUMP BOWL DRAINAGE                            | 3          | QUAD A                                | ELECTRONIC<br>CONTROLS |
|   | SP-4                         | SUMP BOWL DRAINAGE                            | 3          | QUAD B                                | ELECTRONIC<br>CONTROLS |
|   | SP-5                         | SUMP LOADING DOCK                             | 2          | QUAD B, TURCK<br>DOCK                 | ELECTRONIC<br>CONTROLS |
|   | SP-6                         | SUMP FIELD DRAINAGE<br>EAST                   | 2          | QUAD B (NEAR EAST<br>END ZONE)        | ELECTRONIC<br>CONTROLS |
|   | SP-7                         | SUMP FIELD DRAINAGE<br>WEST                   | 2          | QUAD C (NEAR WEST<br>END ZONE)        | ELECTRONIC<br>CONTROLS |
|   | SP-8<br>(NOTE 1)             | FIELD ENTRANCE -<br>STORM WATER               | 1          | QUAD B, FIELD EQUIP<br>STO RM 1.27.03 | FLOAT SWITCH           |
|   | SP-9<br>(NOTE 1)             | STORM WATER<br>GENERATOR PLANT -<br>VESTIBULE | 1          | GENERATOR PLANT -<br>VESTIBULE        | FLOAT SWITCH           |
|   | SP-10<br>(NOTE 1)            | STORM WATER<br>GENERATOR PLANT                | 2          | GENERATOR PLANT                       | ELECTRONIC<br>CONTROLS |
| 1 |                              |                                               |            |                                       |                        |

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

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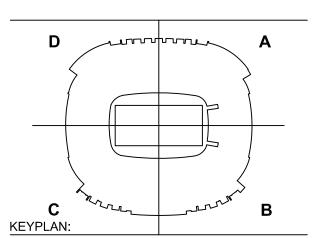
PROJECT NAME:

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



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:

DESCRIPTION 02/12/21 | BID SET 1 04/02/21 ADDENDUM 01

PROJECT NO: **20092.01** 

**AS NOTED** SCALE:

DRAWN BY: MJG

DATE: **FEBRUARY 12, 2021** 

SHEET TITLE:

**AUTOMATIC TEMPERATURE** CONTROLS

|                          |                                                                                                 |                                                   |       |                       | 11       |                               |          |       | υſ                              | ۲U    | 1 3      | sCl                          | 7 <b>   </b> | DUL                     |            | TDU             |               |                                          |             |               |            |          | 0)/2=-                                | N                      | _ ^ -      | IDE C          |                    |                  |               |              |                |
|--------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------|-------|-----------------------|----------|-------------------------------|----------|-------|---------------------------------|-------|----------|------------------------------|--------------|-------------------------|------------|-----------------|---------------|------------------------------------------|-------------|---------------|------------|----------|---------------------------------------|------------------------|------------|----------------|--------------------|------------------|---------------|--------------|----------------|
|                          |                                                                                                 |                                                   |       | NALO                  |          |                               | PUTS     |       | BINARY                          |       |          |                              |              | OUTPUTS  DIGITAL ANALOG |            |                 |               |                                          |             | Al A          | ARMS       | <u> </u> | SYSTE                                 | IVI FE                 |            | APPL           | ICATION            |                  | GENE          |              |                |
|                          |                                                                                                 | MEAS                                              | SURED | ) CA                  | ALCUI    | LATEC                         |          |       | יווט                            |       |          |                              |              | . SITAL                 | -          | <i>-</i>        | •^L           |                                          |             | AL/           | xiVIS      |          |                                       |                        |            | PRO            | GRAMS              |                  |               |              |                |
| SYSTEM                   | I/O LEGEND                                                                                      |                                                   |       | >                     |          |                               |          |       | MC                              |       |          |                              |              |                         |            |                 |               | NO I                                     |             |               |            |          |                                       | NANCE                  |            |                |                    |                  |               |              |                |
| DESIG.                   | X - REQUIRED POINT                                                                              |                                                   |       | ID FLOW               |          |                               |          |       | FREEZE<br>AIR FLOW / FLUID FLOW |       |          | 된                            |              |                         |            | TION            | ,             | PNEUMATIC OPERATION ELECTRONIC OPERATION |             |               |            |          | DNG<br>NG                             | PREVENTIVE MAINTENANCE | H          | - NO OF        |                    | JMENT            | RIDE          | z            | IICS           |
|                          |                                                                                                 | TEMPERATURE                                       |       | JW/FLU                | <u></u>  | WE O                          |          |       | E<br>JW / FLI                   |       | URE      | NT SWI                       |              | OFF AUTO ON             | CLOSE      | R POSI          | INT AD        | ATIC O                                   | NALOG       | VALOG<br>NARY | NARY       |          | SMOKE TIME SCHEDULING DEMAND LIMITING | NTIVE                  | YCLE       | SIOPO          | TOPT               | INSTRI           | L OVERRIDE    | LB ECO       | GRAPI          |
|                          |                                                                                                 | TEMPERAT                                          | RH S  | AIR FLOW/FLUID<br>KWH | ENTHALPY | RUN TIM                       | FILTER   | SMOKE | FREEZE<br>AIR FLO               | METER | PRESSURE | CURRENT SWITCH<br>END SWITCH | OFF ON       | OFF AUTO ON             | OPEN CLOSE | DAMPER POSITION | SET PC        | PNEUMATIC C<br>ELECTRONIC                | HIGH ANALOG | LOW ANALOG    | LOW BINARY | PROOF    | SMOKE TIME SCHEDULING DEMAND LIMITING | PREVE                  | DUTY CYCLE | STAKI STOP OPT | SMOKE OPT<br>TREND | ALARM INSTRUMENT | DDC<br>MANUAL | DRYBULB ECON | COLOR GRAPHICS |
| CHILLED                  | CHILLED WATER PUMP, P-1                                                                         |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            | X        |                                       |                        |            |                |                    |                  |               |              |                |
| WATER<br>SYSTEM          | CHILLED WATER PUMP, P-2 CHILLED WATER PUMP, P-3                                                 | X                                                 |       |                       |          | $\stackrel{\times}{\swarrow}$ |          |       |                                 |       |          | X                            | X            |                         |            |                 |               | X                                        |             |               |            |          |                                       |                        | X          |                | X                  |                  |               |              |                |
|                          | PRIMARY CHILLED WATER SUPPLY TEMPERATURE, T-1 PRIMARY WATER RETURN TEMPERATURE, T-2             |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | SECONDARY CHILLED WATER SUPPLY TEMPERATURE, T-3 SECONDARY CHILLED WATER RETURN TEMPERATURE, T-4 |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | SECONDARY CHILLED WATER RETURN TEMPERATURE, T-5 PRIMARY CHILLED WATER RETURN TEMPERATURE, T-6   |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | PRIMARY CHILLED WATER RETURN TEMPERATURE, T-7 PRIMARY CHILLED WATER RETURN TEMPERATURE, T-8     |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | CHILLED WATER VALVE, V-1                                                                        |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               | X                                        |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | FLOW SWITCH, FS-1 DIFFERENTIAL PRESSURE TRANSMITTER, DPT-1                                      |                                                   |       |                       |          |                               |          |       | X                               |       |          |                              |              |                         |            |                 |               |                                          |             |               | X          |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | DIFFERENTIAL PRESSURE TRANSMITTER, DPT-2 DIFFERENTIAL PRESSURE TRANSMITTER, DPT-3               |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                | X                  |                  | X             |              |                |
|                          | STEAM CONVERTOR, C-1 STEAM CONTROL VALVE, VS-1A                                                 |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  | X             |              | X              |
| HEATING<br>WATER         | STEAM CONTROL VALVE, VS-1B STEAM CONVERTOR, C-2                                                 |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                | X                  |                  |               |              |                |
| SYSTEM                   | STEAM CONTROL VALVE, VS-2A STEAM CONTROL VALVE, VS-2B                                           |                                                   |       |                       |          |                               | +        |       | +                               |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | HEATING PUMP, P-4                                                                               |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            | X        |                                       |                        |            |                |                    | $\Rightarrow$    |               |              |                |
|                          | HEATING PUMP, P-5 HEATING PUMP, P-7                                                             |                                                   |       |                       |          | $\nearrow$                    |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | HEATING PUMP, P-8  CONVERTOR C-1 SUPPLY TEMPERATURE, T-1                                        | X                                                 |       |                       |          | XX                            |          |       |                                 |       |          | X                            |              |                         |            |                 | <b>X</b>      |                                          |             |               |            |          |                                       |                        | X          |                |                    |                  |               |              |                |
|                          | CONVERTOR C-2 SUPPLY TEMPERATURE, T-2 PRIMARY HEATING SUPPLY TEMPERATURE, T-4                   |                                                   |       |                       |          |                               |          |       |                                 | X     |          |                              |              |                         |            |                 | $\rightarrow$ |                                          |             | X             |            |          |                                       |                        |            |                |                    |                  |               |              | X              |
|                          | PRIMARY HEATING RETURN TEMPERATURE, T-5 SECONDARY HEATING SUPPLY TEMPERATURE, T-6               |                                                   |       |                       |          |                               |          |       |                                 | X     |          |                              |              |                         |            |                 | <u> </u>      |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | SECONDARY HEATING RETURN TEMPERATURE, T-7 SECONDARY HEATING SUPPLY TEMPERATURE, T-8             |                                                   |       |                       |          |                               | +        |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    | <b>*</b> *       |               |              |                |
|                          | SECONDARY HEATING RETURN TEMPERATURE, T-9 HIGH LIMIT TEMPERATURE SENSOR, HLT-1                  |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    | <b>}</b>         |               |              |                |
|                          | HIGH LIMIT TEMPERATURE SENSOR, HLP-2                                                            |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 | $\nearrow$    |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | HEATING WATER SUPPLY VALVE, V-1 HEATING WATER SUPPLY VALVE, V-2                                 |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | HEATING WATER SUPPLY VALVE, V-3 DIFFERENTIAL PRESSURE TRANSMITTER, DPT-1                        | X                                                 |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            | <i>&gt;</i>     |               | X                                        |             |               |            |          |                                       |                        |            |                | X                  |                  |               |              |                |
|                          | DIFFERENTIAL PRESSURE TRANSMITTER, DPT-2 DIFFERENTIAL PRESSURE TRANSMITTER, DPT-3               |                                                   |       |                       |          |                               |          |       |                                 | X     |          |                              |              |                         |            |                 |               | X                                        |             |               |            |          |                                       |                        |            |                | X                  |                  | X             |              |                |
| DOMESTIC                 | TANK TEMPERATURE                                                                                |                                                   |       |                       |          |                               |          |       |                                 | X     |          |                              |              |                         |            |                 | X             |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
| WATER<br>HEATERS         | HW RECIRC PUMP  LOOP TEMPERATURE SENSORS                                                        | X                                                 |       |                       |          | $\times$                      |          |       |                                 |       |          | X                            |              |                         |            |                 | $\times$      |                                          |             |               |            | X        |                                       |                        | X          |                |                    |                  |               |              |                |
|                          | HW MAIN SUPPLY TEMP, T-5                                                                        |                                                   |       |                       |          |                               |          |       |                                 | X     |          |                              |              |                         |            |                 | $\rightarrow$ |                                          |             |               |            |          |                                       |                        |            |                | X                  |                  |               |              | X              |
| DOMESTIC<br>WATER        | BOOSTER PUMPS PRESSURE SENSORS                                                                  |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              | X            |                         |            |                 |               | X                                        |             |               |            | X        |                                       |                        | X          |                | X                  |                  |               |              |                |
| BOOSTER<br>PUMPS         | TEMPERATURE SENSOR COMMON SUCTION                                                               |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    | <b>}</b>         |               |              |                |
|                          | COMMON DISCHARGE                                                                                |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
| OTE ANA                  | UTILITY FLOW METER                                                                              |                                                   |       |                       |          |                               |          |       |                                 | X     |          |                              |              |                         |            |                 |               | X                                        |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
| STEAM<br>SYSTEM          | STEAM PRESSURE  CONDENSATE DISCHARGE                                                            |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | CONDENSATE RECEIVER, CRU-1                                                                      |                                                   |       |                       |          | $\times \times$               |          |       |                                 |       |          |                              |              |                         |            |                 |               | X                                        |             |               |            |          |                                       |                        |            |                | X                  |                  | X             |              | X              |
| AIR<br>HANDLING          | AIR FLOW MONITORS, AFM-1, AFM-2, ETC.  DAMPERS, D-1, D-2, D-3 D-4, ETC.                         |                                                   |       |                       |          |                               | <u> </u> |       | X                               |       |          |                              |              |                         |            |                 | <u> </u>      |                                          |             |               | <u> </u>   |          |                                       |                        |            | _              |                    |                  |               |              | X              |
| UNITS<br>&<br>ROOFTOP    | FILTERS, DPS FREEZSTAT, FZ                                                                      |                                                   |       |                       |          |                               | X        |       |                                 |       | X        |                              |              |                         |            |                 |               |                                          | X           |               |            |          |                                       | X                      |            |                |                    |                  |               |              |                |
| UNITS                    | TEMPERATURE SENSORS  SPACE TEMPERATURE SENSORS                                                  |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 | X             |                                          |             |               |            |          |                                       |                        |            |                |                    | <b>*</b> *       |               |              |                |
|                          | HEATING COIL VALVE, V-1 COOLING COIL VALVE, V-2                                                 |                                                   |       |                       |          |                               | +        |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    | <b>\</b>         |               |              |                |
|                          | SMOKE DETECTOR, SD                                                                              |                                                   |       |                       |          |                               | +        |       |                                 |       |          |                              |              |                         |            |                 | +             |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | HIGH STATIC PRESSURE SENSOR, SPS-2                                                              |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                | X                  |                  |               |              |                |
|                          | HUMIDITY, H-1 SUPPLY FAN, W/ VFD                                                                |                                                   |       |                       |          |                               |          |       | +                               |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            | +              |                    |                  |               |              |                |
|                          | RETURN FAN, W/ VFD                                                                              |                                                   |       |                       |          |                               |          |       |                                 |       |          | X                            |              |                         |            |                 |               | X                                        |             |               |            | X        |                                       |                        |            |                |                    |                  | X             |              | X              |
| FAN<br>COIL              | SUPPLY FAN HEATING COIL VALVE, V-1                                                              | <del>                                      </del> |       | $\top$                |          | +                             |          |       |                                 |       |          |                              |              |                         |            | <u> </u>        |               | ×                                        |             |               |            |          |                                       |                        | -          |                | X                  |                  |               |              |                |
| UNITS                    | COOLING COIL VALVE, V-2 SPACE TEMPERATURE                                                       |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 | \<br>\<br>\   |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
| _                        | PRIMARY AIR DAMPER                                                                              |                                                   |       |                       |          |                               | +        |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
| SERIES<br>FAN<br>POWERED | SUPPLY FAN                                                                                      |                                                   |       |                       |          |                               | +        |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    | <b>}</b>         |               |              |                |
| TERMINALS                | REHEAT COIL HEATING VALVE, V-1  SPACE TEMPERATURE                                               | X                                                 |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 | <b>&gt;</b>   |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | TOILET & GENERAL EXHAUST FANS                                                                   |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
| MISC.<br>EQUIPMENT       | HOT WATER UNIT HEATERS HOT WATER CABINET UNIT HEATERS                                           |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  |               |              |                |
|                          | ELECTRIC UNIT HEATERS ELECTRIC CABINET UNIT HEATERS                                             |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    | <b>*</b> *       |               |              |                |
|                          | CONVECTORS & FINNED TUBE RADIATORS                                                              |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              |              |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    | <b>*</b>         |               |              |                |
|                          | VAV TERMINALS WITH ELECTRIC REHEAT                                                              |                                                   |       |                       |          |                               |          |       |                                 |       |          |                              | M            |                         |            |                 |               |                                          |             |               |            |          |                                       |                        |            |                |                    |                  | $\wedge$      |              |                |

|                  |                                                                                               |                         |                         |                                   |          | 11.1=:                   |       |                    |               |                                        |                                 | ED          |              | =               | ITC.                              |                   |                        |             |                  |                 |                 | ·                      |               |           |                   |                                       |                         |                                 |                   |
|------------------|-----------------------------------------------------------------------------------------------|-------------------------|-------------------------|-----------------------------------|----------|--------------------------|-------|--------------------|---------------|----------------------------------------|---------------------------------|-------------|--------------|-----------------|-----------------------------------|-------------------|------------------------|-------------|------------------|-----------------|-----------------|------------------------|---------------|-----------|-------------------|---------------------------------------|-------------------------|---------------------------------|-------------------|
|                  |                                                                                               | INPUTS                  |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              | UTPU            | JTS                               |                   |                        |             |                  |                 | SYS             | STEM FE                |               |           |                   |                                       |                         |                                 | GENERA            |
|                  |                                                                                               | MEAS                    |                         | BINARY                            |          |                          |       |                    | SITAL         |                                        | ANALOG                          |             |              | ALAR            | RMS                               |                   |                        |             |                  | APPLIC<br>PROGI |                 |                        |               |           |                   |                                       |                         |                                 |                   |
| SYSTEM<br>DESIG. | I/O LEGEND X - REQUIRED POINT                                                                 | TEMPERATURE<br>PRESSURE |                         | AIR FLOW/FLUID FLOW KWH ENTHAI PY | RUN TIME | STATUS<br>FILTER         | SMOKE | FREEZE<br>AIR FLOW | METER         | SWITC                                  | CURRENT SWITCH END SWITCH       | OFF AUTO ON | OFF HIGH LOW | DAMPER POSITION | VALVE POSITION SET POINT ADJ. AOP | )E                | HIGH ANALOG LOW ANALOG | HIGH BINARY | LOW BINARY PROOF | SMOKE           | TIME SCHEDULING | PREVENTIVE MAINTENANCE | DUTY CYCLE    | า I iĭi I | SMOKE OPT TREND   | ALARM INSTRUMENT                      | DDC<br>MANIJAI OVERRIDE | MANUAL OVERRIDE<br>DRYBULB ECON | COLOR GRAPHICS    |
|                  |                                                                                               | H R                     | <u> </u>                | AIR F                             |          | S  ∃                     | SN    | H                  | W E           | 9 E                                    |                                 | 2   P       | p   g        | 5 8             | VA<br>SE                          | AOE               | 불   S                  | ≝           | - H              | SN              |                 | R   R                  | <u> </u>      | ō   品     | S T               | \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ | DDC                     | MA RO                           | 8                 |
| MAKEUP           | AIR FLOW MONITOR, AFM-1 OUTSIDE AIR DAMPER, D-1                                               |                         |                         | $\times$                          |          |                          |       | $+$ $\times$       |               |                                        |                                 |             |              | $\downarrow$    |                                   |                   |                        |             |                  |                 |                 |                        |               |           | +                 | $\rightarrow$                         | $\rightarrow$           |                                 | $\longrightarrow$ |
| AIR              | FILTERS                                                                                       | $\rightarrow$           |                         |                                   |          | $\mid \; \mid \; \mid$   |       |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  |                 |                 |                        |               |           |                   |                                       |                         |                                 |                   |
|                  | COOLING COIL VALVE, V-1                                                                       | $\perp$                 |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 | X                                 | X                 |                        |             |                  |                 |                 |                        |               |           | $\rightarrow$     |                                       |                         |                                 |                   |
| -                | GAS HEAT                                                                                      |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  |                 |                 |                        |               | $\perp$   | $\rightarrow$     | $\longrightarrow$                     | $\rightarrow$           |                                 | $\longrightarrow$ |
| -                | SUPPLY FAN  SMOKE DETECTOR, SD                                                                |                         |                         |                                   |          |                          |       |                    |               | +                                      | $\rightarrow$                   |             |              |                 |                                   |                   |                        |             | -                |                 |                 |                        | _             | _         | -                 | $\rightarrow$                         | $\rightarrow$           |                                 | $\longrightarrow$ |
|                  | SPACE TEMPERATURE SENSOR, T-1                                                                 |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  |                 |                 |                        | <u>+</u>      |           |                   |                                       |                         |                                 |                   |
| KITCHEN          | EXHAUST AIR DAMPER, D-2                                                                       |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              | X               |                                   | X                 |                        |             |                  |                 |                 |                        |               |           |                   |                                       |                         |                                 |                   |
| EXHAUST<br>FANS  | EXHAUST FAN WASHBOARD PANEL                                                                   |                         |                         |                                   | X        |                          |       |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  |                 |                 |                        | <del>-</del>  |           |                   |                                       |                         |                                 |                   |
| 112/11110        | OUTSIDE AIR DAMPER, D-1                                                                       |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              | X               |                                   |                   |                        |             |                  |                 |                 |                        |               |           |                   |                                       |                         |                                 |                   |
| VENTILATING∤     |                                                                                               |                         | $\prod$                 |                                   |          |                          |       |                    | +             |                                        |                                 |             |              | X               |                                   | X                 |                        | $\prod$     |                  |                 |                 |                        |               | $\prod$   | $\overline{}$     |                                       | X                       |                                 |                   |
| -                | FILTERS  HEATING COIL VALVE V-1                                                               | $+ \times$              | +                       |                                   |          | $\mid \cdot \mid \times$ |       |                    | + }           | X                                      | ++                              |             |              | +               |                                   |                   | X                      |             |                  |                 |                 |                        | _             | +         | +                 | $\rightarrow$                         | $\rightarrow$           |                                 | $\bowtie$         |
| -                | HEATING COIL VALVE, V-1 COOLING COIL VALVE, V-2                                               | $+ \swarrow$            | +                       |                                   |          |                          |       |                    |               |                                        | ++                              |             |              | +               |                                   |                   |                        |             |                  |                 |                 |                        |               | +         | +                 | $\rightarrow$                         |                         |                                 | $\bigcirc$        |
| -                | FREEZE STAT, FZ                                                                               |                         |                         |                                   |          |                          |       |                    |               |                                        | ++                              |             |              | +               |                                   |                   |                        |             |                  |                 |                 |                        |               | +         | +                 | +                                     |                         |                                 | $\bowtie$         |
|                  | SUPPLY FAN                                                                                    |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   | X                 |                        |             | $\rightarrow$    |                 |                 |                        |               |           |                   |                                       |                         |                                 |                   |
| -                | SMOKE DETECTORS, SD                                                                           |                         |                         |                                   |          |                          | X     |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  | X               |                 |                        |               |           | $\longrightarrow$ | _                                     |                         |                                 |                   |
| -                | STATIC PRESSURE SENSOR, SPS-1                                                                 | $+\times$               | +                       |                                   |          |                          |       |                    |               | _                                      | +                               |             |              |                 |                                   |                   |                        |             |                  |                 |                 |                        | _             |           | +                 | $\longrightarrow$                     | $\rightarrow$           |                                 | $\longrightarrow$ |
| -                | HIGH STATIC PRESSURE SENSOR, SPS-2 SPACE TEMPERATURE SENSOR                                   | +                       | +                       |                                   |          |                          |       | +                  |               |                                        | ++                              |             |              | +               |                                   |                   |                        | +           |                  |                 |                 |                        | _             | +         | +                 | +                                     |                         |                                 | $\triangleright$  |
| -                | SUPPLY AIR TEMPERATURE SENSOR                                                                 |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  |                 |                 |                        | +             |           |                   |                                       |                         |                                 |                   |
|                  | VENTILATION FAN                                                                               |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              | _               |                                   | X                 |                        |             | <u> </u>         |                 |                 |                        | _             |           | $\rightarrow$     |                                       |                         |                                 |                   |
| VENTILATION FANS | SMOKE DETECTOR                                                                                |                         |                         |                                   |          |                          | X     |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  | X               |                 |                        |               |           |                   |                                       |                         |                                 |                   |
|                  | SPACE TEMPERATURE SENSOR                                                                      |                         |                         |                                   |          |                          |       |                    | X             |                                        |                                 |             |              |                 |                                   | X                 | $\times \times$        |             |                  |                 |                 |                        | _             |           |                   |                                       |                         |                                 |                   |
| SMOKE            | SMOKE EXHAUST FAN                                                                             |                         |                         | $\times$                          |          |                          |       |                    |               | $\rightarrow$                          | $\langle \downarrow \downarrow$ |             |              |                 |                                   | X                 |                        |             | $\rightarrow$    |                 |                 |                        |               |           | $\rightarrow$     | _                                     | $\searrow$              |                                 | X +               |
| EANC             | SMOKE DETECTOR  SPACE TEMPERATURE SENSOR                                                      | X                       |                         |                                   |          |                          | X     |                    |               |                                        | +                               |             |              |                 |                                   |                   |                        |             |                  | X               |                 |                        | _             | _         | +                 | $\rightarrow$                         | $\rightarrow$           |                                 | $\longrightarrow$ |
|                  | SMOKE EXHAUST FAN, SEF-5                                                                      |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             | ×                |                 |                 |                        | +             |           |                   |                                       |                         |                                 |                   |
| ATRIUM           | SMOKE EXHAUST FAN, SEF-6                                                                      |                         |                         |                                   |          |                          |       |                    |               | $\nearrow$                             | $\nearrow$                      |             |              |                 |                                   |                   |                        |             | $\rightarrow$    |                 |                 |                        |               |           |                   |                                       |                         |                                 |                   |
| [                | OUTSIDE AIR DAMPER, D-5-1                                                                     |                         |                         |                                   |          |                          |       |                    |               |                                        | X                               |             |              | X               |                                   | X                 |                        |             |                  |                 |                 |                        |               |           |                   |                                       |                         |                                 |                   |
| -                | SMOKE EXHAUST FAN SEF-11                                                                      |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   | X                 |                        | $\prod$     | $\nearrow$       |                 |                 |                        |               | $\prod$   | _>                |                                       | X                       |                                 |                   |
| -                | SMOKE EXHAUST FAN SEF-12 OUTSIDE AIR DAMPER, D-11-1                                           |                         |                         | $\times$                          |          |                          |       |                    |               | \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\ |                                 |             |              |                 |                                   | $\langle \rangle$ |                        |             | <del> </del>   > | +               |                 |                        |               | +         | +                 | $\rightarrow$                         | $\leftarrow$            |                                 | $\bowtie$         |
| -                | SMOKE EXHAUST FAN SEF-7A                                                                      |                         |                         | +                                 |          |                          |       | +                  |               | <u> </u>                               |                                 |             |              | +               |                                   |                   |                        |             | <u> </u>         |                 |                 |                        |               | +         | +                 | +                                     |                         |                                 | $\bigcirc$        |
| -                | SMOKE EXHAUST FAN SEF-7B                                                                      |                         | + +                     |                                   |          |                          |       | +                  |               | $\downarrow$                           | $\downarrow \uparrow \uparrow$  |             |              | +               |                                   | $\forall$         |                        |             | +                | $\downarrow$    |                 |                        | +             | +         | $\Rightarrow$     |                                       |                         |                                 |                   |
| -                | SMOKE EXHAUST FAN SEF-8 OUTSIDE AIR DAMPER, D-7-1                                             |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              | X               |                                   | X                 |                        |             |                  |                 |                 |                        | <u></u>       |           |                   |                                       |                         |                                 |                   |
| -                | SMOKE EXHAUST FAN SEF-9                                                                       |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   | X                 |                        |             | $\rightarrow$    |                 |                 |                        |               |           | $\rightarrow$     |                                       | X                       |                                 |                   |
| -                | SMOKE EXHAUST FAN SEF-10A                                                                     |                         | <del>   </del>          | +                                 |          |                          |       |                    |               | $\downarrow$                           | +                               |             |              | +               |                                   | $\langle \rangle$ |                        |             | $\rightarrow$    | +               |                 |                        | _             |           | $\rightarrow$     | $\rightarrow$                         | $\left  \right\rangle$  |                                 | $\bowtie$         |
| -                | SMOKE EXHAUST FAN SEF-10B  OUTSIDE AIR DAMPER, D-10-1                                         |                         | ++                      |                                   |          |                          |       | -                  |               | +                                      |                                 |             |              |                 |                                   |                   |                        |             | +                |                 |                 |                        |               | +         | +                 | +                                     |                         |                                 | $\triangleright$  |
| -                | FIRE ALARM INTERFACE                                                                          |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  |                 |                 |                        |               |           |                   |                                       |                         |                                 |                   |
| -                | GLOBAL OUTSIDE AIR TEMPERATURE SENSORS, QUAD A                                                |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  |                 |                 |                        | $\frac{1}{2}$ |           |                   |                                       |                         |                                 |                   |
| SENSORS          | GLOBAL OUTSIDE AIR TEMPERATURE SENSORS, QUAD B                                                |                         | +                       | +                                 |          |                          |       |                    | $\rightarrow$ |                                        | ++                              |             |              | +               |                                   |                   | XX                     | +           |                  |                 |                 |                        |               | _         | +                 | <del>\</del>                          | $\rightarrow$           |                                 | $\bowtie$         |
| -                | GLOBAL OUTSIDE AIR TEMPERATURE SENSORS, QUAD C GLOBAL OUTSIDE AIR TEMPERATURE SENSORS, QUAD D | XX                      | +                       | $\rightarrow +$                   |          |                          |       | -                  |               |                                        | ++                              |             |              | +               |                                   |                   | $\langle \chi \rangle$ | +           |                  |                 |                 |                        |               | +         | +                 | <del>\</del>                          |                         |                                 | $\triangleright$  |
|                  | GLOBAL OUTSIDE AIR HUMIDITY SENSORS, QUAD A GLOBAL OUTSIDE AIR HUMIDITY SENSORS, QUAD B       |                         |                         |                                   |          |                          |       |                    |               |                                        |                                 |             |              |                 |                                   |                   |                        |             |                  |                 |                 |                        | +             |           |                   |                                       |                         |                                 |                   |
|                  | GLOBAL OUTSIDE AIR HUMIDITY SENSORS, QUAD C                                                   |                         | $\langle \cdot \rangle$ | +K                                | +        |                          |       | -                  |               |                                        | $\perp$                         | _           |              |                 |                                   | $\leftarrow$      |                        | $\perp$     |                  |                 |                 |                        | $\perp$       | $\perp$   | -                 | +                                     | $\leftarrow$            |                                 | $\bowtie$         |

bkm

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

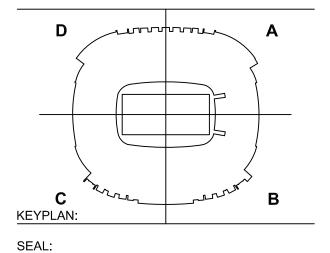
PROJECT NAME:

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



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** 

**AS NOTED** SCALE:

DRAWN BY: MJG

CHECKED BY: CMP / MAF

**FEBRUARY 12, 2021** 

SHEET TITLE:

**AUTOMATIC TEMPERATURE** 

CONTROLS I/O POINTS SCHEDULE

DRAWING NO: