

GENERAL ABBREVIATIONS

ADDN	ADDITION, ADDITIONAL
AFF	ABOVE FINISHED FLOOR
ALT	ALTERNATE
APPROX	APPROXIMATELY
ARCH	ARCHITECT
AUX	AUXILIARY
BAL	BALANCING
BLDG	BUILDING
BSMT	BASEMENT
BTU	BRITISH THERMAL UNIT
BTUH	BRITISH THERMAL UNITS PER HOUR
CAP	CAPACITY
CL	CENTERLINE
COND	CONDENSATE
COL	COLUMN
CONN	CONNECT; CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS; CONTINUATION
COORD	COORDINATE
DEG	DEGREE
DIA	DIAMETER
DIFF	DIFFERENTIAL
DIM	DIMENSION
DISCH	DISCHARGE
DIV	DIVISION
DN	DOWN
DP	DIFFERENTIAL PRESSURE
DR	DRAIN
DWG	DRAWING
EA	EACH
EFF	EFFICIENCY
ELEC	ELECTRICAL ENGINEER
ELEV	ELEVATION; ELEVATOR
EMCS	ENERGY MANAGEMENT CONTROL SYSTEM
ENT	ENTERING
EQ	EQUAL
EQUIP	EQUIPMENT
ET	EXPANSION TANK
EWT	ENTERING WATER TEMPERATURE
EX, (E)	EXISTING
EXP	EXPOSED
EXPL	EXPLOSION
F	FAHRENHEIT
FIO	FURNISHED & INSTALLED BY OWNER
FLEX	FLEXIBLE
FLR	FLOOR
FOIC	FURNISHED BY OWNER, INSTALLED BY CONTRACTOR
FP	FIRE PROTECTION; FREEZE PROTECTION
FT	FEET; FOOT; FEET OF WATER(PRESS)
GA	GAGE; GAUGE
GAL	GALLON
GC	GENERAL CONTRACTOR
GEN	GENERAL
GPM	GALLONS PER MINUTE
GWB	GYPSUM WALLBOARD
H	HEIGHT; HIGH
HOA	HAND OFF AUTOMATIC
HOR	HORIZONTAL
HP	HORSE POWER
HR	HOURLY
HZ	HERTZ
IBC	INTERNATIONAL BUILDING CODE
ID	INSIDE DIAMETER
IFC	INTERNATIONAL FIRE CODE
IMC	INTERNATIONAL MECHANICAL CODE
IN	INCH
INFO	INFORMATION
INSUL	INSULATE; INSULATION
KW	KILOWATT
KWH	KILOWATT HOUR
L	LENGTH; LONG (DIM)
LAB	LABORATORY
LAV	LAVATORY
LB	POUND
LBS/HR	POUNDS PER HOUR
LF	LINEAL FEET
LO	LOW
LTG	LIGHTING
LVG	LEAVING
LWT	LEAVING WATER TEMPERATURE

MAT	MATERIAL
MAX	MAXIMUM
MBH	THOUSAND BRITISH THERMAL UNITS PER HOUR
MECH	MECHANICAL; MECHANICAL CONTRACTOR
MED	MEDIUM
MFG	MANUFACTURING
MFR	MANUFACTURER
MIN	MINIMUM; MINUTE
MISC	MISCELLANEOUS
MTD	MOUNTED
N	NORTH
NA	NOT APPLICABLE
NC	NORMALLY CLOSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN; NUMBER
NOM	NOMINAL
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER; OVERALL DIMENSION
OPP	OPPOSITE
PD	PRESSURE DROP
PERF	PERFORATED
PERP	PERPENDICULAR
PH	PHASE
POC	POINT OF CONNECTION
PRELIM	PRELIMINARY
PRESS	PRESSURE
PROP	PROPERTY; PROPOSAL
PS	PRESSURE SWITCH
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH GAGE
PT	PRESSURE/TEMPERATURE TAP
QTY	QUANTITY
RAD	RADIATOR
REF	REFERENCE
REFR	REFRIGERATION
REQD	REQUIRED
RET	RETURN
RM	ROOM
RPM	REVOLUTIONS PER MINUTE
S	SOUTH
SCHED	SCHEDULE
SECT	SECTION
SF	SQUARE FEET
SHT	SHEET
SIM	SIMILAR
SOL	SOLENOID
SPEC	SPECIFICATION
SPEC'D	SPECIFIED
SQ	SQUARE
STD	STANDARD
STRUCT	STRUCTURAL ENGINEER
TBD	TO BE DETERMINED
TD	TEMPERATURE DIFFERENTIAL
TEMP	TEMPERATURE
TH	TOTAL HEAD
THRU	THROUGH
TYP	TYPICAL
UBC	UNIFORM BUILDING CODE
UL	UNDERWRITER'S LABORATORY
UTIL	UTILITY
V	VOLT
VAR	VARIABLE
VEL	VELOCITY
VERT	VERTICAL
VOL	VOLUME
W	WATER; WIDE(DIM); WATT
W/	WITH
W/O	WITHOUT
WT	WEIGHT
YD	YARD
YR	YEAR

HVAC ABBREVIATIONS

AL	ACOUSTIC LINED; ALUMINUM
AC	AIR CONDITIONING
AD	AUTOMATIC DAMPER
AF	AIR FOIL
AHU	AIR HANDLING UNIT
BDD	BACKDRAFT DAMPER
BHP	BRAKE HORSEPOWER
BI	BACKWARD INCLINED
BOD	BOTTOM OF DUCT
C	CONDENSATE; COMMON
CC	COOLING COIL
CFM	CUBIC FEET PER MINUTE
CG	CEILING GRILLE
CLG	COOLING
CLWR	COOLING WATER RETURN
CLWS	COOLING WATER SUPPLY
COND	CONDENSATE
CT	COOLING TOWER
CV	CONSTANT VOLUME
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
DDC	DIRECT DIGITAL CONTROLS
DMPR	DAMPER
DB	DRY BULB TEMPERATURE(°F)
EA	EXHAUST AIR
EAT	ENTERING AIR TEMPERATURE
EF	EXHAUST FAN
EG	EXHAUST GRILLE
EXH	EXHAUST
FA	FACE AREA
FC	FAN COIL; FORWARD CURVED
FCU	FAN COIL UNIT
FD	FIRE DAMPER
FF	FINAL FILTER
FPM	FEET PER MINUTE
FS	FLOW SWITCH
FV	FACE VELOCITY
GALV	GALVANIZED
GR	GRILLE
H	HUMIDIFIER, HUMIDISTAT
H/C	HEATING COIL
HPC	HIGH PRESSURE CONDENSATE
HPS	HIGH PRESSURE STEAM
HTG	HEATING
HV	HEAT AND VENT UNIT
HHWR	HEATING WATER RETURN
HHWS	HEATING WATER SUPPLY
HX	HEAT EXCHANGER
IMC	INTERNATIONAL MECHANICAL CODE
LAT	LEAVING AIR TEMPERATURE
LPC	LOW PRESSURE CONDENSATE
LPS	LOW PRESSURE STEAM
MA	MIXED AIR
MPC	MEDIUM PRESSURE CONDENSATE
MPS	MEDIUM PRESSURE STEAM
NPSH	NET POSITIVE SUCTION HEAD
OA	OUTSIDE AIR
OAT	OUTSIDE AIR TEMPERATURE
ODP	OPEN DRIPPROOF
OSA	OUTSIDE AIR
OV	OUTLET VELOCITY
PF	PREFILTER
PHC	PREHEAT COIL
RL	REFRIGERANT LIQUID
RS	REFRIGERANT SUCTION (GAS)
RHC	REHEAT COIL
RH	RELATIVE HUMIDITY
RA	RETURN AIR
RF	RETURN FAN
RG	RETURN GRILLE
S	SUPPLY
SFD	SMOKE/FIRE DAMPER
SP	STATIC PRESSURE
SD	SMOKE DAMPER; SUPPLY DIFFUSER
SA	SUPPLY AIR; SOUND ATTENUATOR
SF	SUPPLY FAN
SG	SUPPLY GRILLE
SR	SUPPLY REGISTER
STM	STEAM

T, TSTAT	THERMOSTAT
TEFC	TOTALLY ENCLOSED, FAN COOLED
TG	TRANSFER GRILLE
UMC	UNIFORM MECHANICAL CODE
UH	UNIT HEATER
UV	UNIT VENTILATOR
VAV	VARIABLE AIR VOLUME
VSD	VARIABLE SPEED DRIVE
VENT	VENTILATE; VENTILATION
VD	VOLUME DAMPER
WG	WALL GRILLE; WATER GAGE
WSEC	WASHINGTON STATE ENERGY CODE
WSNEC	WASHINGTON STATE NON-RESIDENTIAL ENERGY CODE
WB	WET BULB TEMPERATURE(°F)

GENERAL LEGEND

	NORTH ARROW
	DETAIL/DRAWING REFERENCE
	SECTION REFERENCE
	CONSTRUCTION NOTE
	REVISION SYMBOL
	POINT OF CONNECTION
	BOLD LINE WEIGHT INDICATES NEW WORK
	LIGHT LINE WEIGHT INDICATES EXISTING WORK
	SLASHED LINE INDICATES EXISTING WORK TO BE DEMOLISHED

HVAC DUCTWORK LEGEND

SINGLE LINE DUCTWORK INDICATES VIEW  
DIMENSION LESS THAN 12 INCHES

	SUPPLY OR EXHAUST TAKEOFF
	SUPPLY DUCT TURNING TOWARD
	SUPPLY DUCT TURNING AWAY
	EXHAUST DUCT TURNING TOWARD
	EXHAUST DUCT TURNING AWAY
	ROUND DUCT TURNING TOWARD
	ROUND DUCT TURNING AWAY
	TRANSITION
	SMOKE DAMPER
	MOTORIZED DAMPER
	VOLUME DAMPER
	BACKDRAFT DAMPER
	FIRE DAMPER
	FLEXIBLE CONNECTION
	TURNING VANES
	FLEXIBLE DUCT
	SUPPLY DIFFUSER
	RETURN GRILLE
	EXHAUST GRILLE
	THERMOSTAT
	EQUIPMENT TAG
	DIFFERENTIAL PRESSURE SENSOR
	CARBON DIOXIDE SENSOR
	HYDROGEN (H2) SENSOR

GENERAL CONSTRUCTION NOTES

- PLANS ARE DIAGRAMMATIC AND DO NOT SHOW ALL BRANCHES, VALVES, SPECIALTIES AND EQUIPMENT.
- ALL PIPING, VALVES AND EQUIPMENT ARE TO BE REMOVED IN DEMOLITION AREAS.
- VALVES INDICATED FOR SHUT-OFF ISOLATION ARE SHOWN IN APPROXIMATE LOCATIONS. REFER TO REFERENCED BLDG. DRAWINGS FOR DETAILED SYSTEMS.
- FIELD VERIFY EXACT LOCATIONS VALVES, EQUIPMENT AND PIPING.
- CONTRACTOR TO VERIFY SYSTEM SHUT DOWN PRIOR TO ANY REMOVAL WORK.
- CONTRACTOR TO RE-OPEN VALVES AFTER COMPLETION OF REMOVAL, CAP, & CUT TO RESTORE SYSTEM OPERATION WHERE REQUIRED.
- SYSTEM SHUT DOWN REMOVAL, CUT & CAP SHALL ONLY BEGIN AFTER NEW, RE-ROUTED SYSTEM IS IN PLACE FOR SERVICE CONTINUITY WHERE REQUIRED.
- ALL SYSTEMS SHALL BE DRAINED AND DISPOSAL OF FLUIDS HANDLED AS REQUIRED PER OWNER'S STANDARDS.
- MECHANICAL DRAWINGS SHOW DISCONNECT AND RECONNECT POINTS AT THE PROJECT'S BOUNDARIES. AN ATTEMPT WAS MADE TO SHOW MAJOR MECHANICAL UTILITY WORK WITHIN THE PROJECT'S BOUNDARIES. THE CONTRACTOR IS RESPONSIBLE FOR REMOVAL/DISPOSAL OF ALL MECHANICAL WORK WITHIN THE PROJECT'S BOUNDARY.

2021 WASHINGTON STATE ENERGY CODE NOTES

- PROVIDE POST CONSTRUCTION COMMISSIONING AND COMPLETION REQUIREMENTS IN ACCORDANCE WITH SECTION C408 AND ACCORDING WITH THE CONTRACT DOCUMENTS. SEE SPECIFICATION SECTIONS 23 05 00, 23 08 00 AND ALL OTHER APPLICABLE SPECIFICATION SECTIONS.
- PROVIDE CLOSE OUT DOCUMENTATION AND TRAINING OF BUILDING OPERATIONS PERSONNEL FOR ALL MECHANICAL COMPONENTS IN ACCORDANCE WITH SECTION C103.6. SEE SPECIFICATIONS FOR MORE INFORMATION.
- EACH SUPPLY AIR OUTLET AND ZONE TERMINAL DEVICE SHALL BE EQUIPPED WITH MEANS FOR AIR BALANCING PER SECTION C408.2.2.1. SEE SPECIFICATIONS FOR DETAILS.
- BALANCE ALL HVAC SYSTEMS IN ACCORDANCE WITH SECTION C408.2.2, GENERALLY ACCEPTED ENGINEERING STANDARDS AND IN ACCORDANCE WITH THE CONTRACT DOCUMENTS. SEE SPECIFICATION SECTION 23 05 93 AND ALL OTHER APPLICABLE SPECIFICATION SECTIONS.
- ALL DUCTWORK SHALL BE CONSTRUCTED AND ERECTED PER THE INTERNATIONAL MECHANICAL CODE 2021 EDITION. SEE SECTION C403.10.2 OF THE 2021 WASHINGTON STATE ENERGY CODE AND SPECIFICATIONS FOR MORE INFORMATION.
- ALL DUCTS AND PLENUMS THAT ARE PART OF AN HVAC SYSTEM SHALL BE THERMALLY INSULATED IN ACCORDANCE WITH TABLE C403.10.1.1 OR C403.10.1.2. SEE SPECIFICATIONS FOR MORE INFORMATION.
- PROVIDE CONTROLS IN ACCORDANCE WITH SECTION C403.4 AND IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

DRAWING INDEX

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M1.03	FIRST FLOOR EQUIPMENT PLAN – WASH & FUEL
M2.01S	SECOND FLOOR EQUIPMENT PLAN – SOUTH
M2.01N	SECOND FLOOR EQUIPMENT PLAN – NORTH
M3.01	PARTIAL ROOF EQUIPMENT PLAN
M5.01	EQUIPMENT SCHEDULES
M5.02	EQUIPMENT SCHEDULES
M7.01	CONTROL DIAGRAM & POINTS LIST
M7.02	CONTROL DIAGRAM & POINTS LIST
M7.03	CONTROL DIAGRAM & POINTS LIST
M7.04	CONTROL DIAGRAM & POINTS LIST
M7.05	CONTROL DIAGRAM & POINTS LIST
M7.06	CONTROL DIAGRAM & POINTS LIST
M7.07	CONTROL DIAGRAMS & POINTS LIST
M7.08	CONTROL DIAGRAM & POINTS LIST
M7.09	CONTROL DIAGRAMS & POINTS LIST

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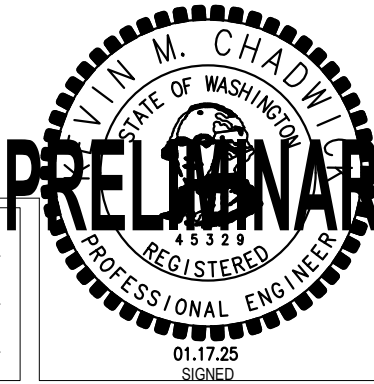
WTA MOAB DDC UPGRADE  
HVAC LEGEND, ABBREVIATIONS & GENERAL NOTES

DWG # MO.00

SHEET # 1 of 18

Date	No	Revision	By

DESIGNED BY:	BAQ
DRAWN BY:	KH
CHECKED BY:	BAQ



WHATCOM COUNTY  
TRANSPORTATION AUTHORITY  
BELLINGHAM, WASHINGTON




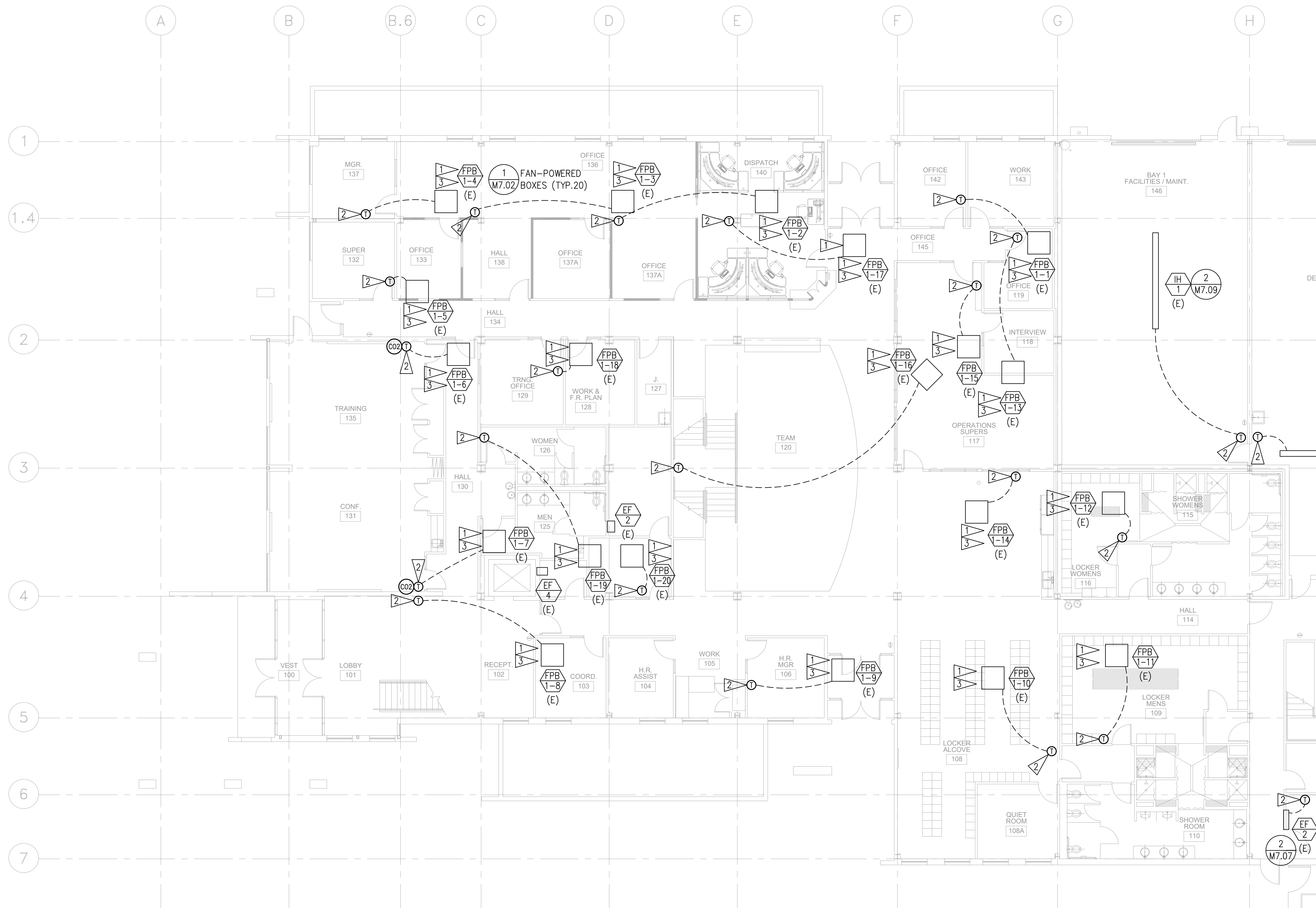
WTA PROJECT #:	2023-046 FRQ
CONSULTANT #:	
SUBMITTAL DATE:	10/16/2024



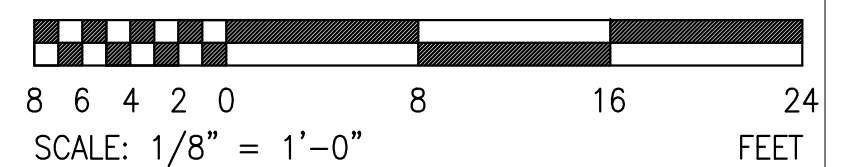
SCALE:  $1/8" = 1'-0"$

1. ALL HVAC EQUIPMENT IS EXISTING, TO REMAIN.  
MAKE REPAIRS/REPLACEMENTS AS NOTED.

- 1 REMOVE EXISTING DAMPER MOTOR AND PROVIDE NEW DAMPER MOTOR.
- 2 REMOVE EXISTING THERMOSTAT AND PROVIDE NEW THERMOSTAT.
- 3 REMOVE EXISTING CONTROLS AND PROVIDE NEW CONTROLS TO EXISTING EQUIPMENT. UTILIZE EXISTING COMPONENTS AS POSSIBLE AND REPLACE WITH NEW ANY COMPONENT THAT IS AT OR NEAR END OF LIFE. SEE SEQUENCE AND CONTROL DETAILS.



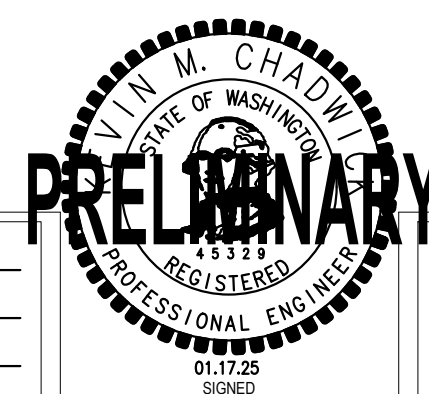
SCALE:  $1/8" = 1'-0"$



WTA MOAB DDC UPGRADE  
FIRST FLOOR EQUIPMENT PLAN - SOUTH

**SHEET # 2 OF 18**

DESIGNED BY: BAQ  
DRAWN BY: KH  
CHECKED BY: BAQ

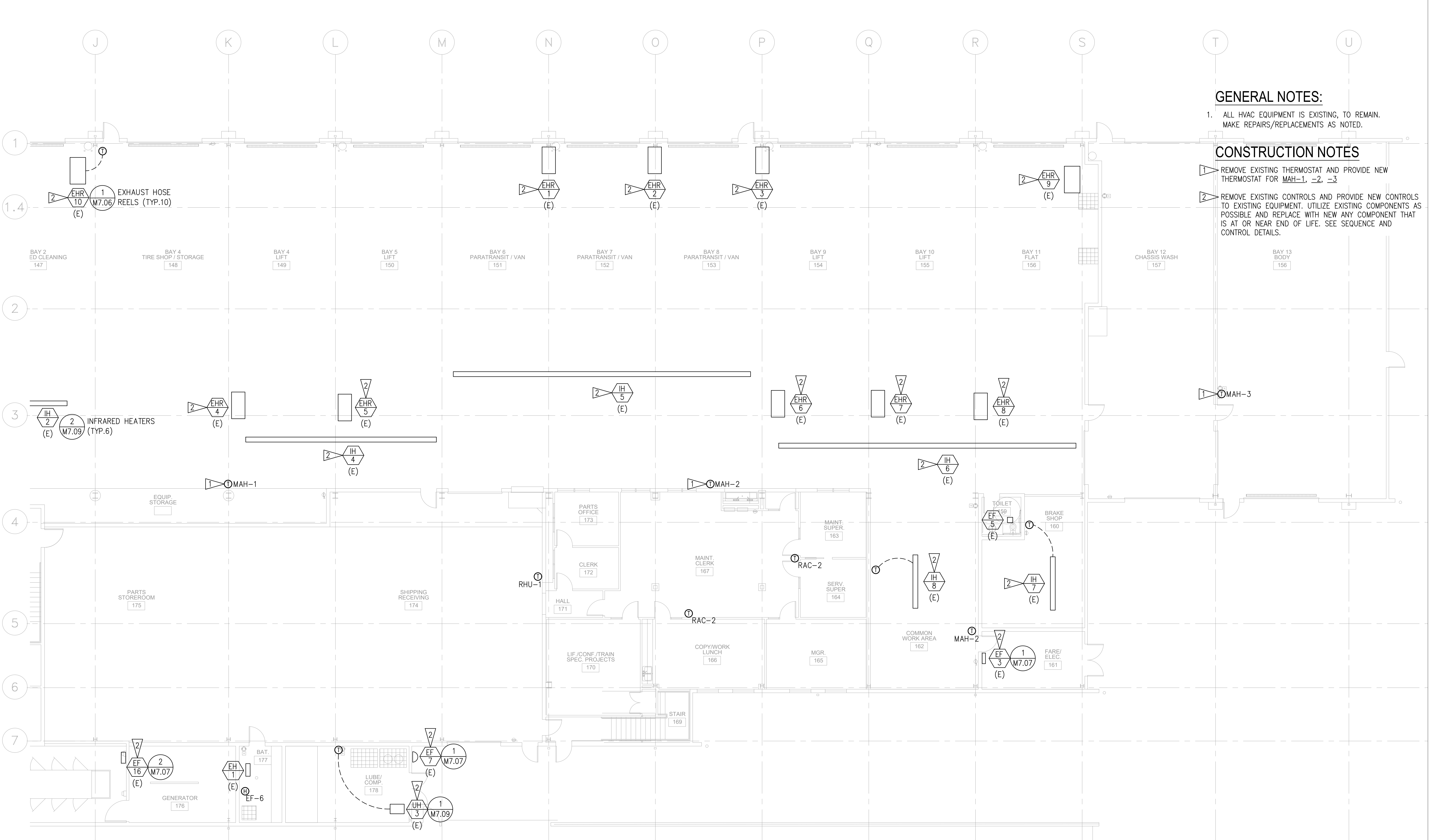


**WHATCOM COUNTY  
TRANSPORTATION AUTHORITY  
BELLINGHAM, WASHINGTON**



WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #:  
SUBMITTAL DATE: 10/16/2024

WTA CONTACT PERSON: **DEVON DEBOER** PHONE #: **360-201-6440**



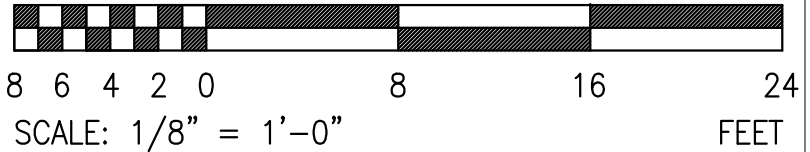
**GENERAL NOTES:**

1. ALL HVAC EQUIPMENT IS EXISTING, TO REMAIN. MAKE REPAIRS/REPLACEMENTS AS NOTED.

**CONSTRUCTION NOTES**

1. REMOVE EXISTING THERMOSTAT AND PROVIDE NEW THERMOSTAT FOR MAH-1, -2, -3
2. REMOVE EXISTING CONTROLS AND PROVIDE NEW CONTROLS TO EXISTING EQUIPMENT. UTILIZE EXISTING COMPONENTS AS POSSIBLE AND REPLACE WITH NEW ANY COMPONENT THAT IS AT OR NEAR END OF LIFE. SEE SEQUENCE AND CONTROL DETAILS.

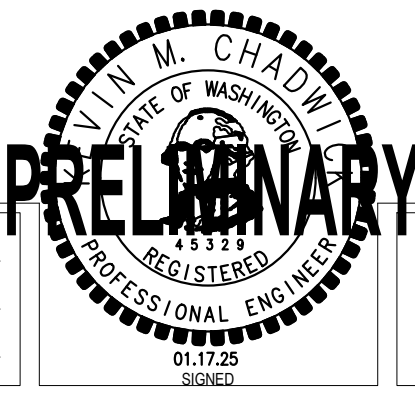
**1 FIRST FLOOR EQUIPMENT PLAN - NORTH**  
SCALE: 1/8"=1'-0"



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DESIGNED BY: BAQ  
DRAWN BY: KH  
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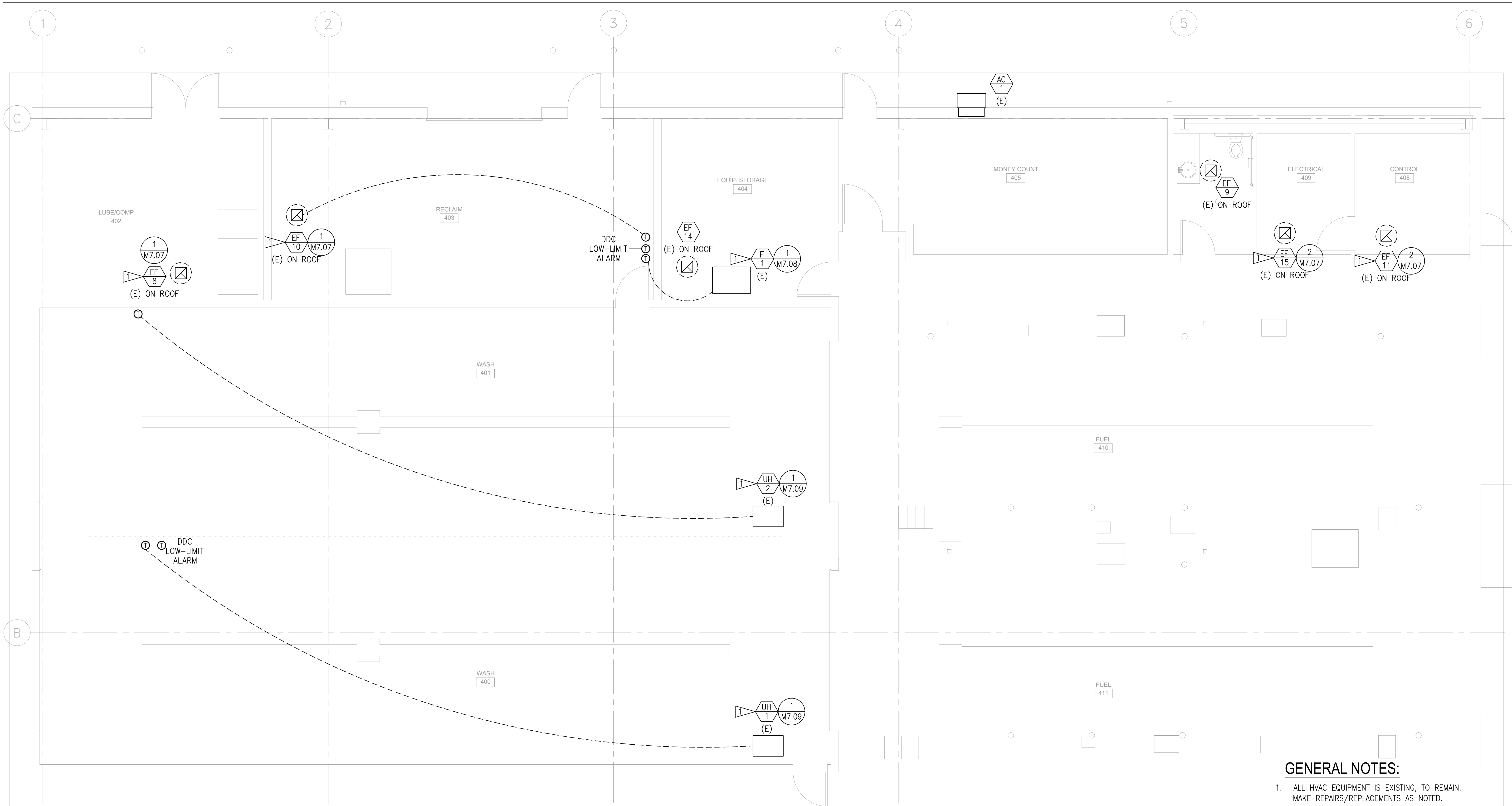


WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #:   
SUBMITTAL DATE: 10/16/2024

WTA MOAB DDC UPGRADE  
FIRST FLOOR EQUIPMENT PLAN - SOUTH

DWG # M1.01N  
SHEET # 3 of 18

WTA CONTACT PERSON: DEVON DEBOER PHONE #: 360-201-6440




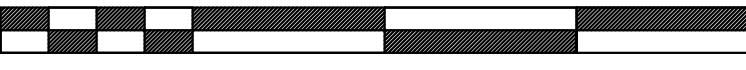
 **1** **EQUIPMENT PLAN - FUEL & WASH**  
SCALE: 1/4"=1'-0"

**GENERAL NOTES:**

1. ALL HVAC EQUIPMENT IS EXISTING, TO REMAIN. MAKE REPAIRS/REPLACEMENTS AS NOTED.

**CONSTRUCTION NOTES**

 REMOVE EXISTING CONTROLS AND PROVIDE NEW CONTROLS TO EXISTING EQUIPMENT. UTILIZE EXISTING COMPONENTS AS POSSIBLE AND REPLACE WITH NEW ANY COMPONENT THAT IS AT OR NEAR END OF LIFE. SEE SEQUENCE AND CONTROL DETAILS.

  
SCALE: 1/4" = 1'-0" FEET

Date	No	Revision	By		

WTa CONTACT PERSON: DEVON DEBOER PHONE #: 360-201-6440

DESIGNED BY: BAQ  
DRAWN BY: KH  
CHECKED BY: BAQ



**WHATCOM COUNTY  
TRANSPORTATION AUTHORITY**  
BELLINGHAM, WASHINGTON



WTa PROJECT #: 2023-046 RFQ  
CONSULTANT #:   
SUBMITTAL DATE: 10/16/2024

**WTa MOAB DDC UPGRADE**  
FIRST FLOOR EQUIPMENT PLAN - WASH & FUEL

DWG # M1.03  
SHEET # 4 OF 18

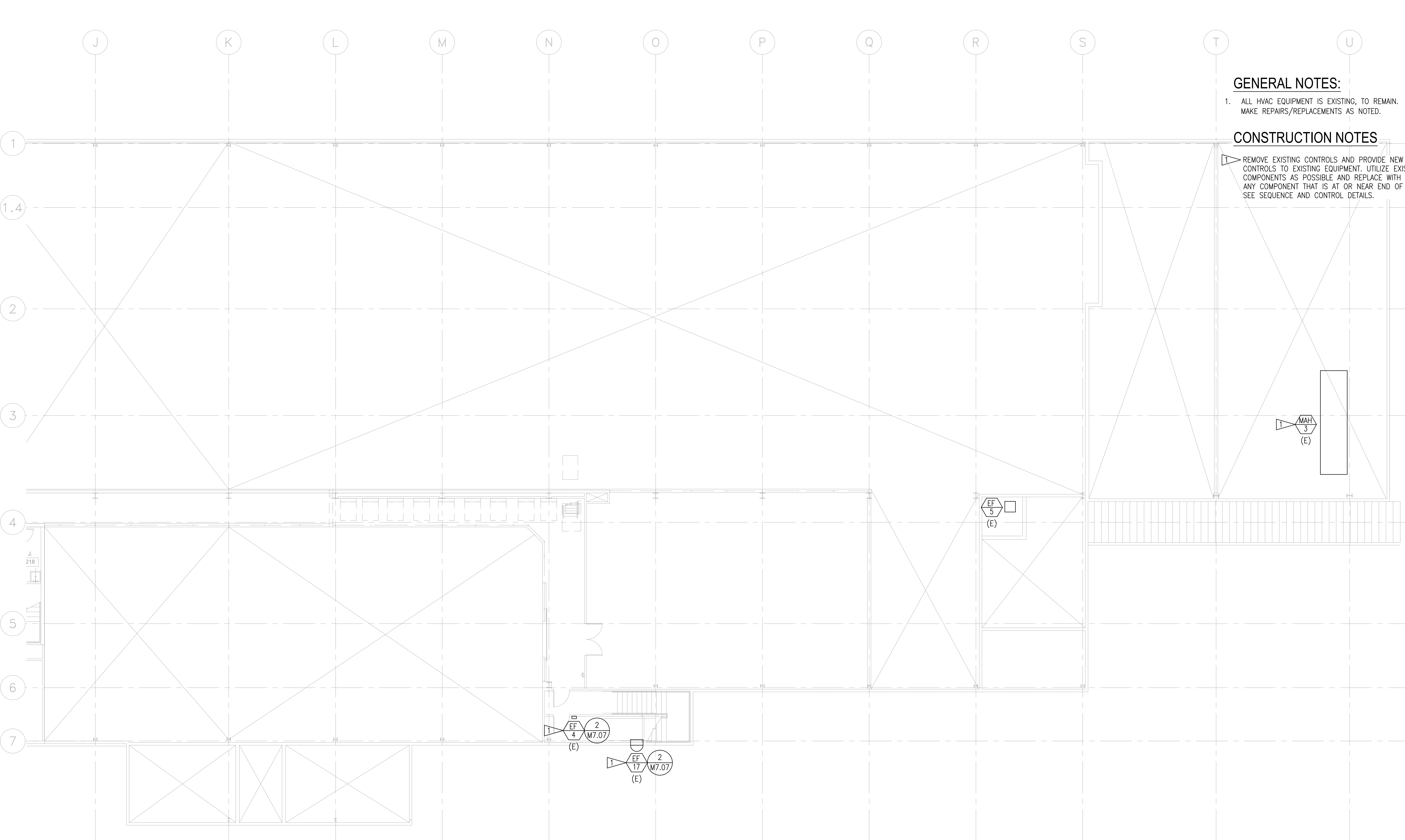
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SCALE:  $1/8" = 1'-0"$

8 6 4 2 0 8 16 24  
SCALE: 1/8" = 1'-0" FEET

WTA CONTACT PERSON: **DEVON DEBOER** PHONE #: **360-201-6440**

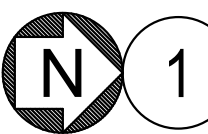


**GENERAL NOTES:**

1. ALL HVAC EQUIPMENT IS EXISTING, TO REMAIN. MAKE REPAIRS/REPLACEMENTS AS NOTED.

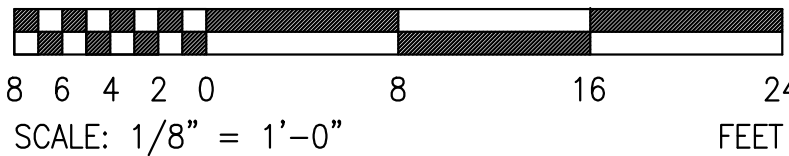
**CONSTRUCTION NOTES**

1. REMOVE EXISTING CONTROLS AND PROVIDE NEW CONTROLS TO EXISTING EQUIPMENT. UTILIZE EXISTING COMPONENTS AS POSSIBLE AND REPLACE WITH NEW ANY COMPONENT THAT IS AT OR NEAR END OF LIFE. SEE SEQUENCE AND CONTROL DETAILS.



**1 SECOND FLOOR EQUIPMENT PLAN - NORTH**

SCALE: 1/8"=1'-0"



**ISSUED FOR BID**

Date	No	Revision	By

DESIGNED BY: BAO  
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CHECKED BY: BAO



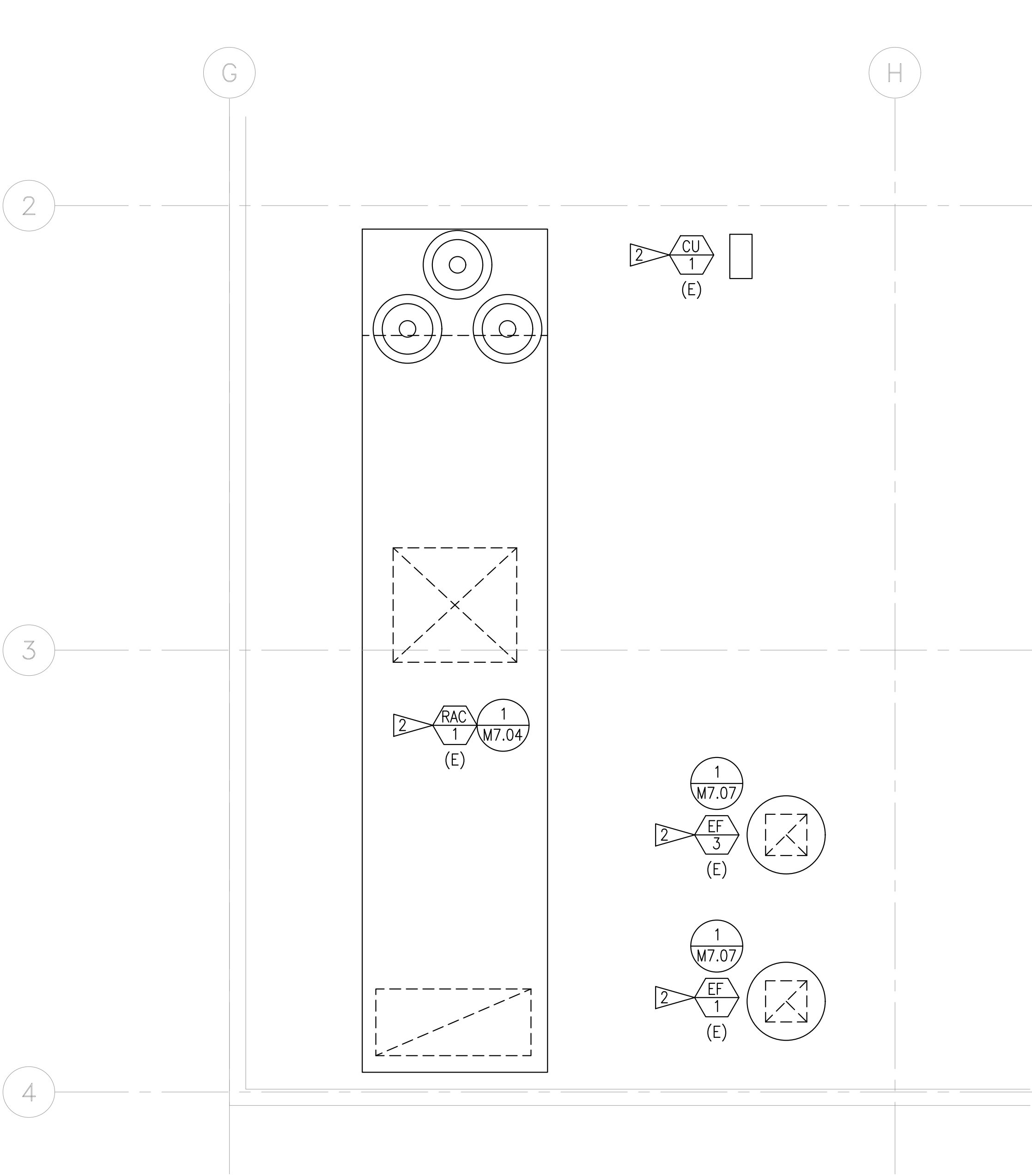
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BELLINGHAM, WASHINGTON



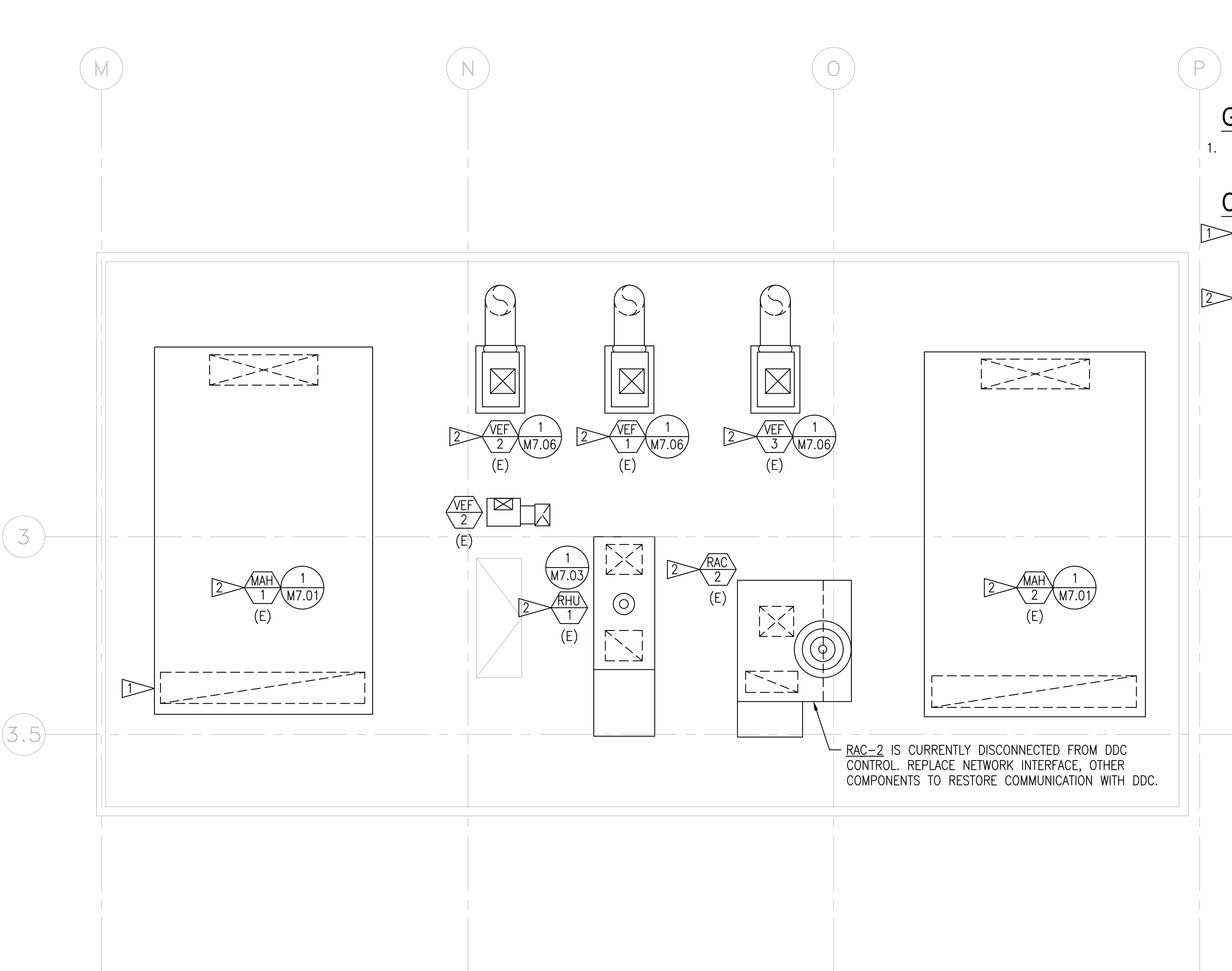
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CONSULTANT #:   
SUBMITTAL DATE: 10/16/2024

**WTA MOAB DDC UPGRADE**  
SECOND FLOOR EQUIPMENT PLAN - NORTH

DWG # M2.01N  
SHEET # 6 of 18



**1 PARTIAL ROOF EQUIPMENT PLAN**  
SCALE: 1/4"=1'-0"



**2 PARTIAL ROOF EQUIPMENT PLAN**  
SCALE: 1/4"=1'-0"

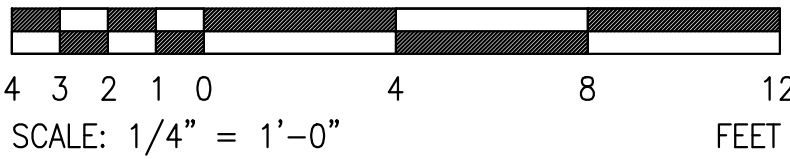
**GENERAL NOTES:**

1. ALL HVAC EQUIPMENT IS EXISTING, TO REMAIN. MAKE REPAIRS/REPLACEMENTS AS NOTED.

**CONSTRUCTION NOTES**

1. PROVIDE NEW EXHAUST FAN VFD TO ACHIEVE 1CFM/S.F. AT LOW SPEED (8000 CFM)
2. REMOVE EXISTING CONTROLS AND PROVIDE NEW CONTROLS TO EXISTING EQUIPMENT. UTILIZE EXISTING COMPONENTS AS POSSIBLE AND REPLACE WITH NEW ANY COMPONENT THAT IS AT OR NEAR END OF LIFE. SEE SEQUENCE AND CONTROL DETAILS.

RAC-2 IS CURRENTLY DISCONNECTED FROM DDC CONTROL. REPLACE NETWORK INTERFACE, OTHER COMPONENTS TO RESTORE COMMUNICATION WITH DDC.



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DRAWN BY: KH  
CHECKED BY: BAQ



**WHATCOM COUNTY  
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BELLINGHAM, WASHINGTON



WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #:  
SUBMITTAL DATE: 10/16/2024

WTA MOAB DDC UPGRADE  
PARTIAL ROOF EQUIPMENT PLAN

DWG # M3.01  
SHEET # 7 of 18



AIR HANDLING UNIT WITH HEAT RECOVERY SCHEDULE																								
CALLOUT		LOCATION	SERVICE					EXHAUST FAN [10]				HEAT RECOVERY			NATURAL GAS HEATING COIL			ELECTRICAL			OPERATING WEIGHT (LBS)	BASIS OF DESIGN		
TYPE	MARK			CFM	E.S.P. (IN WC) [2]	MOTOR		CFM	E.S.P. (IN WC) [2]	MOTOR		WINTER			INPUT MBH	OUTPUT MBH	GAS PRESSURE, (IN. W.C.)	V	HZ	ø		MANUFACTURER	NOTES	
						HP	BHP			HP	BHP	EAT (DEG F)	LAT (DEG F)	EFF										
MAH	1	ROOF	MAINT. BAY 1–6	14,000	1.0	20	14.8	14,000	¾	15	11.94	10	52.7	65%	875	700	14	460	60	3	14,500	ICE	[1], [3] [5]	
MAH	2	ROOF	MAINT. BAY 7–12, BRAKES, FARE, COMM	18,000	1.0	25	14.8	18,000	¾	15	11.94	10	52.7	65%	875	700	14	460	60	3	14,500	ICE	[1], [3] [4]	
MAH	3	ROOF	PAINT BAY 13	3200	1.0	5	14.8	3200	½	5	3.3	10	52.7	65%	220	176	14	460	60	3	5100	ICE	[1], [3]	

SCHEDULE NOTES:  
[1] DUCT SMOKE DETECTOR AT UNIT DISCHARGE  
[2] STATIC PRESSURE EXTERNAL TO UNIT  
[3] DDC CONTROL  
[4] WITH EXHAUST FAN VFD (E)  
[5] PROVIDE NEW EXHAUST FAN VFD TO ACHIEVE 1 CFM/S.F. AT LOW SPEED (8000 CFM)

PACKAGED AIR HANDLING UNIT SCHEDULE																										
CALLOUT		LOCATION	SERVICE					RETURN FAN		DX COOLING				GAS BURNER		FILTER		OPERATING WEIGHT (LBS)	ELECTRICAL					BASIS OF DESIGN		NOTES
TYPE	MARK			CFM [1]	MIN. OA CFM	E.S.P. (IN WC) [2]	MOTOR		CFM [1]	E.S.P. (IN WC) [2]	TOTAL CAPACITY (MBH)	MIN EFFICIENCY (EER)	EAT DB/WB	LAT DB/WB	INPUT MBH	OUTPUT MBH	TYPE		V	HZ	ø	FLA	MCA	MANUFACTURER	MODEL	
							HP	BHP																		
RHU	1	ROOF	PARTS STORAGE	1800	600	0.6	1	0.6	—	—				175	136.5	2"	750	208	60	1			REZNOR	HRGB-175		
RAC	1	ROOF	ADMIN WING	29,000		1.75	30		29,000	0.75	10.3	80.6/65	53.5/52.1	1631	1240	2" PRE-FILTER, 12" CARTRIDGE	18,000	460	60	3	182	192	AAON	RF-070	[3], [4]	
RAC	2	ROOF	SHOP OFFICES	600		0.65	3		—	—	83.5	10.7	78/65	57.5/56	90.0	72.9	2" DISPOSABLE	1400	460	60	3	18	21	AAON	RK-06	[4], [5]

SCHEDULE NOTES:  
[1] WITH UNIT AT MAXIMUM CONDITIONS.  
[2] STATIC PRESSURE EXTERNAL TO UNIT.  
[3] WITH SUPPLY, RETURN FAN VFDS (E)  
[4] WITH CONTACT–CLOSURE FOR REFRIGERATION LOCK–OUT (E)  
[5] NETWORK COMMUNICATION FOR THIS UNIT HAS FAILED. REPLACE NETWORK INTERFACE, OTHER COMPONENTS TO RESTORE DDC CONTROL

NATURAL GAS FURNACE SCHEDULE																			
CALLOUT		LOCATION	SERVICE	SUPPLY FAN		GAS BURNER		FILTE R	OPERATING WEIGHT (LBS)	ELECTRICAL				BASIS OF DESIGN		NOTES			
TYPE	MARK			CFM	E.S.P. (IN WC)	INPUT MBH	OUTPUT MBH	TYPE		V	HZ	ø	MCA	MANUFACTURER	MODEL				
F	1			FUEL WASH STORAGE	FUEL WASH STORAGE	1975	0.5	138		128	2"	250	115	60	1		18.8	CARRIER	58MXA 140-20

SCHEDULE NOTES:  
[1] STATIC PRESSURE EXTERNAL TO UNIT.

GAS-FIRED UNIT HEATER SCHEDULE											
CALLOUT			GAS BURNER		ELECTRICAL			OPERATING WEIGHT (LBS)	BASIS OF DESIGN		NOTES
TYPE	MARK		INPUT (BTUH)	EFFICIENCY	V	HZ	AMPS		MANUFACTURER	MODEL	
UH	1	WASHDOWN	100	80%	120	60	4	200	REZNOR	SCA-100	[1], [2], [3], [4]
UH	2	WASHDOWN	100	80%	120	60	4	200	REZNOR	SCA-100	[1], [2], [3], [4]
UH	3	LUBE RM.	100	80%	120	60	4	200	REZNOR	SCA-100	[1], [2], [3], [5]

SCHEDULE NOTES:  
[1] 24V T–STAT CONTROL  
[2] STAINLESS STEEL HEAT EXCHANGER  
[3] 2–STAGE GAS VALVE  
[4] VERTICAL VENT & INTAKE  
[5] HORIZONTAL VENT & INTAKE W/CONCENTRIC ADAPTER

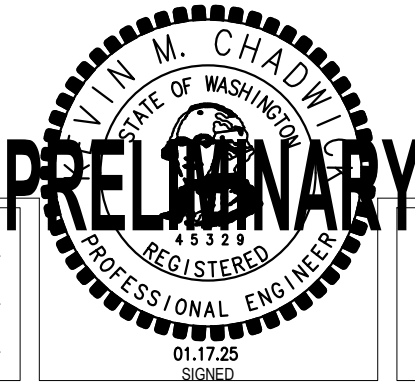
SPLIT SYSTEM UNIT SCHEDULE															
CALLOUT		LOCATION	AREA SERVED	RATED UNIT EFFICIENCY		INDOOR FAN	COOLING		ELECTRICAL				BASIS OF DESIGN		NOTES
TYPE	MARK			SEER	EER	CFM	NOMINAL CAPACITY (TONS)	TOTAL COOLING (BTUH)	V	HZ	ø	MCA	MANUFACTURER	MODEL	
FC	1	MIS	MIS	—	—	240	1	12,000					CARRIER	53QNB–40QNB–012	[1], [2]
CU	1	OUTSIDE	MIS	10.5	9.7	—	1	12,00	208	60	1	8.9	CARRIER	38AN012	[1], [2]

SCHEDULE NOTES:  
[1] MCA IS FOR FC–1 AND CU–1 COMBINED  
[2] AUXILIARY STATUS FOR DDC MONITORING/INTERLOCK

Date	No	Revision			By

WTA CONTACT PERSON: DEVON DEBOER PHONE #: 360-201-6440

DESIGNED BY: BAQ  
DRAWN BY: KH  
CHECKED BY: BAQ



WHATCOM COUNTY  
TRANSPORTATION AUTHORITY  
BELLINGHAM, WASHINGTON



WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #: \_\_\_\_\_  
SUBMITTAL DATE: 10/16/2024

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WTA MOAB DDC UPGRADE  
EQUIPMENT SCHEDULES

DWG # M5.01  
SHEET # 8 of 18



SERIES FAN POWERED VAV BOX SCHEDULE														
CALLOUT		LOCATION	SERVICE	CFM MIN.	CFM MAX.	CFM FAN	FAN HP	ESP (IN WC)	ELECTRICAL	REHEAT COIL	BRANCH DUCT DIAMETER (IN)	ELECTRICAL		
TYPE	MARK								HEATING CAPACITY (KW)	NO. OF STAGES		V	HZ	Ø
FPB	1-1	L1	DIR. OPS	210	600	600	1/4	0.35	4	3	8	277	60	1
FPB	1-2	L1	DISP.	275	750	750	1/3	0.35	5	3	10	277	60	1
FPB	1-3	L1	OFFICE	200	600	600	1/4	0.35	4	3	8	277	60	1
FPB	1-4	L1	MGR.	100	310	310	1/6	0.35	2	3	6	277	60	1
FPB	1-5	L1	TRAINING SUP.	100	250	250	1/6	0.35	2	3	6	277	60	1
FPB	1-6	L1	TRAINING	400	1000	1000	1/3	0.35	7	3	12	460	60	3
FPB	1-7	L1	CONF.	400	1000	1000	1/3	0.35	7	3	12	460	60	3
FPB	1-8	L1	LOBBY	360	1200	1200	1/3	0.35	5	3	12	277	60	1
FPB	1-9	L1	HR	250	800	800	1/3	0.35	5	3	10	277	60	1
FPB	1-10	L1	LOCKER ALCOVE	525	700	700	1/4	0.35	4	3	10	277	60	1
FPB	1-11	L1	MEN'S LOCKERS	750	750	750	1/3	0.35	5	3	10	277	60	1
FPB	1-12	L1	WOMEN'S LOCKERS	325	325	325	1/4	0.35	4	3	6	277	60	1
FPB	1-13	L1	OPS COORD	150	420	420	1/4	0.35	-	-	8	277	60	1
FPB	1-14	L1	CAFE	250	800	800	1/3	0.35	-	-	8	277	60	1
FPB	1-15	L1	OPS SUPS	270	600	600	1/3	0.35	-	-	8	277	60	1
FPB	1-16	L1	TEAM ROOM	720	2400	2400	3/4	0.35	-	-	16	277	60	1
FPB	1-17	L1	PT CSRS	220	700	700	1/3	0.35	-	-	10	277	60	1
FPB	1-18	L1	TRAINING	240	740	740	1/3	0.35	-	-	10	277	60	1
FPB	1-19	L1	TOILETS	480	480	480	1/4	0.35	-	-	8	277	60	1
FPB	1-20	L1	STORAGE	100	400	400	1/4	0.35	-	-	8	277	60	1
FPB	2-1	L2	MIS	200	550	550	1/4	0.35	4	3	8	277	60	1
FPB	2-2	L2	MIS CONSULTANT	220	600	600	1/3	0.35	4	3	8	460	60	3
FPB	2-3	L2	OFFICE	345	1150	1150	1/3	0.35	7	3	12	460	60	3
FPB	2-4	L2	OFFICE	320	1060	1060	1/3	0.35	6	3	12	460	60	3
FPB	2-5	L2	GEN. MGR.	210	700	700	1/4	0.35	4	3	10	277	60	1
FPB	2-6	L2	OFFICE	465	1550	1550	1/3	0.35	10	3	14	460	60	3
FPB	2-7	L2	CONFERENCE	400	1310	1310	1/3	0.35	8	3	14	460	60	3
FPB	2-8	L2	SEATING	270	750	750	1/3	0.35	5	3	10	277	60	1
FPB	2-9	L2	SMALL CONF.	330	1100	1100	1/3	0.35	5	3	12	277	60	1
FPB	2-10	L2	WORKROOM	230	775	775	1/3	0.35	4	3	10	277	60	1
FPB	2-11	L2	OFFICE	270	900	900	1/3	0.35	5	3	10	277	60	1
FPB	2-12	L2	PROCUREMENT	445	1485	1485	1/3	0.35	9	3	12	460	60	3
FPB	2-13	L2	BUYER/FILES	270	900	900	1/3	0.35	5	3	10	277	60	1
FPB	2-14	L2	CENTRAL FILES	275	900	900	1/3	0.35	5	3	10	277	60	1
FPB	2-15	L2	OFFICE	360	1200	1200	1/3	0.35	8	3	12	460	60	3
FPB	2-16	L2	RECEPTION	360	1200	1200	1/3	0.35	8	3	12	460	60	3
FPB	2-17	L2	OFFICE	250	760	760	1/3	0.35	4	3	10	277	60	1
FPB	2-18	L2	STORAGE/UTILITY	250	600	600	1/3	0.35	3	3	10	277	60	1
FPB	2-19	L3	ATTIC STORAGE	350	1400	1800	3/4	0.35	9	3	12	277	60	3

SCHEDULE NOTES:  
[1] REMOVE EXISTING DAMPER MOTOR, REPLACE WITH NEW.

GAS-FIRED INFRARED HEATER SCHEDULE											
CALLOUT		LOCATION	GAS BURNER	ELECTRICAL				OPERATING WEIGHT (LBS)	BASIS OF DESIGN		NOTES
TYPE	MARK		INPUT (BTUH)	V	HZ	Ø	AMPS		MANUFACTURER	MODEL	
IH	1	SHOP	40	120	60	1	3.0	125	SOLARONICS	STG-40-15A	[1], [2]
IH	2	SHOP	40	120	60	1	3.0	125	SOLARONICS	STG-40-15A	[1], [2]
IH	3	--	--	--	--		--	--	--	--	--
IH	4	SHOP	100	120	60	1	3.0	275	SOLARONICS	STG-100-35B	[1], [2]
IH	5	SHOP	180	120	60	1	3.0	385	SOLARONICS	STG-180-55C	[1], [2]
IH	6	SHOP	180	120	60	1	3.0	385	SOLARONICS	STG-180-55C	[1], [2]
IH	7	BRAKE SHOP	40	120	60	1	3.0	125	SOLARONICS	STG-40-10A	[1], [2]
IH	8	SHOP	40	120	60	1	3.0	125	SOLARONICS	STG-40-10A	[1], [2]

SCHEDULE NOTES:  
[1] DIRECT SPARK IGNITION  
[2] 12 FT. A.F.F.

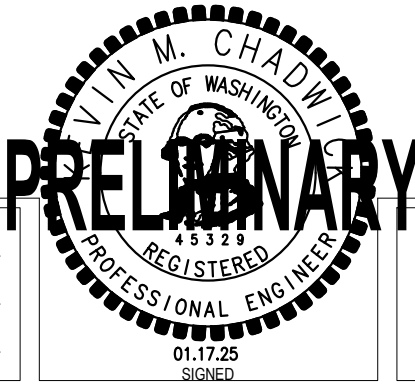
EXHAUST FAN SCHEDULE																
CALLOUT		LOCATION	FAN TYPE	SERVICE	FAN								BASIS OF DESIGN		NOTES	
TYPE	MARK				CFM	DRIVE TYPE	E.S.P (IN WC) [1]	MOTOR		ELECTRICAL			MANUFACTURER	MODEL		
								HP	BHP	V	HZ	ø				
EF	1	ROOF	UPBLAST	L1 SHOWER/TOILET EXHAUST	2300	BELT	0.55	1/2	0.40	460	60	3	GREENHECK	CUBE-200	[2]	
EF	2	L1 ELEC. RM.	INLINE CENTRIFUGAL	L1 TOILET EXHAUST	740	BELT	0.75	1/2	0.30	120	60	1	GREENHECK	BSQ-900	[2]	
EF	3	ROOF	INLINE CENTRIFUGAL	L2 TOILET EXHAUST	500	BELT	0.375	1/4	0.07	120	60	1	GREENHECK	CUBE-95	[2]	
EF	4	ELEV. MACHINE RM.	CEILING	MACHINE RM. COOLING	225	DIRECT	0.25	120W	120W	120	60	1	GREENHECK	SP-224	[3]	
EF	5	SHOP TOILET	INLINE CENTRIFUGAL	SHOP TOILET	200	DIRECT	0.25	1/30	0.03	120	60	1	GREENHECK	SQ-80	[6]	
EF	6	BATTERY RM.	UTILITY BLOWER	H2 GAS REMOVAL	500	BELT	0.50	1/4	0.10	120	60	1	GREENHECK	SFB-9	[4]	
EF	7	LUBE/COMP. RM.	INLINE CENTRIFUGAL	VENT	400	DIRECT	0.25	1/15	0.02	120	60	1	GREENHECK	SQ-80D-CW-90	[5]	
EF	8	FUEL/WASH LUBE/COMP.	INLINE CENTRIFUGAL	VENT	400	DIRECT	0.25	1/15	0.02	120	60	1	GREENHECK	SQ-80D-CW-90	[5]	
EF	9	FUEL/WASH TOILET	UPBLAST	TOILET	120	DIRECT	0.25	1/30	0.022	120	60	1	GREENHECK	CW-70	[6]	
EF	10	FUEL/WASH	UPBLAST	RECLAIM RM.	270	DIRECT	0.25	1/20	0.025	120	60	1	GREENHECK	CW-75	[5]	
EF	11	FUEL WASH CTRL. RM.	UPBLAST	FUEL/WASH CONTROL RM.	200	DIRECT	0.375	1/30	0.04	120	60	1	GREENHECK	CW-85	[3]	
EF	12	L2 JAN.	CEILING	L2 JAN. RM.	120	DIRECT	0.375	120W	0.012	120	60	1	GREENHECK	SP-224	[5]	
EF	13	JAN. RM.	CEILING	JAN. RM.	200	DIRECT	0.375	81W	0.028	120	60	1	GREENHECK	SP-226	[5]	
EF	14	FUEL/WASH STORAGE	UPBLAST	FUEL/WASH STORAGE	200	DIRECT	0.375	1/30	0.04	120	60	1	GREENHECK	CW-85	[5]	
EF	15	FUEL/WASH	UPBLAST	ELEC. RM.	400	DIRECT	0.25	1/20	0.035	120	60	1	GREENHECK	CW-90	[3]	
EF	16	ELEC. SERVICE RM.	UPBLAST	ELEC. SERVICE RM.	700	DIRECT	0.25	1/8	0.095	120	60	1	GREENHECK	CW-95	[3]	
EF	17	ELEC. RM. WALL	UPBLAST	ELEC. RM.	400	DIRECT	0.25	1/25	0.035	120	60	1	GREENHECK	CW-90	[3]	
VEF	1	ROOF	EXTRACTOR	VEHICLE EXHAUST	900		4.20	3		460	60	3	NEDERMAN	RBE-7	[7]	
VEF	2	ROOF	EXTRACTOR	VEHICLE EXHAUST	1800		3.00	2		460	60	3	NEDERMAN	HDBI-160	[7]	
VEF	3	ROOF	EXTRACTOR	VEHICLE EXHAUST	2400		3.00	3		460	60	3	NEDERMAN	HDBI-180	[7]	

SCHEDULE NOTES:  
[1] STATIC PRESSURE EXTERNAL TO FAN.  
[2] DDC CONTROL  
[3] THERMOSTATIC CONTROL  
[4] FAN SHALL OPERATE UPON SIGNAL FROM H2 GAS DETECTION SYSTEM OR WALL SWITCH ACTIVATION  
[5] WALL SWITCH  
[6] FAN INTERLOCKED TO OPERATE WHEN ROOM LIGHT IS ON  
[7] FAN CONTROLLED BY MANUFACTURER'S PENDANT SWITCH, ACTIVATED THROUGH DDC INTERLOCK WITH HOSE REEL.

Date	No	Revision	By	

WTA CONTACT PERSON: DEVON DEBOER PHONE #: 360-201-6440

DESIGNED BY: BAQ  
DRAWN BY: KH  
CHECKED BY: BAQ



WHATCOM COUNTY  
TRANSPORTATION AUTHORITY  
BELLINGHAM, WASHINGTON



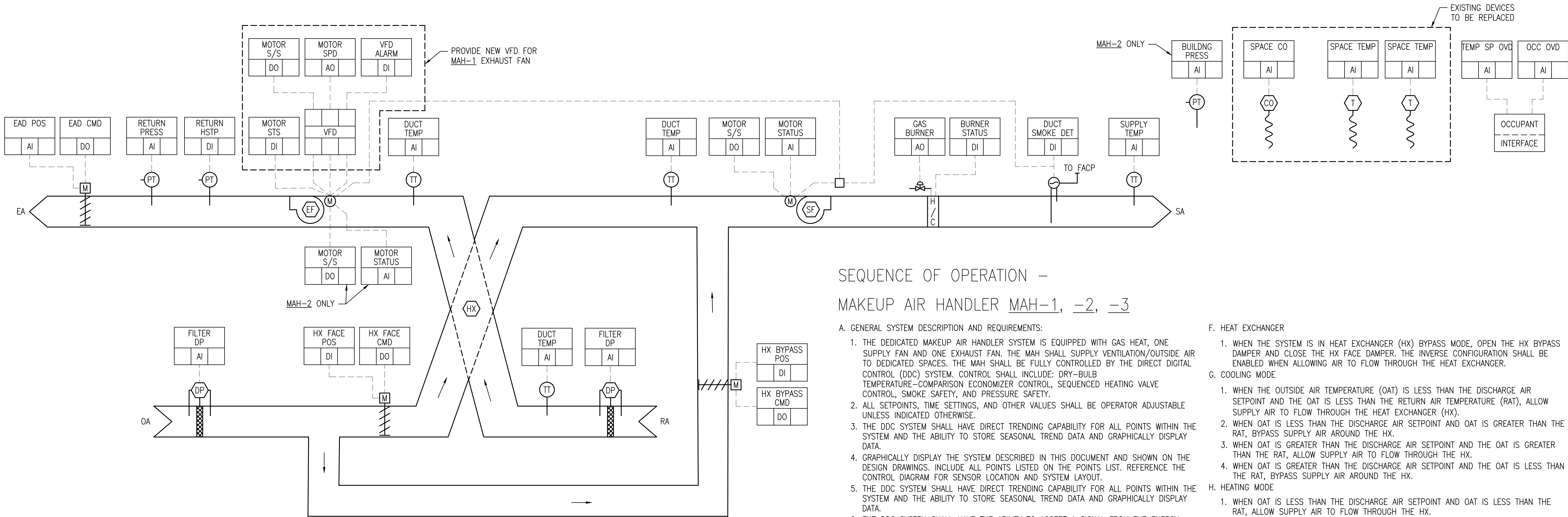
WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #: \_\_\_\_\_  
SUBMITTAL DATE: 10/16/2024

ISSUED FOR BID

WTA MOAB DDC UPGRADE  
EQUIPMENT SCHEDULES

DWG # M5.02  
SHEET # 9 of 18





1 CONTROL DIAGRAM - MAH-1, 2, 3  
SCALE: NONE

SYSTEM NAME: MAKE-UP AIR HANDLER CONTROL							
DESCRIPTION:	DIGITAL	DIGITAL	ANALOG	ANALOG	VIRTUAL	ALARMS	NOTES
MAH-1, MAH-2, MAH-3							
EXHAUST AIR DAMPER POSITION	1		1				
FACE DAMPER POSITION	1	1					
BYPASS DAMPER POSITION	1	1					
EXHAUST FILTER STATUS (DIFF. PRESSURE SENSOR)				1			
SUPPLY FILTER STATUS (DIFF. PRESSURE SENSOR)				1			
GAS BURNER		1	1				
SUPPLY FAN ENABLE	1						
SUPPLY FAN STATUS				1			
DUCT SMOKE DETECTOR		1					
SUPPLY AIR TEMPERATURE				1			
OUTSIDE AIR TEMPERATURE					1		GLOBAL/FACILITY
EXHAUST TEMP. (PRE-H/X)				1			
EXHAUST TEMP. (POST H/X)				1			
SUPPLY TEMP. (POST H/X)				1			
ROOM TEMPERATURE				2			
CO SENSOR				1			QTY BASED ON SQ.FT.
BUILDING STATIC PRESSURE SENSOR				1			MAH-2 ONLY
EXHAUST FAN VFD CONTROL	1	2	1				MAH-1, MAH-2
EXHAUST FAN ENABLE	1						MAH-3 ONLY
EXHAUST FAN STATUS				1			MAH-3 ONLY
GLOBAL SCHEDULE					1		OCCUPIED/UNOCCUPIED
TOTAL NUMBER OF POINTS:	5	6	3	11			
GRAND TOTAL NUMBER OF POINTS:				79			VERIFY CO SENSOR COUNT

SEQUENCE OF OPERATION –  
MAKEUP AIR HANDLER MAH-1, -2, -3

A. GENERAL SYSTEM DESCRIPTION AND REQUIREMENTS:

1. THE DEDICATED MAKEUP AIR HANDLER SYSTEM IS EQUIPPED WITH GAS HEAT, ONE SUPPLY FAN AND ONE EXHAUST FAN. THE MAH SHALL SUPPLY VENTILATION/OUTSIDE AIR TO DEDICATED SPACES. THE MAH SHALL BE FULLY CONTROLLED BY THE DIRECT DIGITAL CONTROL (DDC) SYSTEM. CONTROL SHALL INCLUDE: DRY-BULB TEMPERATURE-COMPARISON ECONOMIZER CONTROL, SEQUENCED HEATING VALVE CONTROL, SMOKE SAFETY, AND PRESSURE SAFETY.
2. ALL SETPOINTS, TIME SETTINGS, AND OTHER VALUES SHALL BE OPERATOR ADJUSTABLE UNLESS INDICATED OTHERWISE.
3. THE DDC SYSTEM SHALL HAVE DIRECT TRENDING CAPABILITY FOR ALL POINTS WITHIN THE SYSTEM AND THE ABILITY TO STORE SEASONAL TREND DATA AND GRAPHICALLY DISPLAY DATA.
4. GRAPHICALLY DISPLAY THE SYSTEM DESCRIBED IN THIS DOCUMENT AND SHOWN ON THE DESIGN DRAWINGS. INCLUDE ALL POINTS LISTED ON THE POINTS LIST. REFERENCE THE CONTROL DIAGRAM FOR SENSOR LOCATION AND SYSTEM LAYOUT.
5. THE DDC SYSTEM SHALL HAVE DIRECT TRENDING CAPABILITY FOR ALL POINTS WITHIN THE SYSTEM AND THE ABILITY TO STORE SEASONAL TREND DATA AND GRAPHICALLY DISPLAY DATA.
6. THE DDC SYSTEM SHALL HAVE THE ABILITY TO ACCEPT A SIGNAL FROM THE ENERGY UTILITY(S) AND IMPLEMENT DEMAND RESPONSE SEQUENCES TO LIMIT ELECTRICAL DEMAND. THE DDC SYSTEM SHALL HAVE A PRIORITY OF ACTIONS AND SHALL INCLUDE TEMPERATURE RESET, SELECT EQUIPMENT SHUTDOWN, AND COMMUNICATION WITH THE LIGHTING SYSTEM TO LIMIT DEMAND.
7. ROOM TEMPERATURE SETPOINTS SHALL BE 68°F HEATING, 75°F COOLING, UNLESS OTHERWISE NOTED. IN ROOMS WITH MULTIPLE ZONES, A 5-DEGREE MINIMUM DEADBAND SHALL BE MAINTAINED IN AND BETWEEN ALL ZONES. THERMOSTATS SERVING MULTIPLE ZONES SHALL LOCK OUT TEMPERATURE CHANGES WITHIN THE DEADBAND.

B. MAH START/STOP

1. THE DDC SYSTEM SHALL START/STOP EACH MAH ON ITS OWN "OCCUPIED/UNOCCUPIED" SCHEDULE OR IF A SPACE BECOMES OCCUPIED DURING UNOCCUPIED HOURS (OCCURS WHEN A TERMINAL UNIT THERMOSTAT'S OCCUPIED BUTTON IS DEPRESSED). THE MAH SUPPLY AND RETURN/EXHAUST FAN SHALL START AFTER EXHAUST AND ZONE DAMPERS ARE PROVEN OPEN BY DAMPER END SENSORS. PROOF OF FAN RUN STATUS SHALL BE MONITORED BY A CURRENT SENSOR, UNLESS NOTED OTHERWISE. ANY ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO START. WHEN THE UNIT IS STOPPED (NORMAL OR OTHERWISE), THE ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO STOP.
2. WHEN AN MAH IS STOPPED, ITS OUTSIDE AIR AND EXHAUST AIR DAMPER SHALL CLOSE, AFTER THE FANS COME TO A STOP AS PROVEN BY THE FAN'S CURRENT SENSOR. WHEN THE UNIT IS STOPPED, HEATING COIL VALVES SHALL CLOSE TO THE GAS BURNER.

C. VARIABLE SPEED DRIVE (VFD) FAN MOTOR CONTROL

1. THE CONTROLLER SHALL MODULATE THE EXHAUST FAN SPEED TO MAINTAIN BUILDING STATIC PRESSURE (THE AIR BALANCER SHALL DETERMINE THE STATIC PRESSURE SETPOINT REQUIRED TO MAINTAIN THE SCHEDULED CFM).

D. TEMPERATURE CONTROL

1. DISCHARGE TEMPERATURE CONTROL: THE DISCHARGE TEMPERATURE SET POINT SHALL ADHERE TO THE FOLLOWING RESET SCHEDULE:

OUTSIDE AIR TEMPERATURE	DISCHARGE TEMPERATURE SETPOINT
65°F	55°F
75°F	50°F

OUTSIDE AIR TEMPERATURE DISCHARGE TEMPERATURE SETPOINT65°F55°F75°F50°F

E. HEATING SECTION

1. HEATING GAS VALVE: WHENEVER MAH IS ENERGIZED, THE GAS HEATING COIL VALVE SHALL MODULATE PER THE HIGHER OF A DISCHARGE AIR PROPORTIONAL-INTEGRAL-DERIVATIVE (PID) LOOP TO MAINTAIN THE DISCHARGE AIR TEMPERATURE AND 2) A PROPORTIONAL-ONLY LOOP MAINTAINING A LOW LIMIT OF 45°F LEAVING THE HEATING COIL.

F. HEAT EXCHANGER

1. WHEN THE SYSTEM IS IN HEAT EXCHANGER (HX) BYPASS MODE, OPEN THE HX BYPASS DAMPER AND CLOSE THE HX FACE DAMPER. THE INVERSE CONFIGURATION SHALL BE ENABLED WHEN ALLOWING AIR TO FLOW THROUGH THE HEAT EXCHANGER.

G. COOLING MODE

1. WHEN THE OUTSIDE AIR TEMPERATURE (OAT) IS LESS THAN THE DISCHARGE AIR SETPOINT AND THE OAT IS LESS THAN THE RETURN AIR TEMPERATURE (RAT), ALLOW SUPPLY AIR TO FLOW THROUGH THE HEAT EXCHANGER (HX).
2. WHEN OAT IS LESS THAN THE DISCHARGE AIR SETPOINT AND OAT IS GREATER THAN THE RAT, BYPASS SUPPLY AIR AROUND THE HX.
3. WHEN OAT IS GREATER THAN THE DISCHARGE AIR SETPOINT AND THE OAT IS GREATER THAN THE RAT, ALLOW SUPPLY AIR TO FLOW THROUGH THE HX.
4. WHEN OAT IS GREATER THAN THE DISCHARGE AIR SETPOINT AND THE OAT IS LESS THAN THE RAT, BYPASS SUPPLY AIR AROUND THE HX.

H. HEATING MODE

1. WHEN OAT IS LESS THAN THE DISCHARGE AIR SETPOINT AND OAT IS LESS THAN THE RAT, ALLOW SUPPLY AIR TO FLOW THROUGH THE HX.
2. WHEN OAT IS LESS THAN THE DISCHARGE AIR SETPOINT AND THE OAT IS GREATER THAN THE RAT, BYPASS HX.
3. WHEN OAT IS GREATER THAN THE DISCHARGE AIR SETPOINT AND THE OAT IS GREATER THAN THE RAT, ALLOW SUPPLY AIR TO FLOW THROUGH THE HX.
4. WHEN THE OAT IS GREATER THAN THE DISCHARGE AIR SETPOINT AND THE OAT IS LESS THAN THE RAT, BYPASS SUPPLY AIR AROUND THE HX.

I. SAFETIES AND ALARMS

1. ANNUNCIATE ALARMS AT THE DDC SYSTEM'S FRONT-END COMPUTER WHEN ANY OF THE FOLLOWING EVENTS OCCUR. CREATE SEPARATE POINTS FOR EACH ALARM LISTED BELOW.

J. SMOKE DETECTORS

1. UPON INDICATION OF SMOKE BY A SMOKE DETECTOR, DDC SYSTEM SHALL DE-ENERGIZE THE MAH. SMOKE DETECTOR SHALL NOTIFY THE FIRE ALARM SYSTEM AND SHUT DOWN THE FANS VIA HARD-WIRED INTERLOCK. ALL DAMPERS AND VALVES SHALL RETURN TO THEIR NORMAL POSITIONS INDICATED. SMOKE DETECTORS SHALL REQUIRE MANUAL RESET.

K. HIGH/LOW PRESSURE SAFETY

1. UPON ACTIVATION OF THE HIGH/LOW PRESSURE SAFETY SWITCH, MAH SHALL BE DE-ENERGIZED, FANS SHALL BE DE-ENERGIZED VIA A HARD-WIRED INTERLOCK, AND AN INDICATION OF THE OPERATION SHALL BE SENSED BY THE DDC SYSTEM. DDC SYSTEM SHALL ANNUNCIATE APPROPRIATE ALARM AND REMOVE AND LOCK OUT THE START COMMAND, WHICH SHALL INITIATE "FAN FAILURE" ALARMS. PRESSURE SAFETY SWITCHES SHALL REQUIRE MANUAL RESET.

L. AIR FILTERS

1. THE DDC PANEL SHALL MONITOR THE DIFFERENTIAL PRESSURE SWITCH ACROSS SPECIFIED FILTERS AND SHALL PROVIDE AN ALARM WHEN THE PRESSURE DROP EXCEEDS THE SETPOINT.

M. VFD (IF EQUIPPED)

1. OBTAIN ALARM HARDWARE/NETWORK FROM VFD.

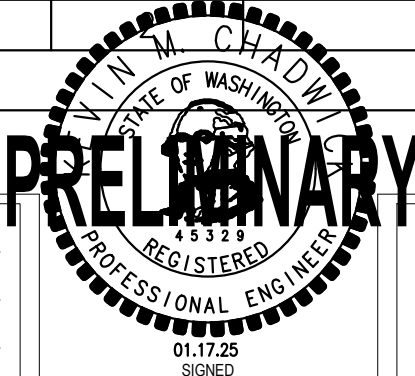
N. FAN FAILURE

1. ALARM WHEN CONTROLLER SENDS START OR STOP SIGNAL TO FAN AND THERE IS NO PROOF OF STATUS ALIGNMENT FOR 1-MINUTE (ADJ.).
2. END OF SEQUENCE OF OPERATIONS

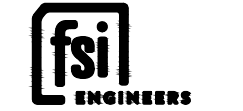
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DRAWN BY: KH  
CHECKED BY: BAQ



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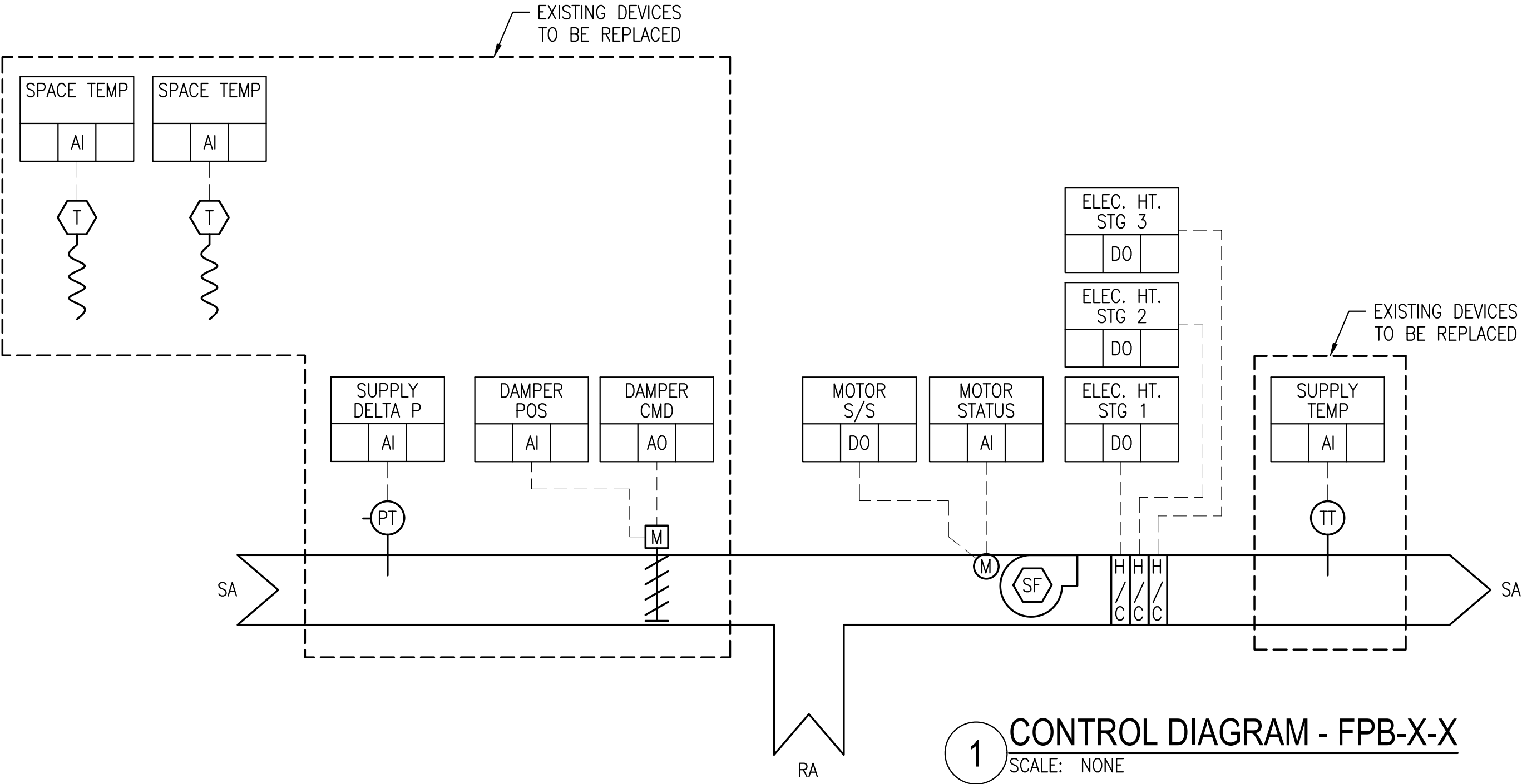


WTA PROJECT #: 2023-046 FRQ  
CONSULTANT #:   
SUBMITTAL DATE: 10/16/2024

WTA MOAB DDC UPGRADE  
CONTROL DIAGRAM & POINTS LIST

DWG # M7.01  
SHEET # 10 of 18





SYSTEM NAME: FAN-POWERED BOX CONTROL						
DESCRIPTION:	DIGITAL	DIGITAL	ANALOG	ANALOG	ALARMS	NOTES
FPB-1-1 THROUGH FPB-2-16 (39 UNITS)	OUTPUTS	INPUTS	OUTPUTS	INPUTS	(DI)	
SUPPLY DELTA P			1			
DAMPER POSITION			1	1		
ELECTRIC STRIP HEAT (STG. 1, STG. 2, STG. 3)	3					NO HEAT, UNITS FPB-1-13 THROUGH -20
SUPPLY FAN ENABLE	1					
SUPPLY FAN STATUS				1		
SUPPLY AIR TEMPERATURE				1		
SUPPLY DIFF. PRESSURE				1		
ROOM TEMPERATURE				2		
TOTAL NUMBER OF POINTS:	4		2	6		
GRAND TOTAL NUMBER OF POINTS (EA):			12			
GRAND TOTAL NUMBER OF POINTS:			444			

SEQUENCE OF OPERATION –  
SINGLE-DUCT FAN-POWERED BOX

GENERAL SYSTEM DESCRIPTION AND REQUIREMENTS

THE STANDARD SERIES FAN POWERED VAV BOX IS EQUIPPED WITH 3-STAGE ELECTRIC HEAT (TYP. (38) UNITS. (8) UNITS WITHOUT ELECTRIC HEAT) AND ONE (1) FAN.

ALL SETPOINTS, TIME SETTINGS AND OTHER VALUES SHALL BE OPERATOR ADJUSTABLE UNLESS INDICATED OTHERWISE.

THE DDC SYSTEM SHALL HAVE DIRECT TRENDING CAPABILITY FOR ALL POINTS WITHIN THE SYSTEM AND THE ABILITY TO STORE SEASONAL TREND DATA AND GRAPHICALLY DISPLAY DATA.

GRAPHICALLY DISPLAY THE SYSTEM DESCRIBED IN THIS DOCUMENT AND SHOWN ON THE DESIGN DRAWINGS. INCLUDE ALL POINTS LISTED ON THE POINTS LIST. REFERENCE THE CONTROL DIAGRAM FOR SENSOR LOCATION AND SYSTEM LAYOUT.

RUN MODE

WHEN THE DDC SYSTEM ENABLES THE VAV SYSTEM THE VAV TERMINAL UNITS SHALL STROKE THE VAV DAMPERS TO 50% (ADJ.), AFTER ONE (1) MINUTE DELAY ENABLE THE SERIES FAN. VAV DAMPERS MUST BE OPEN BEFORE ENABLING VAV AHU (SEE AHU START SEQUENCE).

OFF MODE

WHEN THE DDC SYSTEM INDEXES A VAV TERMINAL UNIT TO "OFF MODE". THE TERMINAL UNIT CONTROLLER SHALL SHUT THE FAN DOWN. AFTER A ONE (1) MINUTE DELAY THE VAV DAMPER SHALL CLOSE. THE DDC SYSTEM SHALL RECEIVE PROOF OF AHU SHUTDOWN BEFORE INDEXING VAV TERMINAL UNITS TO OFF-MODE.

TEMPERATURE CONTROL

EACH SPACE TEMPERATURE SENSOR SHALL RESET THE BOX DISCHARGE TEMPERATURE TO MAINTAIN THE INDIVIDUAL SPACE SET POINT PER THE FOLLOWING SCHEDULE:

SPACE TEMPERATURE (°F)	SYSTEM RESPONSE	SYSTEM STATUS
65	MAX DAMPER/MINIMUM VALVE	FULL COOLING
75	–	HIGH DEADBAND LIMIT. ENABLE COOLING MODE
72	MAINTAIN EXISTING	SETPOINT ACHIEVED. MAINTAIN POSITION.
71	+	LOW DEADBAND LIMIT. ENABLE HEATING MODE
70	MINIMUM DAMPER/MAX VALVE.	FULL HEATING

SPACE TEMPERATURE (°F)SYSTEM RESPONSE SYSTEM STATUS75MAX DAMPER/MINIMUM VALVE FULL COOLING73-HIGH DEADBAND LIMIT. ENABLE COOLING MODE72MAINTAIN EXISTING SETPOINT ACHIEVED. MAINTAIN POSITION.71+LOW DEADBAND LIMIT. ENABLE HEATING MODE70MINIMUM DAMPER/MAX VALVE.FULL HEATING

WHEN THE CALL FOR COOLING INCREASES, THE DDC SYSTEM SHALL OPEN THE VAV BOX PRIMARY AIR DAMPER. AS THE CALL FOR COOLING DROPS, THE DDC SHALL CLOSE THE VAV BOX PRIMARY AIR DAMPER. AS THE PRIMARY AIR DAMPER REACHES ITS MINIMUM SETTING AND THERE IS A CONTINUED DROP IN TEMPERATURE (A CALL FOR HEATING), THE DDC SYSTEM SHALL ENGAGE THE TERMINAL ELECTRIC HEATING COIL STAGES, IF PRESENT AS NECESSARY TO MAINTAIN THE SPACE TEMPERATURE SETPOINT.

ROOM SENSOR WITH OCCUPANCY OVERRIDE AND TEMPERATURE ADJUSTMENT

OVERRIDE SWITCH ON ASSOCIATED THERMOSTAT SHALL ALLOW THE ZONE TO BECOME OCCUPIED FOR 3 HOURS (ADJ.). THE OVERRIDE SWITCH WILL ENABLE THE ASSOCIATED ZONE VAV TERMINAL UNITS, AND THE VAV AHU SHALL START IN OCCUPIED MODE.

THE TEMPERATURE OVERRIDE SHALL ALLOW SPACE TEMPERATURE ADJUSTMENTS TO INCREASE/DECREASE BY THE DDC SYSTEM SETPOINT BY ±3°F.

WHEN THE ZONE TEMPERATURE SETPOINT OF A ZONE IS INCREASED AT THE SPACE SENSOR, THE ADJACENT OPEN ZONE (NO WALL) MUST NOT ALLOW ADDITIONAL MECHANICAL COOLING (ONLY ALLOW DAMPER MODULATION) UNTIL THE ADJACENT ZONE IS 5°F ABOVE SETPOINT.

WHEN THE ZONE TEMPERATURE SETPOINT OF A ZONE IS DECREASED AT THE SPACE SENSOR, THE ADJACENT OPEN ZONE (NO WALL) MUST NOT ALLOW ADDITIONAL MECHANICAL HEATING (ONLY ALLOW DAMPER MODULATION) UNTIL THE ADJACENT ZONE IS 5°F ABOVE SETPOINT.

RESET ALL OVERRIDDEN SETPOINTS WHEN THE SYSTEMS TOGGLES FROM OCCUPIED MODE TO UNOCCUPIED MODE.

DEMAND CONTROL

THE DDC SYSTEM SHALL HAVE THE CAPABILITY OF ADJUSTING SETPOINTS TO REDUCE DEMAND PER THE UTILITY COMPANIES DEMAND PERIOD.

DIAGNOSTIC FAULTS AND ALARMS

ANNUNCIATE ALARMS AT THE DDC SYSTEM'S FRONT-END COMPUTER WHEN ANY OF THE FOLLOWING EVENTS OCCUR. CREATE SEPARATE POINTS FOR EACH ALARM LISTED BELOW.

- 1) LOW AIRFLOW: WHEN THE VAV TERMINAL UNIT AIRFLOW IS LESS THAN 50% OF SETPOINT FOR FIVE (5) MINUTES.
- 2) AIRFLOW SENSOR CALIBRATION: WHEN AIRFLOW SENSOR INDICATES A VALUE OTHER THAN ZERO WHEN THE AHU IS OFF.
- 3) LOW DISCHARGE TEMPERATURE: WHEN THE HEATING IS 100% ENABLED BUT THE DISCHARGE VAV TEMPERATURE IS BELOW SETPOINT.
- 4) FAN FAILURE: WHEN THE PARALLEL OR SERIES FAN IS ENABLED BUT THERE IS NO FAN STATUS FEEDBACK OR THERE IS NO FLOW FEEDBACK FROM THE PARALLEL FAN FLOW SENSOR.
- 5) ZONE TEMPERATURE ALARM: WHEN THE SPACE TEMPERATURE CONNECTED TO THE ASSOCIATED VAV TERMINAL UNIT IS ±3°F OF SETPOINT. WHEN THE SPACE SETPOINT CHANGES, ALLOW A 30-MINUTE PERIOD TO ALLOW SYSTEM TO STABILIZE BEFORE EVALUATING THE PARAMETER FOR AN ALARM CONDITION.

Date	No	Revision	By	

DESIGNED BY: BAQ  
DRAWN BY: KH  
CHECKED BY: BAQ



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BELLINGHAM, WASHINGTON

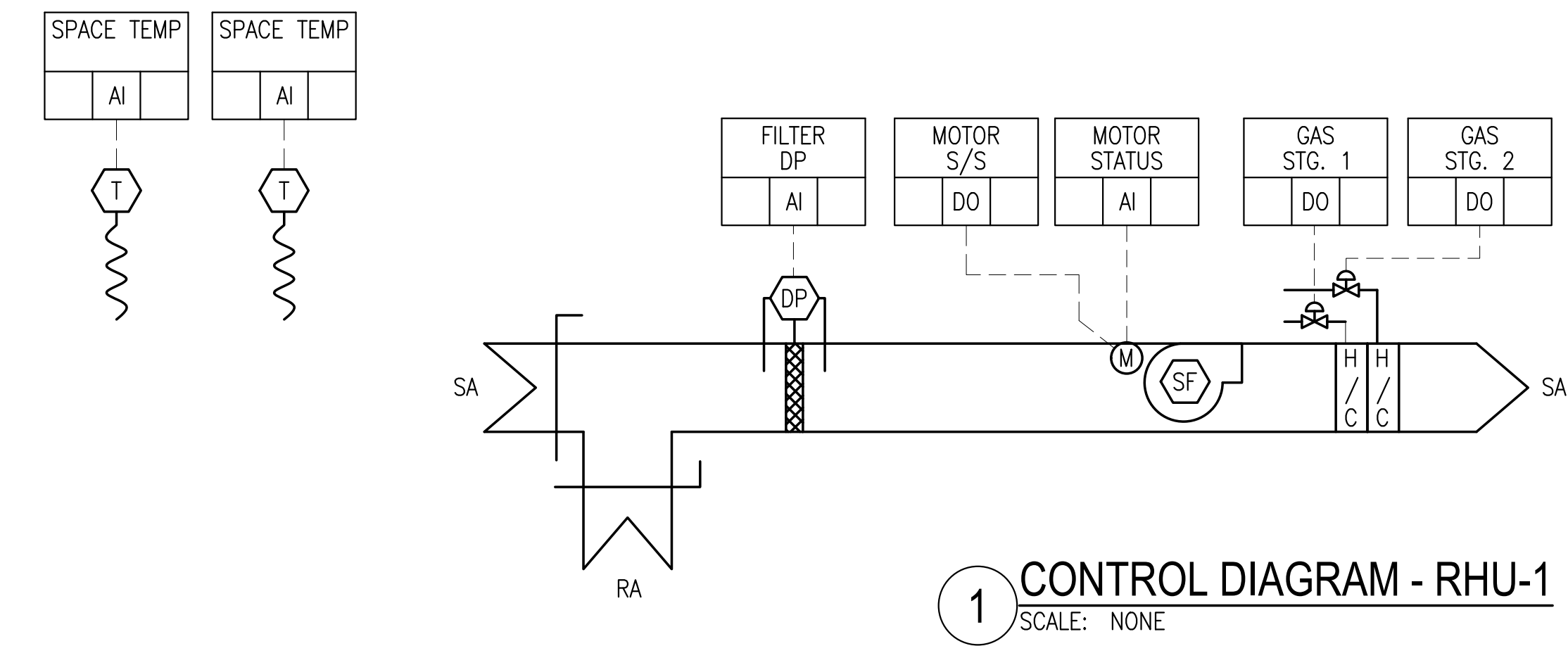


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WTA MOAB DDC UPGRADE  
CONTROL DIAGRAM & POINTS LIST

DWG # M7.02  
SHEET # 11 of 18



1 CONTROL DIAGRAM - RHU-1  
SCALE: NONE

SYSTEM NAME: HEATING UNIT CONTROL						
DESCRIPTION: RHU-1	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS (DI)	NOTES
FILTER STATUS (DIFF. PRESSURE SENSOR)				1		
BURNER (STG. 1, STG. 2)	2					
SUPPLY FAN ENABLE	1					
SUPPLY FAN STATUS				1		
ROOM TEMPERATURE				2		
TOTAL NUMBER OF POINTS:	3			4		
GRAND TOTAL NUMBER OF POINTS:			7			

SEQUENCE OF OPERATION –  
ROOFTOP HEATING UNIT RHU-1

A. GENERAL SYSTEM DESCRIPTION AND REQUIREMENTS:

1. THE AIR HANDLING UNIT (AHU) IS EQUIPPED WITH GAS HEAT AND ONE SUPPLY FAN. THE AHU SHALL BE FULLY CONTROLLED BY THE DIRECT DIGITAL CONTROL (DDC) SYSTEM.
2. CONTROL SHALL INCLUDE: SEQUENCED HEATING VALVE CONTROL.
3. ALL SETPOINTS, TIME SETTINGS, AND OTHER VALUES SHALL BE OPERATOR ADJUSTABLE UNLESS INDICATED OTHERWISE.
4. THE DDC SYSTEM SHALL HAVE DIRECT TRENDING CAPABILITY FOR ALL POINTS WITHIN THE SYSTEM AND THE ABILITY TO STORE SEASONAL TREND DATA AND GRAPHICALLY DISPLAY DATA.
5. GRAPHICALLY DISPLAY THE SYSTEM DESCRIBED IN THIS DOCUMENT AND SHOWN ON THE DESIGN DRAWINGS. INCLUDE ALL POINTS LISTED ON THE POINTS LIST. REFERENCE THE CONTROL DIAGRAM FOR SENSOR LOCATION AND SYSTEM LAYOUT.
6. THE DDC SYSTEM SHALL HAVE THE ABILITY TO ACCEPT A SIGNAL FROM THE ENERGY UTILITY(S) AND IMPLEMENT DEMAND RESPONSE SEQUENCES TO LIMIT ELECTRICAL DEMAND. THE DDC SYSTEM SHALL HAVE A PRIORITY OF ACTIONS AND SHALL INCLUDE TEMPERATURE RESET, SELECT EQUIPMENT SHUTDOWN, AND COMMUNICATION WITH THE LIGHTING SYSTEM TO LIMIT DEMAND.
7. ROOM TEMPERATURE SETPOINTS SHALL BE 68 DEGREES HEATING, UNLESS OTHERWISE NOTED. IN ROOMS WITH MULTIPLE ZONES, A 5 DEGREE MINIMUM DEADBAND SHALL BE MAINTAINED IN AND BETWEEN ALL ZONES. THERMOSTATS SERVING MULTIPLE ZONES SHALL LOCK OUT TEMPERATURE CHANGES WITHIN THE DEADBAND.

B. UNIT START/STOP

1. THE DDC SYSTEM SHALL START/STOP THE AHU ON ITS OWN “OCCUPIED/UNOCCUPIED” SCHEDULE OR IF A SPACE BECOMES OCCUPIED DURING UNOCCUPIED HOURS (OCCURS WHEN A SPACE THERMOSTAT’S OCCUPIED BUTTON IS DEPRESSED). WHEN IN OCCUPIED MODE, THE AHU SUPPLY FAN SHALL START AFTER A 2\_MINUTE DELAY TO ALLOW OUTSIDE AIR DAMPER TO FULLY OPEN (IF DAMPER END SWITCH PROOF IS REQUIRED, THE DELAYED START IS NOT REQUIRED).
2. PROOF OF FAN MOTOR RUN STATUS SHALL BE MONITORED BY A CURRENT SENSOR, UNLESS NOTED OTHERWISE. ANY ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO START. WHEN THE UNIT IS STOPPED (NORMAL OR OTHERWISE), THE ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO STOP.
3. WHEN THE AHU IS IN UNOCCUPIED MODE, ITS OUTSIDE AIR DAMPER SHALL CLOSE, AFTER THE FAN COMES TO A STOP AS PROVEN BY THE FAN’S CURRENT SENSOR. WHEN THE UNIT IS STOPPED HEATING COIL VALVES SHALL CLOSE.

C. OUTSIDE AIR/VENTILATION CONTROL

1. THE OUTSIDE AIR DAMPER AND RETURN AIR DAMPER SHALL RECEIVE INVERSELY PROPORTIONAL CONTROL SIGNALS. THE EXHAUST DAMPER SHALL REMAIN 100% OPEN WHILE THE UNIT IS IN OCCUPIED MODE.
2. THE DDC SYSTEM SHALL MODULATE THE OA DAMPER TO MAINTAIN THE MINIMUM OUTSIDE AIR FLOW SETPOINT.

D. TEMPERATURE CONTROL

1. THE DDC SYSTEM SHALL MONITOR THE INDIVIDUAL SPACE TEMPERATURES SERVED BY THE AHU.
2. THE DDC SHALL RESET THE AHU DISCHARGE TEMPERATURE TO MEET THE GREATEST SPACE DEMAND.
3. HEATING MODE: UPON A CALL FOR HEATING, THE DDC SHALL ENABLE GAS HEAT STAGE 1, STAGE 2, TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.
4. DISCHARGE TEMPERATURE CONTROL: THE DISCHARGE TEMPERATURE SET POINT SHALL ADHERE TO THE FOLLOWING RESET SCHEDULE:

RETURN AIR TEMPERATURE	DISCHARGE TEMPERATURE SETPOINT
60°F	85°F
80°F	50°F

E. NIGHT SETBACK

1. WHEN UNIT IS IN UNOCCUPIED MODE AND THE SPACE TEMPERATURE REACHES 60°F, THE DDC SYSTEM SHALL START THE FAN(S), SET THE DAMPERS TO FULL RECIRCULATION POSITION. COMMAND THE HEATING TO 100%. WHEN THE SPACE TEMPERATURE REACHES 63°F, THE FAN(S) SHALL STOP AND THE DDC SYSTEM SHALL RELEASE THE HEATING COMMAND.

F. MORNING WARMUP AND OPTIMIZATION

1. THE DDC SYSTEM SHALL “LEARN” THE THERMAL CHARACTERISTICS OF THE BUILDING AND AIR HANDLING SYSTEMS TO PROVIDE OPTIMUM START TIMES FOLLOWING NIGHT SETBACKS. THE OPTIMUM START TIMES SHALL BE BASED ON LOGGED WARMUP TIMES, OUTSIDE AIR TEMPERATURES AND TIME OF DAY. THE DDC SYSTEM SHALL REFINE THE OPTIMUM START TO BE THE LATEST TIME TO HAVE THE SPACES UP TO OCCUPIED TEMPERATURE BY THE BEGINNING OF THE OCCUPIED PERIOD.
2. WHEN AN AHU IS IN MORNING WARMUP MODE, THE DDC SYSTEM SHALL ENABLE THE SUPPLY, RETURN AND ASSOCIATED INTERLOCKED EQUIPMENT. THE DDC SHALL SET THE AHU DAMPERS TO FULL RECIRCULATION POSITION AND COMMAND THE SYSTEM TO HEATING MODE PER THE TEMPERATURE CONTROL SECTION.
3. THE AHU MUST SWITCH TO OCCUPIED MODE WHEN SCHEDULED.

G. AIR FILTERS

- THE DDC PANEL SHALL MONITOR THE DIFFERENTIAL PRESSURE SWITCH ACROSS SPECIFIED FILTERS AND SHALL PROVIDE AN ALARM WHEN THE PRESSURE DROP EXCEEDS THE SETPOINT.

H. FAN FAILURE

1. ALARM WHEN CONTROLLER SENDS START OR STOP SIGNAL TO FAN AND THERE IS NO PROOF OF STATUS ALIGNMENT FOR ONE (1) MINUTE (ADJ.).

Date	No	Revision	By		

DESIGNED BY: BAO  
DRAWN BY: KH  
CHECKED BY: BAO



WHATCOM COUNTY  
TRANSPORTATION AUTHORITY  
BELLINGHAM, WASHINGTON



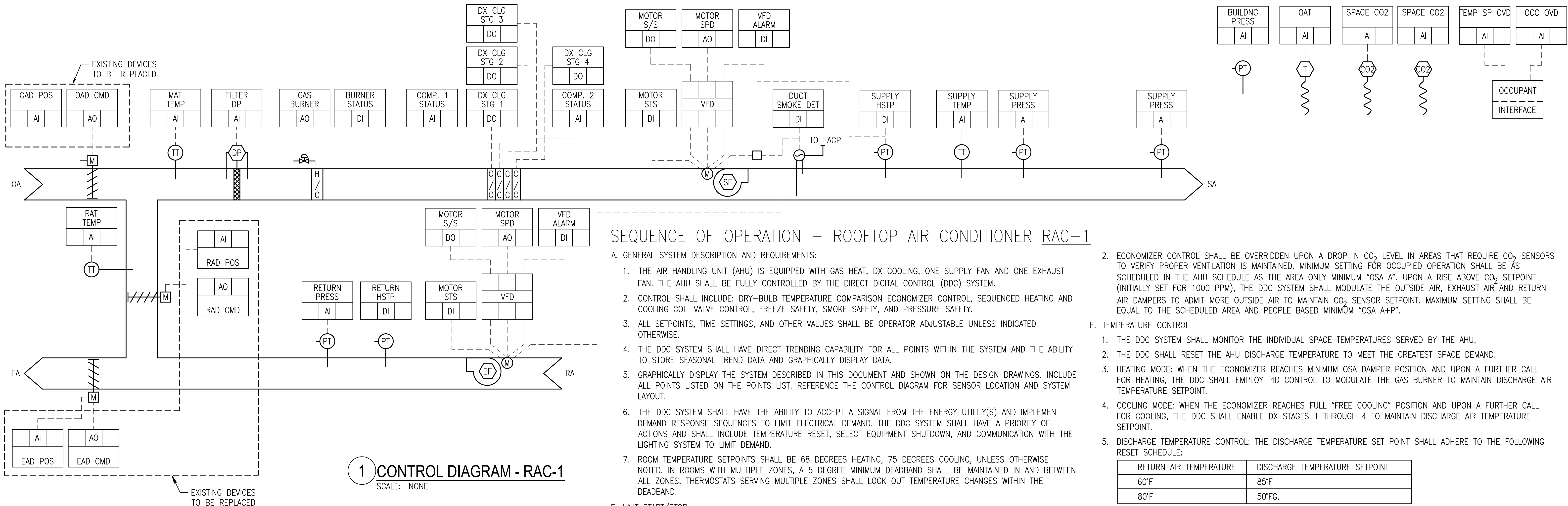
WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #:   
SUBMITTAL DATE: 10/16/2024

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WTA MOAB DDC UPGRADE  
CONTROL DIAGRAM & POINTS LIST

DWG # M7.03  
SHEET # 12 of 18





SYSTEM NAME: ROOFTOP AIR CONDITIONER CONTROL							
DESCRIPTION:	DIGITAL	DIGITAL	ANALOG	ANALOG	VIRTUAL	ALARMS	NOTES
RAC-1	OUTPUTS	INPUTS	OUTPUTS	INPUTS	POINTS		
EXHAUST AIR DAMPER POSITION (EAD)			1	1			
RETURN AIR DAMPER POSITION (RAD)			1	1			
OUTSIDE AIR DAMPER POSITION (OAD)			1	1			
SUPPLY FILTER STATUS (DIFF. PRESSURE SENSOR)				1			ALARM AT SPECIFIED SETPOINT PROVIDE BY MANUFACTURER OR DESIGN DOCUMENTATION.
GAS BURNER		1	1				
DX COIL (STG.1-4)	4						
DX COMPRESSOR STATUS				2			
SUPPLY FAN VFD CONTROL	1	2	1				
RETURN FAN VFD CONTROL	1	2	1				
SUPPLY DUCT SMOKE DETECTOR		1					
SUPPLY DUCT STATIC PRESSURE SENSOR				2			
SUPPLY DUCT HIGH STATIC PRESSURE SENSOR		1					
RETURN DUCT STATIC PRESSURE SENSOR				1			
RETURN DUCT HIGH STATIC PRESSURE SENSOR		1					
BUILDING STATIC PRESSURE SENSOR				1			
SUPPLY AIR TEMPERATURE				1			
OUTSIDE AIR TEMPERATURE					1		GLOBAL/FACILITY
MIXED AIR TEMPERATURE				1			
RETURN AIR TEMPERATURE				1			
CO <sub>2</sub> SENSOR				2			
GLOBAL SCHEDULE					1		OCCUPIED/UNOCCUPIED
ZONE DAMPER STATUS					39		
TOTAL NUMBER OF POINTS:	6	8	6	15	41		
GRAND TOTAL NUMBER OF POINTS:				76			

## SEQUENCE OF OPERATION – ROOFTOP AIR CONDITIONER RAC-1

### A. GENERAL SYSTEM DESCRIPTION AND REQUIREMENTS:

- THE AIR HANDLING UNIT (AHU) IS EQUIPPED WITH GAS HEAT, DX COOLING, ONE SUPPLY FAN AND ONE EXHAUST FAN. THE AHU SHALL BE FULLY CONTROLLED BY THE DIRECT DIGITAL CONTROL (DDC) SYSTEM.
- CONTROL SHALL INCLUDE: DRY-BULB TEMPERATURE COMPARISON ECONOMIZER CONTROL, SEQUENCED HEATING AND COOLING COIL VALVE CONTROL, FREEZE SAFETY, SMOKE SAFETY, AND PRESSURE SAFETY.
- ALL SETPOINTS, TIME SETTINGS, AND OTHER VALUES SHALL BE OPERATOR ADJUSTABLE UNLESS INDICATED OTHERWISE.
- THE DDC SYSTEM SHALL HAVE DIRECT TRENDING CAPABILITY FOR ALL POINTS WITHIN THE SYSTEM AND THE ABILITY TO STORE SEASONAL TREND DATA AND GRAPHICALLY DISPLAY DATA.
- GRAPHICALLY DISPLAY THE SYSTEM DESCRIBED IN THIS DOCUMENT AND SHOWN ON THE DESIGN DRAWINGS. INCLUDE ALL POINTS LISTED ON THE POINTS LIST. REFERENCE THE CONTROL DIAGRAM FOR SENSOR LOCATION AND SYSTEM LAYOUT.
- THE DDC SYSTEM SHALL HAVE THE ABILITY TO ACCEPT A SIGNAL FROM THE ENERGY UTILITY(S) AND IMPLEMENT DEMAND RESPONSE SEQUENCES TO LIMIT ELECTRICAL DEMAND. THE DDC SYSTEM SHALL HAVE A PRIORITY OF ACTIONS AND SHALL INCLUDE TEMPERATURE RESET, SELECT EQUIPMENT SHUTDOWN, AND COMMUNICATION WITH THE LIGHTING SYSTEM TO LIMIT DEMAND.
- ROOM TEMPERATURE SETPOINTS SHALL BE 68 DEGREES HEATING, 75 DEGREES COOLING, UNLESS OTHERWISE NOTED. IN ROOMS WITH MULTIPLE ZONES, A 5 DEGREE MINIMUM DEADBAND SHALL BE MAINTAINED IN AND BETWEEN ALL ZONES. THERMOSTATS SERVING MULTIPLE ZONES SHALL LOCK OUT TEMPERATURE CHANGES WITHIN THE DEADBAND.

### B. UNIT START/STOP

- THE DDC SYSTEM SHALL START/STOP THE AHU ON ITS OWN “OCCUPIED/UNOCCUPIED” SCHEDULE OR IF A SPACE BECOMES OCCUPIED DURING UNOCCUPIED HOURS (OCCURS WHEN A SPACE THERMOSTAT’S OCCUPIED BUTTON IS DEPRESSED). WHEN IN OCCUPIED MODE, THE AHU SUPPLY AND EXHAUST FAN SHALL START AFTER A 2-MINUTE DELAY TO ALLOW SUPPLY DAMPER, RETURN DAMPER AND EXHAUST DAMPER TO FULLY OPEN (IF DAMPER END SWITCH PROOF IS REQUIRED, THE DELAYED START IS NOT REQUIRED. AT MINIMUM, ONE (1) ZONE DAMPER MUST PROVE TO BE OPEN)
- PROOF OF FAN MOTOR RUN STATUS SHALL BE MONITORED BY A CURRENT SENSOR, UNLESS NOTED OTHERWISE. ANY ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO START. WHEN THE UNIT IS STOPPED (NORMAL OR OTHERWISE), THE ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO STOP.
- WHEN THE AHU IS IN UNOCCUPIED MODE, ITS OUTSIDE AIR AND EXHAUST AIR DAMPER SHALL CLOSE, AFTER THE FANS COME TO A STOP AS PROVEN BY THE FAN’S CURRENT SENSOR. WHEN THE UNIT IS STOPPED, COOLING-COIL VALVES AND HEATING COIL VALVES SHALL CLOSE TO THE COIL.

### C. VARIABLE SPEED DRIVE (VFD) FAN MOTOR CONTROL

- THE CONTROLLER SHALL MODULATE THE SUPPLY FAN SPEED TO MAINTAIN THE SPECIFIED AIR FLOW BASED ON FEEDBACK SIGNAL FROM SUPPLY DUCT STATIC PRESSURE SENSOR (THE AIR BALANCER SHALL DETERMINE THE STATIC PRESSURE SETPOINT REQUIRED TO MAINTAIN THE SCHEDULED CFM).
- THE CONTROLLER SHALL MODULATE THE EXHAUST FAN SPEED TO MAINTAIN THE SPECIFIED AIRFLOW BASED ON FEEDBACK SIGNAL FROM EXHAUST DUCT STATIC PRESSURE SENSOR (THE AIR BALANCER SHALL DETERMINE THE STATIC PRESSURE SETPOINT REQUIRED TO MAINTAIN THE SCHEDULED CFM).

### D. OUTSIDE AIR/VENTILATION CONTROL

- THE OUTSIDE AIR DAMPER AND RETURN AIR DAMPER SHALL RECEIVE INVERSELY PROPORTIONAL CONTROL SIGNALS. THE EXHAUST DAMPER SHALL REMAIN 100% OPEN WHILE THE UNIT IS IN OCCUPIED MODE.
- THE DDC SYSTEM SHALL MODULATE THE OA DAMPER TO MAINTAIN THE MINIMUM OUTSIDE AIR FLOW SETPOINT. THE OUTSIDE AIR AFMS SHALL PROVIDE FEEDBACK FOR THE OA DAMPER POSITION CONTROL PI LOOP.
- THE DDC SYSTEM SHALL MONITOR CO<sub>2</sub> SENSORS INSTALLED FOR INTERNAL AIR QUALITY. WHEN THE DDC SYSTEM DETECTS A CO<sub>2</sub> LEVEL ABOVE THE SETPOINT OF 500 PPM, THE DDC SYSTEM SHALL MODULATE THE OA DAMPER OPEN IN 10% INCREMENTS, EVERY 30 MINUTES UNTIL THE CO<sub>2</sub> LEVEL FALLS BELOW SETPOINT. WHEN THE CO<sub>2</sub> LEVEL FALLS 10% BELOW SETPOINT, THE DDC SYSTEM SHALL RETURN THE OAD TO MINIMUM POSITION.

### E. ECONOMIZER CONTROL

- THE DDC SYSTEM SHALL COMPARE THE SIGNAL OF AN OUTSIDE AIR TEMPERATURE SENSOR AND THE RETURN AIR TEMPERATURE. AS LONG AS THE OUTSIDE AIR TEMPERATURE IS BELOW THE RETURN AIR TEMPERATURE AND THE UNIT IS CALLING FOR COOLING, THE DDC SYSTEM SHALL MODULATE THE OUTSIDE AIR, EXHAUST AIR AND RETURN AIR DAMPERS TO ADMIT MORE OUTSIDE AIR TO MAINTAIN DISCHARGE SETPOINT. AS LONG AS THE OUTSIDE AIR TEMPERATURE IS ABOVE THE RETURN AIR TEMPERATURE AND THE UNIT IS CALLING FOR COOLING, THE DDC SYSTEM SHALL RETURN THE OUTSIDE AIR DAMPER TO THE MINIMUM OUTDOOR AIR SETTING. ECONOMIZER SHALL IMPLEMENT FAULT DETECTION AND DIAGNOSTICS TO DETECT ECONOMIZER FAILURE, EXCESS OUTSIDE AIR, AND DAMPER MODULATION FAILURE.

- ECONOMIZER CONTROL SHALL BE OVERRIDDEN UPON A DROP IN CO<sub>2</sub> LEVEL IN AREAS THAT REQUIRE CO<sub>2</sub> SENSORS TO VERIFY PROPER VENTILATION IS MAINTAINED. MINIMUM SETTING FOR OCCUPIED OPERATION SHALL BE AS SCHEDULED IN THE AHU SCHEDULE AS THE AREA ONLY MINIMUM “OSA A”. UPON A RISE ABOVE CO<sub>2</sub> SETPOINT (INITIALLY SET FOR 1000 PPM), THE DDC SYSTEM SHALL MODULATE THE OUTSIDE AIR, EXHAUST AIR AND RETURN AIR DAMPERS TO ADMIT MORE OUTSIDE AIR TO MAINTAIN CO<sub>2</sub> SENSOR SETPOINT. MAXIMUM SETTING SHALL BE EQUAL TO THE SCHEDULED AREA AND PEOPLE BASED MINIMUM “OSA A+P”.

### F. TEMPERATURE CONTROL

- THE DDC SYSTEM SHALL MONITOR THE INDIVIDUAL SPACE TEMPERATURES SERVED BY THE AHU.
- THE DDC SHALL RESET THE AHU DISCHARGE TEMPERATURE TO MEET THE GREATEST SPACE DEMAND.
- HEATING MODE: WHEN THE ECONOMIZER REACHES MINIMUM OSA DAMPER POSITION AND UPON A FURTHER CALL FOR HEATING, THE DDC SHALL EMPLOY PID CONTROL TO MODULATE THE GAS BURNER TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.
- COOLING MODE: WHEN THE ECONOMIZER REACHES FULL “FREE COOLING” POSITION AND UPON A FURTHER CALL FOR COOLING, THE DDC SHALL ENABLE DX STAGES 1 THROUGH 4 TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.
- DISCHARGE TEMPERATURE CONTROL: THE DISCHARGE TEMPERATURE SET POINT SHALL ADHERE TO THE FOLLOWING RESET SCHEDULE:

RETURN AIR TEMPERATURE	DISCHARGE TEMPERATURE SETPOINT
60°F	85°F
80°F	50°F <sub>G</sub> .

### G. NIGHT SETBACK

- WHEN UNIT IS IN UNOCCUPIED MODE AND THE SPACE TEMPERATURE REACHES 60 DEG F, THE DDC SYSTEM SHALL START THE FAN(S), SET THE DAMPERS TO FULL RECIRCULATION POSITION (OAD – 100% CLOSED, RAD – 100% OPEN, BYPASS DAMPER – OPEN 100%. COMMAND THE HEATING TO 100%. WHEN THE SPACE TEMPERATURE REACHES 63°F, THE FAN(S) SHALL STOP AND THE DDC SYSTEM SHALL RELEASE THE HEATING COMMAND.

### H. MORNING WARMUP AND OPTIMIZATION

- THE DDC SYSTEM SHALL “LEARN” THE THERMAL CHARACTERISTICS OF THE BUILDING AND AIR HANDLING SYSTEMS TO PROVIDE OPTIMUM START TIMES FOLLOWING NIGHT SETBACKS. THE OPTIMUM START TIMES SHALL BE BASED ON LOGGED WARMUP TIMES, OUTSIDE AIR TEMPERATURES AND TIME OF DAY. THE DDC SYSTEM SHALL REFINES THE OPTIMUM START TO BE THE LATEST TIME TO HAVE THE SPACES UP TO OCCUPIED TEMPERATURE BY THE BEGINNING OF THE OCCUPIED PERIOD.
- WHEN AN AHU IS IN MORNING WARMUP MODE, THE DDC SYSTEM SHALL ENABLE THE SUPPLY, RETURN AND ASSOCIATED INTERLOCKED EQUIPMENT. THE DDC SHALL SET THE AHU DAMPERS TO FULL RECIRCULATION POSITION AND COMMAND THE SYSTEM TO HEATING OR COOLING MODE PER THE TEMPERATURE CONTROL SECTION.
- THE AHU MUST SWITCH TO OCCUPIED MODE WHEN SCHEDULED.

### I. SAFETIES AND ALARMS

- ANNUNCIATE ALARMS AT THE DDC SYSTEM’S FRONT-END COMPUTER WHEN ANY OF THE FOLLOWING EVENTS OCCUR. CREATE SEPARATE POINTS FOR EACH ALARM LISTED BELOW.
  - SMOKE DETECTORS
    - SMOKE DETECTOR(S) IN THE SUPPLY AIR DUCT AND RETURN AIR DUCT AS SPECIFIED ON THE DRAWINGS SHALL PROVIDE A “HARD-WIRED” SHUTDOWN OF THE SUPPLY FAN AND THE RETURN FAN AND INITIATE A SMOKE DETECTOR ALARM TO THE DDC SYSTEM AND FACP.
  - HIGH/LOW PRESSURE SAFETY
    - UPON ACTIVATION OF THE HIGH/LOW PRESSURE SAFETY SWITCH, AHU SHALL BE DE-ENERGIZED, FANS SHALL BE DE-ENERGIZED VIA A HARD-WIRED INTERLOCK, AND AN INDICATION OF THE OPERATION SHALL BE SENSED BY THE DDC SYSTEM. DDC SYSTEM SHALL ANNUNCIATE APPROPRIATE ALARM AND REMOVE AND LOCK OUT THE START COMMAND, WHICH SHALL INITIATE “FAN FAILURE” ALARMS. PRESSURE SAFETY SWITCHES SHALL REQUIRE MANUAL RESET.

### J. AIR FILTERS

- THE DDC PANEL SHALL MONITOR THE DIFFERENTIAL PRESSURE SWITCH ACROSS SPECIFIED FILTERS AND SHALL PROVIDE AN ALARM WHEN THE PRESSURE DROP EXCEEDS THE SETPOINT.

### K. VFD

- OBTAIN ALARM HARDWARE/NETWORK FROM VFD.

### L. FAN FAILURE

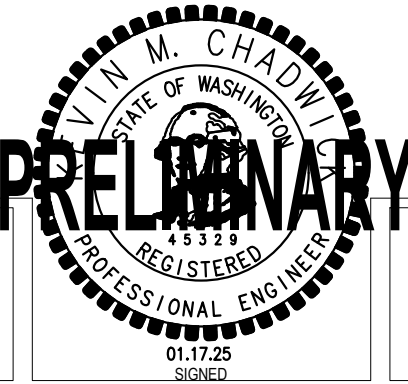
- ALARM WHEN CONTROLLER SENDS START OR STOP SIGNAL TO FAN AND THERE IS NO PROOF OF STATUS ALIGNMENT FOR ONE (1) MINUTE (ADJ.).

## ISSUED FOR BID

Date	No	Revision	By	

WTA CONTACT PERSON: **DEVON DEBOER** PHONE #: **360-201-6440**

DESIGNED BY: **BAQ**  
DRAWN BY: **KH**  
CHECKED BY: **BAQ**



**WHATCOM COUNTY  
TRANSPORTATION AUTHORITY**  
BELLINGHAM, WASHINGTON

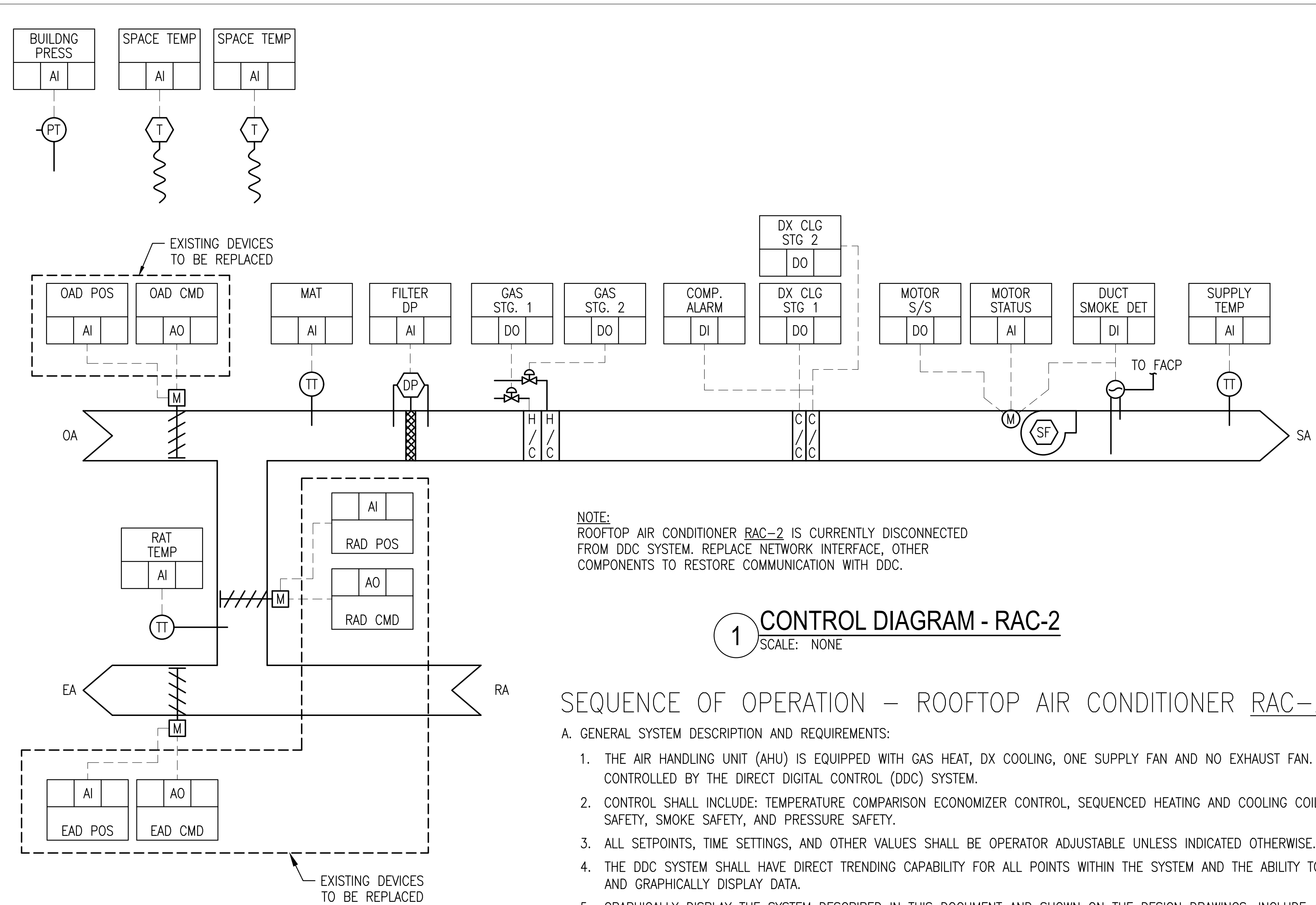


WTA PROJECT #: **2023-046 FRQ**  
CONSULTANT #:   
SUBMITTAL DATE: **10/16/2024**

**WTA MOAB DDC UPGRADE  
CONTROL DIAGRAM & POINTS LIST**

DWG # **M7.04**  
SHEET # **13** of **18**





NOTE:  
ROOFTOP AIR CONDITIONER RAC-2 IS CURRENTLY DISCONNECTED  
FROM DDC SYSTEM. REPLACE NETWORK INTERFACE, OTHER  
COMPONENTS TO RESTORE COMMUNICATION WITH DDC.

### 1 CONTROL DIAGRAM - RAC-2

SCALE: NONE

## SEQUENCE OF OPERATION – ROOFTOP AIR CONDITIONER RAC-2

### A. GENERAL SYSTEM DESCRIPTION AND REQUIREMENTS:

1. THE AIR HANDLING UNIT (AHU) IS EQUIPPED WITH GAS HEAT, DX COOLING, ONE SUPPLY FAN AND NO EXHAUST FAN. THE AHU SHALL BE FULLY CONTROLLED BY THE DIRECT DIGITAL CONTROL (DDC) SYSTEM.
2. CONTROL SHALL INCLUDE: TEMPERATURE COMPARISON ECONOMIZER CONTROL, SEQUENCED HEATING AND COOLING COIL VALVE CONTROL, FREEZE SAFETY, SMOKE SAFETY, AND PRESSURE SAFETY.
3. ALL SETPOINTS, TIME SETTINGS, AND OTHER VALUES SHALL BE OPERATOR ADJUSTABLE UNLESS INDICATED OTHERWISE.
4. THE DDC SYSTEM SHALL HAVE DIRECT TRENDING CAPABILITY FOR ALL POINTS WITHIN THE SYSTEM AND THE ABILITY TO STORE SEASONAL TREND DATA AND GRAPHICALLY DISPLAY DATA.
5. GRAPHICALLY DISPLAY THE SYSTEM DESCRIBED IN THIS DOCUMENT AND SHOWN ON THE DESIGN DRAWINGS. INCLUDE ALL POINTS LISTED ON THE POINTS LIST. REFERENCE THE CONTROL DIAGRAM FOR SENSOR LOCATION AND SYSTEM LAYOUT.
6. THE DDC SYSTEM SHALL HAVE THE ABILITY TO ACCEPT A SIGNAL FROM THE ENERGY UTILITY(S) AND IMPLEMENT DEMAND RESPONSE SEQUENCES TO LIMIT ELECTRICAL DEMAND. THE DDC SYSTEM SHALL HAVE A PRIORITY OF ACTIONS AND SHALL INCLUDE TEMPERATURE RESET, SELECT EQUIPMENT SHUTDOWN, AND COMMUNICATION WITH THE LIGHTING SYSTEM TO LIMIT DEMAND.
7. ROOM TEMPERATURE SETPOINTS SHALL BE 68 DEGREES HEATING, 75 DEGREES COOLING, UNLESS OTHERWISE NOTED. IN ROOMS WITH MULTIPLE ZONES, A 5 DEGREE MINIMUM DEADBAND SHALL BE MAINTAINED IN AND BETWEEN ALL ZONES. THERMOSTATS SERVING MULTIPLE ZONES SHALL LOCK OUT TEMPERATURE CHANGES WITHIN THE DEADBAND.

### B. UNIT START/STOP

1. THE DDC SYSTEM SHALL START/STOP THE AHU ON ITS OWN "OCCUPIED/UNOCCUPIED" SCHEDULE OR IF A SPACE BECOMES OCCUPIED DURING UNOCCUPIED HOURS (OCCURS WHEN A SPACE THERMOSTAT'S OCCUPIED BUTTON IS DEPRESSED). WHEN IN OCCUPIED MODE, THE AHU SUPPLY FAN SHALL START AND RUN CONTINUOUSLY AFTER A 2-MINUTE DELAY TO ALLOW OUTSIDE AIR DAMPER, RETURN DAMPER AND EXHAUST DAMPER TO FULLY OPEN (IF DAMPER END SWITCH PROOF IS REQUIRED, THE DELAYED START IS NOT REQUIRED).
2. PROOF OF FAN MOTOR RUN STATUS SHALL BE MONITORED BY A CURRENT SENSOR, UNLESS NOTED OTHERWISE. ANY ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO START. WHEN THE UNIT IS STOPPED (NORMAL OR OTHERWISE), THE ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO STOP.
3. WHEN THE AHU IS IN UNOCCUPIED MODE, ITS OUTSIDE AIR AND EXHAUST AIR DAMPER SHALL CLOSE, AFTER THE FAN COMES TO A STOP AS PROVEN BY THE FAN'S CURRENT SENSOR. WHEN THE UNIT IS STOPPED, COOLING-COIL VALVES AND HEATING COIL VALVES SHALL CLOSE TO THE COILS. WHEN A SPACE TEMPERATURE FALLS BELOW 60°F THE FAN AND GAS HEAT SHALL ENGAGE UNTIL SPACE TEMPERATURE IS SATISFIED, AT WHICH TIME GAS HEAT AND FAN SHALL TURN OFF, AS ABOVE.

### C. OUTSIDE AIR/VENTILATION CONTROL

1. THE OUTSIDE AIR DAMPER AND RETURN AIR DAMPER SHALL RECEIVE INVERSELY PROPORTIONAL CONTROL SIGNALS. THE EXHAUST DAMPER SHALL REMAIN 100% OPEN WHILE THE UNIT IS IN OCCUPIED MODE.
2. THE DDC SYSTEM SHALL MODULATE THE OA DAMPER TO MAINTAIN THE MINIMUM OUTSIDE AIR FLOW SETPOINT.

### D. ECONOMIZER CONTROL

1. THE DDC SYSTEM SHALL COMPARE THE SIGNAL OF AN OUTSIDE AIR TEMPERATURE SENSOR AND THE RETURN AIR TEMPERATURE. AS LONG AS THE OUTSIDE AIR TEMPERATURE IS BELOW THE RETURN AIR TEMPERATURE AND THE UNIT IS CALLING FOR COOLING, THE DDC SYSTEM SHALL MODULATE THE OUTSIDE AIR, EXHAUST AIR AND RETURN AIR DAMPERS TO ADMIT MORE OUTSIDE AIR TO MAINTAIN DISCHARGE SETPOINT. AS LONG AS THE OUTSIDE AIR TEMPERATURE IS ABOVE THE RETURN AIR TEMPERATURE AND THE UNIT IS CALLING FOR COOLING, THE DDC SYSTEM SHALL RETURN THE OUTSIDE AIR DAMPER TO THE MINIMUM OUTDOOR AIR SETTING. ECONOMIZER SHALL IMPLEMENT FAULT DETECTION AND DIAGNOSTICS TO DETECT ECONOMIZER FAILURE, EXCESS OUTSIDE AIR, AND DAMPER MODULATION FAILURE.

SYSTEM NAME: ROOFTOP AIR CONDITIONER CONTROL					
DESCRIPTION: RAC-2	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS (DI)
EXHAUST AIR DAMPER POSITION			1	1	
RETURN AIR DAMPER POSITION			1	1	
OUTSIDE AIR DAMPER POSITION			1	1	
FILTER STATUS (DIFF. PRESSURE SENSOR)				1	
GAS BURNER (STG. 1, STG. 2)	2				
DX COIL (STG. 1, STG. 2, ALM)	2				1
SUPPLY FAN ENABLE	1				
SUPPLY FAN STATUS				1	
DUCT SMOKE DETECTOR		1			
SUPPLY AIR TEMPERATURE				1	
RETURN AIR TEMPERATURE				1	
MIXED AIR TEMPERATURE				1	
ROOM TEMPERATURE				2	
BUILDING STATIC PRESSURE				1	
TOTAL NUMBER OF POINTS:	5	1	3	11	1
GRAND TOTAL NUMBER OF POINTS:			21		

### E. TEMPERATURE CONTROL

1. THE DDC SYSTEM SHALL MONITOR THE INDIVIDUAL SPACE TEMPERATURES SERVED BY THE AHU.
2. THE DDC SHALL RESET THE AHU DISCHARGE TEMPERATURE TO MEET THE GREATEST SPACE DEMAND.
3. HEATING MODE: WHEN THE ECONOMIZER REACHES MINIMUM OSA DAMPER POSITION AND UPON A FURTHER CALL FOR HEATING, THE DDC SHALL ENABLE GAS HEAT STAGES TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.
4. COOLING MODE: WHEN THE ECONOMIZER REACHES FULL "FREE COOLING" POSITION AND UPON A FURTHER CALL FOR COOLING, THE DDC SHALL ENABLE DX STAGES TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.
5. DISCHARGE TEMPERATURE CONTROL: THE DISCHARGE TEMPERATURE SET POINT SHALL ADHERE TO THE FOLLOWING RESET SCHEDULE:

RETURN AIR TEMPERATURE	DISCHARGE TEMPERATURE SETPOINT
60°F	85°F
80°F	50°F

### F. NIGHT SETBACK

1. WHEN UNIT IS IN UNOCCUPIED MODE AND THE SPACE TEMPERATURE REACHES 60 DEG F, THE DDC SYSTEM SHALL START THE FAN(S), SET THE DAMPERS TO FULL RECIRCULATION POSITION (OAD – 100% CLOSED, RAD – 100% OPEN, BYPASS DAMPER – OPEN 100%. COMMAND THE HEATING TO 100%. WHEN THE SPACE TEMPERATURE REACHES 63°F, THE FAN(S) SHALL STOP AND THE DDC SYSTEM SHALL RELEASE THE HEATING COMMAND.

### G. MORNING WARMUP AND OPTIMIZATION

1. THE DDC SYSTEM SHALL "LEARN" THE THERMAL CHARACTERISTICS OF THE BUILDING AND AIR HANDLING SYSTEMS TO PROVIDE OPTIMUM START TIMES FOLLOWING NIGHT SETBACKS. THE OPTIMUM START TIMES SHALL BE BASED ON LOGGED WARMUP TIMES, OUTSIDE AIR TEMPERATURES AND TIME OF DAY. THE DDC SYSTEM SHALL REFINE THE OPTIMUM START TO BE THE LATEST TIME TO HAVE THE SPACES UP TO OCCUPIED TEMPERATURE BY THE BEGINNING OF THE OCCUPIED PERIOD.
2. WHEN AN AHU IS IN MORNING WARMUP MODE, THE DDC SYSTEM SHALL ENABLE THE SUPPLY AND RETURN FANS AND ASSOCIATED INTERLOCKED EQUIPMENT. THE DDC SHALL SET THE AHU DAMPERS TO FULL RECIRCULATION POSITION AND COMMAND THE SYSTEM TO HEATING OR COOLING MODE PER THE TEMPERATURE CONTROL SECTION.
3. THE AHU MUST SWITCH TO OCCUPIED MODE WHEN SCHEDULED.

### H. SAFETIES AND ALARMS

1. ANNUNCIATE ALARMS AT THE DDC SYSTEM'S FRONT-END COMPUTER WHEN ANY OF THE FOLLOWING EVENTS OCCUR. CREATE SEPARATE POINTS FOR EACH ALARM LISTED BELOW.
  - a. SMOKE DETECTORS
    - i. SMOKE DETECTOR(S) IN THE SUPPLY AIR DUCT AND RETURN AIR DUCT AS SPECIFIED ON THE DRAWINGS SHALL PROVIDE A "HARD-WIRED" SHUTDOWN OF THE SUPPLY FAN AND THE RETURN FAN AND INITIATE A SMOKE DETECTOR ALARM TO THE DDC SYSTEM AND FACP.
  - b. HIGH/LOW PRESSURE SAFETY
    - i. UPON ACTIVATION OF THE HIGH/LOW PRESSURE SAFETY SWITCH, AHU SHALL BE DE-ENERGIZED AND AN INDICATION OF THE OPERATION SHALL BE SENSED BY THE DDC SYSTEM. DDC SYSTEM SHALL ANNUNCIATE ALARM AND REMOVE AND LOCK OUT THE START COMMAND, WHICH SHALL INITIATE "FAN FAILURE" ALARMS. PRESSURE SAFETY SWITCHES SHALL REQUIRE MANUAL RESET.

### I. AIR FILTERS

- THE DDC PANEL SHALL MONITOR THE DIFFERENTIAL PRESSURE SWITCH ACROSS SPECIFIED FILTERS AND SHALL PROVIDE AN ALARM WHEN THE PRESSURE DROP EXCEEDS THE SETPOINT.

### J. FAN FAILURE

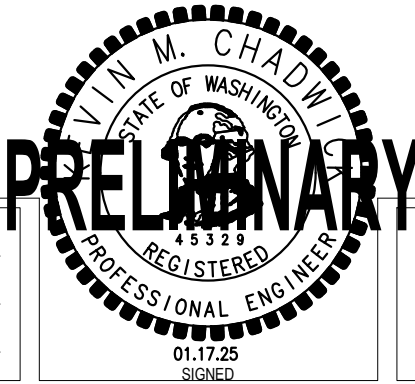
2. ALARM WHEN CONTROLLER SENDS START OR STOP SIGNAL TO FAN AND THERE IS NO PROOF OF STATUS ALIGNMENT FOR ONE (1) MINUTE (ADJ.).

### ISSUED FOR BID

Date	No	Revision		By

WTA CONTACT PERSON: DEVON DEBOER PHONE #: 360-201-6440

DESIGNED BY: BAQ  
DRAWN BY: KH  
CHECKED BY: BAQ



**WHATCOM COUNTY  
TRANSPORTATION AUTHORITY**  
BELLINGHAM, WASHINGTON

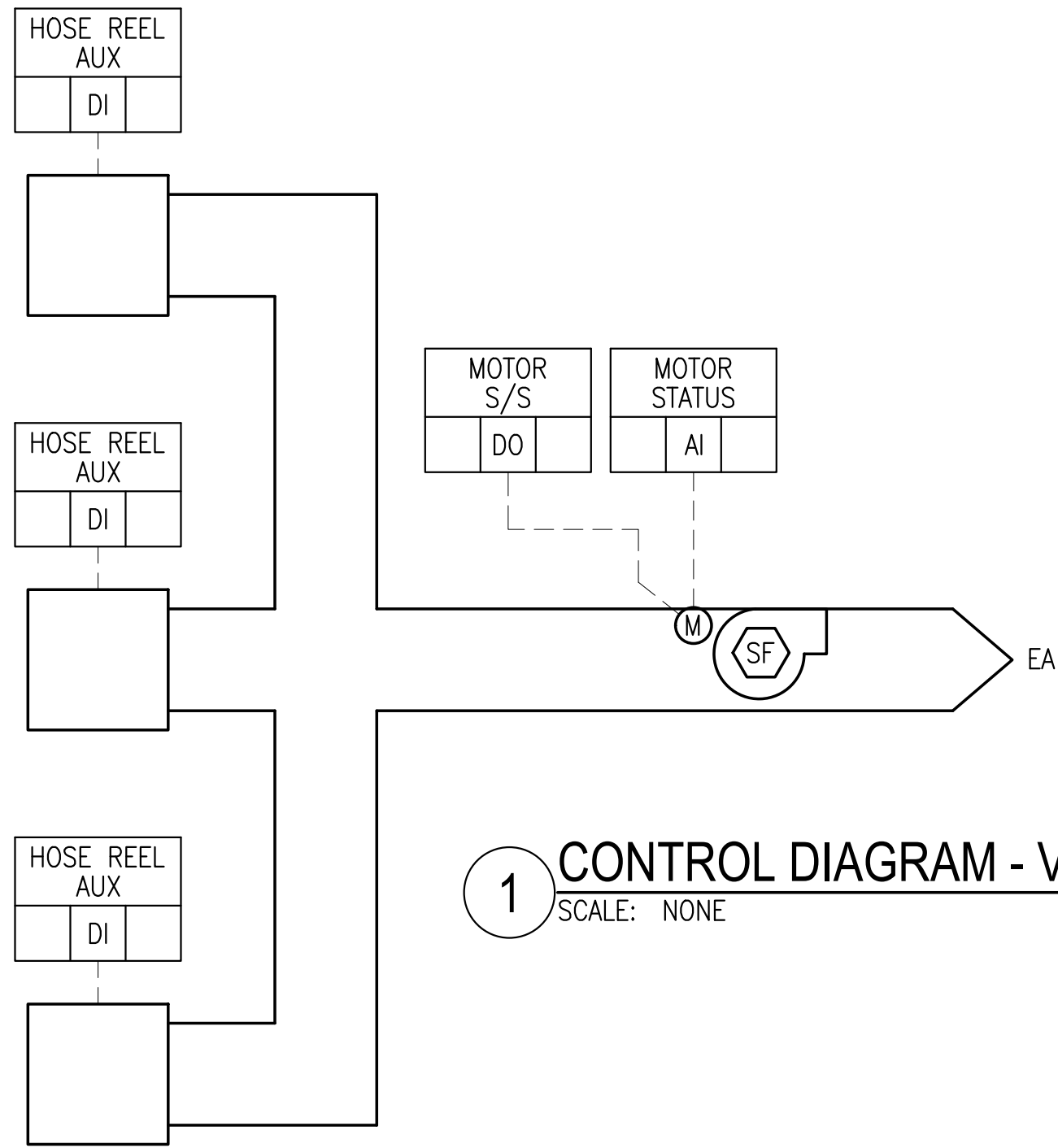


WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #: \_\_\_\_\_  
SUBMITTAL DATE: 10/16/2024

**WTA MOAB DDC UPGRADE  
CONTROL DIAGRAM & POINTS LIST**

DWG # M7.05  
SHEET # 14 of 18





1 CONTROL DIAGRAM - VEF-X  
SCALE: NONE

NOTE:  
HOSE REEL EXHAUST FAN ACTIVATED  
BY MANUFACTURER'S PENDANT SWITCH.

SYSTEM NAME: VEHICLE EXHAUST FAN CONTROL						
DESCRIPTION: VEF-1, VEF-2, VEF-3	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS	NOTES
EXHAUST FAN ENABLE	1					
EXHAUST FAN STATUS				1		
HOSE REEL AUX CONTACT		3				HOSEREEL (EHR-X), INTERLOCK W/FAN (10 TOTAL)
TOTAL NUMBER OF POINTS:	1	3		1		
GRAND TOTAL NUMBER OF POINTS (EA):	5					
GRAND TOTAL NUMBER OF POINTS:	16					

Date	No	Revision	By

DESIGNED BY: BAO  
DRAWN BY: KH  
CHECKED BY: BAO



WHATCOM COUNTY  
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BELLINGHAM, WASHINGTON

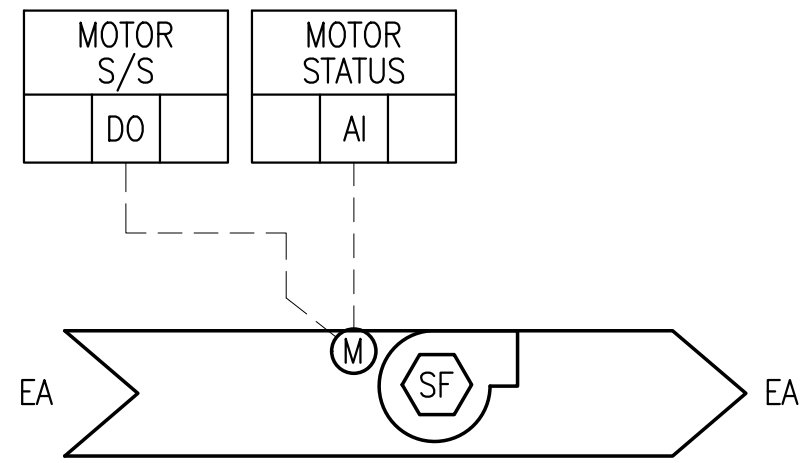


WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #:  
SUBMITTAL DATE: 10/16/2024

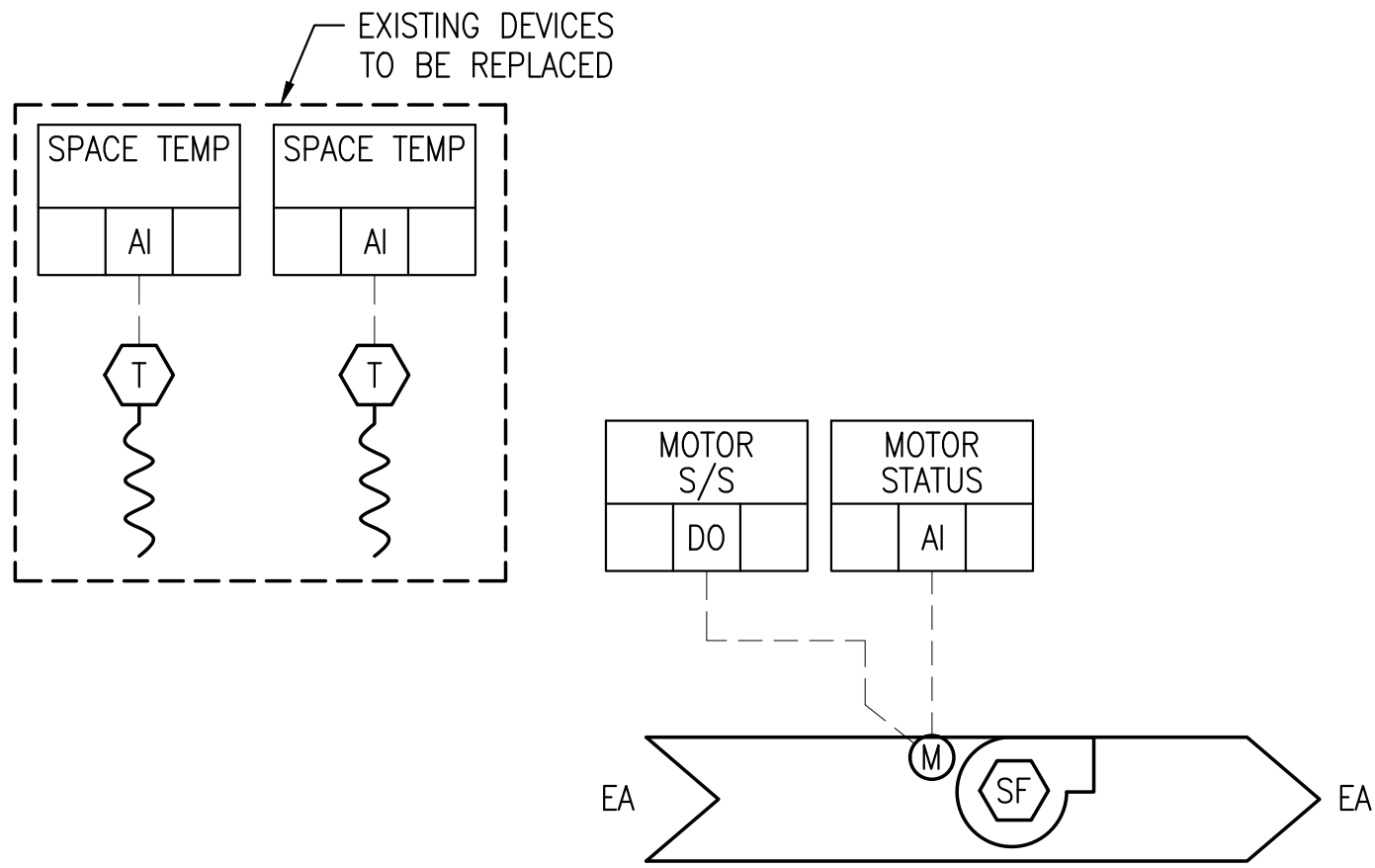
ISSUED FOR BID

WTA MOAB DDC UPGRADE  
CONTROL DIAGRAM & POINTS LIST

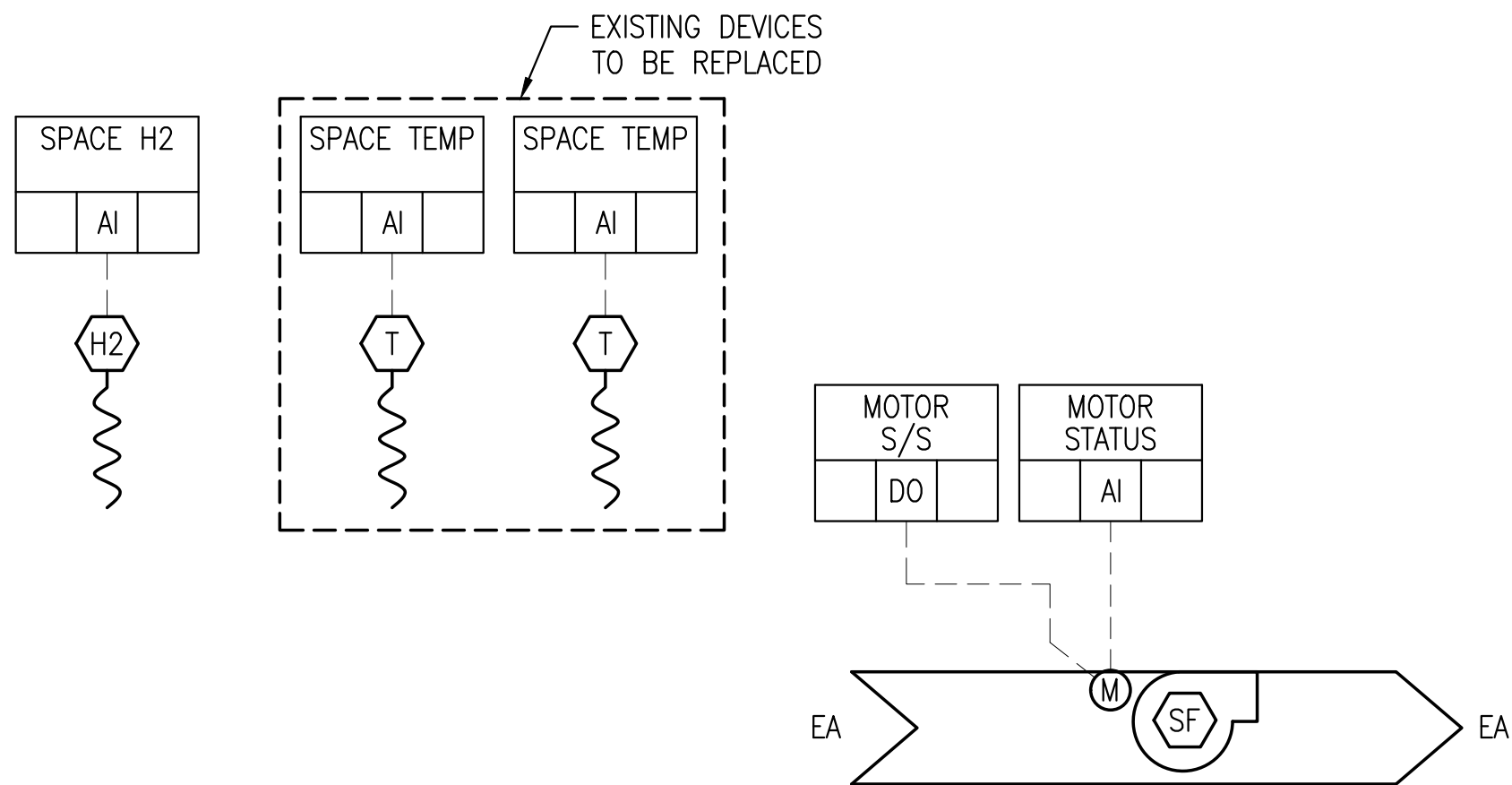
DWG # M7.06  
SHEET # 15 of 18



1 CONTROL DIAGRAM - EF-X  
SCALE: NONE



2 CONTROL DIAGRAM - EF-X  
SCALE: NONE



3 CONTROL DIAGRAM - EF-6  
SCALE: NONE

SYSTEM NAME: EXHAUST FAN CONTROL						
DESCRIPTION:	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS	NOTES
EF-1, EF-3, EF-7, EF-8, EF-10						
EXHAUST FAN ENABLE	1					
EXHAUST FAN STATUS				1		
TOTAL NUMBER OF POINTS:	1			1		
GRAND TOTAL NUMBER OF POINTS (EA):	2					
GRAND TOTAL NUMBER OF POINTS:	10					

SYSTEM NAME: EXHAUST FAN CONTROL						
DESCRIPTION:	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS	NOTES
EF-2, EF-4, EF-11, EF-15, EF-16, EF-17						
EXHAUST FAN ENABLE	1					
EXHAUST FAN STATUS				1		
ROOM TEMPERATURE				2		
TOTAL NUMBER OF POINTS:	1			3		
GRAND TOTAL NUMBER OF POINTS (EA):	4					
GRAND TOTAL NUMBER OF POINTS:	24					

SYSTEM NAME: EXHAUST FAN CONTROL						
DESCRIPTION:	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS	NOTES
EF-6						
EXHAUST FAN ENABLE	1					
EXHAUST FAN STATUS				1		
ROOM TEMPERATURE				2		
H <sub>2</sub> SENSOR				1		
TOTAL NUMBER OF POINTS:	1			4		
GRAND TOTAL NUMBER OF POINTS:	5					

Date	No	Revision	By	

WTA CONTACT PERSON: DEVON DEBOER PHONE #: 360-201-6440

DESIGNED BY: BAQ  
DRAWN BY: KH  
CHECKED BY: BAQ



WHATCOM COUNTY  
TRANSPORTATION AUTHORITY  
BELLINGHAM, WASHINGTON

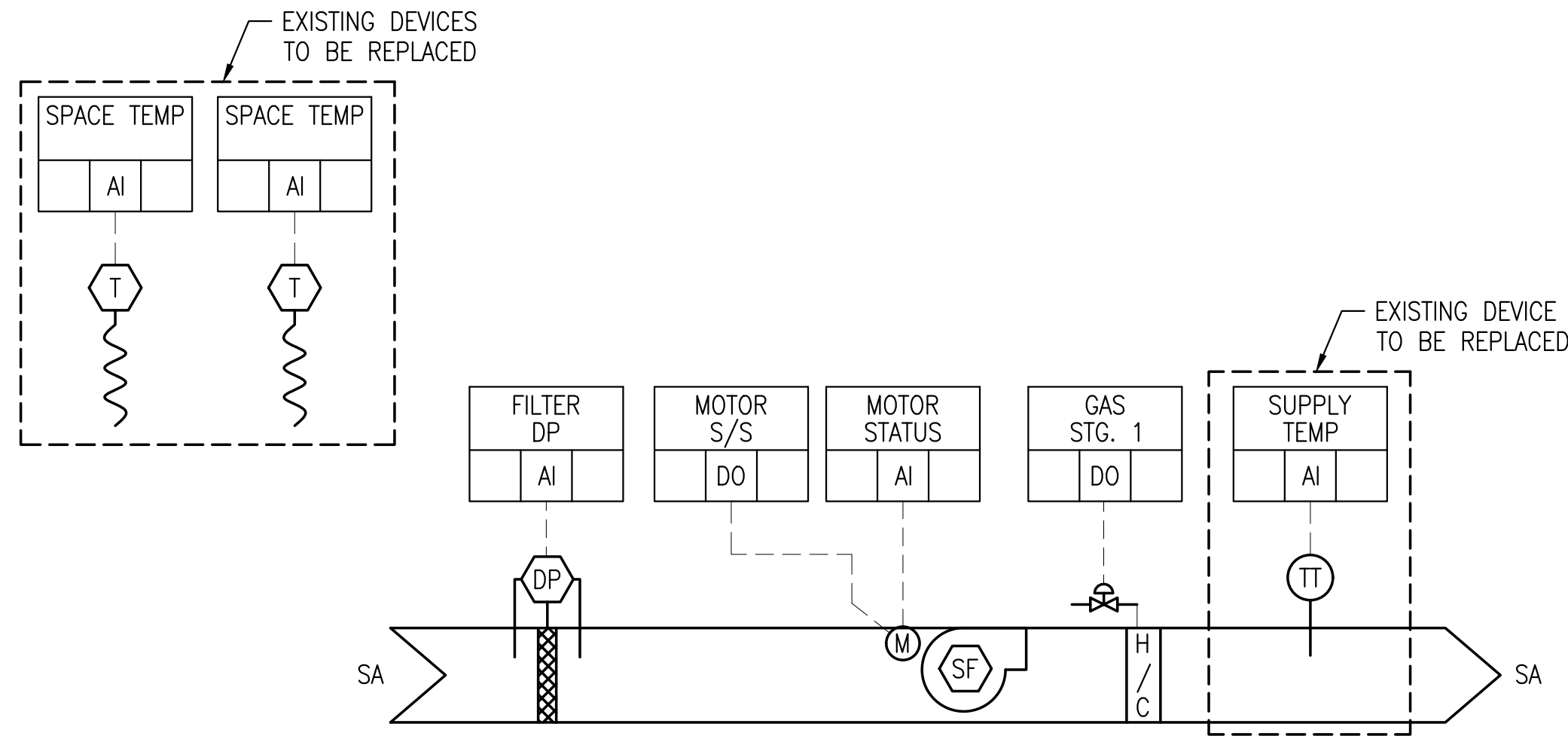


WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #:   
SUBMITTAL DATE: 10/16/2024

ISSUED FOR BID  
WTA MOAB DDC UPGRADE  
CONTROL DIAGRAMS & POINTS LIST

DWG # M7.07  
SHEET # 16 of 18





NOTE:  
FURNACE F-1 IS CURRENTLY DISCONNECTED FROM DDC SYSTEM. RE-ENABLE EXISTING CONTROL DEVICES AS NECESSARY TO RESTORE DDC CONTROL.

1 CONTROL DIAGRAM - F-1  
SCALE: NONE

SYSTEM NAME: FURNACE CONTROL						
DESCRIPTION: F-1	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS	NOTES
FILTER STATUS (DIFF. PRESSURE SENSOR)				1		
SUPPLY FAN ENABLE	1					
SUPPLY FAN STATUS				1		
GAS BURNER	1					
SUPPLY AIR TEMPERATURE				1		
ROOM TEMPERATURE				2		
TOTAL NUMBER OF POINTS:	2			5		
GRAND TOTAL NUMBER OF POINTS:	7					

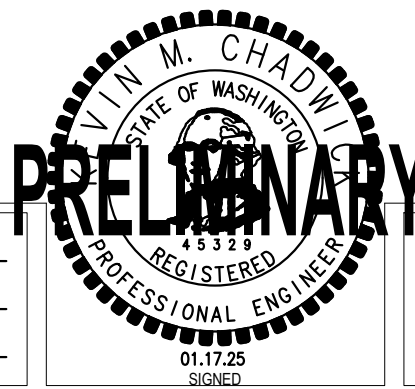
SEQUENCE OF OPERATION – GAS FURNACE F-1

- A. GENERAL SYSTEM DESCRIPTION AND REQUIREMENTS:
- THE FURNACE UNIT IS EQUIPPED WITH GAS HEAT AND ONE SUPPLY FAN. THE FURNACE SHALL BE FULLY CONTROLLED BY THE DIRECT DIGITAL CONTROL (DDC) SYSTEM.
  - CONTROL SHALL INCLUDE: HEATING VALVE CONTROL.
  - ALL SETPOINTS, TIME SETTINGS, AND OTHER VALUES SHALL BE OPERATOR ADJUSTABLE UNLESS INDICATED OTHERWISE.
  - THE DDC SYSTEM SHALL HAVE DIRECT TRENDING CAPABILITY FOR ALL POINTS WITHIN THE SYSTEM AND THE ABILITY TO STORE SEASONAL TREND DATA AND GRAPHICALLY DISPLAY DATA.
  - GRAPHICALLY DISPLAY THE SYSTEM DESCRIBED IN THIS DOCUMENT AND SHOWN ON THE DESIGN DRAWINGS. INCLUDE ALL POINTS LISTED ON THE POINTS LIST. REFERENCE THE CONTROL DIAGRAM FOR SENSOR LOCATION AND SYSTEM LAYOUT.
  - THE DDC SYSTEM SHALL HAVE THE ABILITY TO ACCEPT A SIGNAL FROM THE ENERGY UTILITY(S) AND IMPLEMENT DEMAND RESPONSE SEQUENCES TO LIMIT ELECTRICAL DEMAND. THE DDC SYSTEM SHALL HAVE A PRIORITY OF ACTIONS AND SHALL INCLUDE TEMPERATURE RESET, SELECT EQUIPMENT SHUTDOWN, AND COMMUNICATION WITH THE LIGHTING SYSTEM TO LIMIT DEMAND.
  - ROOM TEMPERATURE SETPOINT SHALL BE 68 DEGREES UNLESS OTHERWISE NOTED.
- B. UNIT START/STOP
- THE DDC SYSTEM SHALL START/STOP THE UNIT ON ITS OWN "OCCUPIED/UNOCCUPIED" SCHEDULE OR IF A SPACE BECOMES OCCUPIED DURING UNOCCUPIED HOURS (OCCURS WHEN A SPACE THERMOSTAT'S OCCUPIED BUTTON IS DEPRESSED).
  - PROOF OF FAN MOTOR RUN STATUS SHALL BE MONITORED BY A CURRENT SENSOR, UNLESS NOTED OTHERWISE. ANY ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO START. WHEN THE UNIT IS STOPPED (NORMAL OR OTHERWISE), THE ASSOCIATED INTERLOCKED EQUIPMENT SHALL ALSO STOP.
  - WHEN THE UNIT IS IN UNOCCUPIED MODE, THE FANS COME TO A STOP AS PROVEN BY THE FAN'S CURRENT SENSOR, HEATING COIL VALVES SHALL CLOSE TO THE COIL.
- C. TEMPERATURE CONTROL
- THE DDC SYSTEM SHALL MONITOR THE INDIVIDUAL SPACE TEMPERATURES SERVED BY THE UNIT.
  - THE DDC SHALL RESET THE DISCHARGE TEMPERATURE TO MEET THE GREATEST SPACE DEMAND.
  - HEATING MODE: UPON A CALL FOR HEATING, THE DDC SHALL ENABLE GAS HEAT TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.
  - DISCHARGE TEMPERATURE CONTROL: THE DISCHARGE TEMPERATURE SET POINT SHALL ADHERE TO THE FOLLOWING RESET SCHEDULE:
- |                        |                                |
|------------------------|--------------------------------|
| RETURN AIR TEMPERATURE | DISCHARGE TEMPERATURE SETPOINT |
| 60°F                   | 85°F                           |
- D. NIGHT SETBACK
- WHEN UNIT IS IN UNOCCUPIED MODE AND THE SPACE TEMPERATURE FALLS BELOW 60 DEG F, THE DDC SYSTEM SHALL START THE FAN AND COMMAND THE HEATING TO 100%. WHEN THE SPACE TEMPERATURE REACHES 63°F, THE FAN SHALL STOP AND THE DDC SYSTEM SHALL RELEASE THE HEATING COMMAND.
- E. MORNING WARMUP AND OPTIMIZATION
- THE DDC SYSTEM SHALL "LEARN" THE THERMAL CHARACTERISTICS OF THE BUILDING AND AIR HANDLING SYSTEMS TO PROVIDE OPTIMUM START TIMES FOLLOWING NIGHT SETBACKS. THE OPTIMUM START TIMES SHALL BE BASED ON LOGGED WARMUP TIMES, OUTSIDE AIR TEMPERATURES AND TIME OF DAY. THE DDC SYSTEM SHALL REFINES THE OPTIMUM START TO BE THE LATEST TIME TO HAVE THE SPACES UP TO OCCUPIED TEMPERATURE BY THE BEGINNING OF THE OCCUPIED PERIOD.
  - WHEN UNIT IS IN MORNING WARMUP MODE, THE DDC SYSTEM SHALL ENABLE THE INTERLOCKED EQUIPMENT. THE DDC SHALL COMMAND THE SYSTEM TO HEATING PER THE TEMPERATURE CONTROL SECTION.
  - THE UNIT MUST SWITCH TO OCCUPIED MODE WHEN SCHEDULED.
- F. SAFETIES AND ALARMS
- ANNUNCIATE ALARMS AT THE DDC SYSTEM'S FRONT-END COMPUTER WHEN ANY OF THE FOLLOWING EVENTS OCCUR. CREATE SEPARATE POINTS FOR EACH ALARM LISTED BELOW.
    - LOW-TEMPERATURE ALARM
      - WHEN THE SPACE TEMPERATURE ALARM SETPOINT OF 60°F (ADJ.) AN ALARM WILL BE INITIATED AT THE OPERATOR WORKSTATION.
- G. AIR FILTERS
- THE DDC PANEL SHALL MONITOR THE DIFFERENTIAL PRESSURE SWITCH ACROSS SPECIFIED FILTERS AND SHALL PROVIDE AN ALARM WHEN THE PRESSURE DROP EXCEEDS THE SETPOINT.
- H. FAN FAILURE
- ALARM WHEN CONTROLLER SENDS START OR STOP SIGNAL TO FAN AND THERE IS NO PROOF OF STATUS ALIGNMENT FOR ONE (1) MINUTE (ADJ.).

Date	No	Revision	By		

WTA CONTACT PERSON: DEVON DEBOER PHONE #: 360-201-6440

DESIGNED BY: BAQ  
DRAWN BY: KH  
CHECKED BY: BAQ



WHATCOM COUNTY  
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BELLINGHAM, WASHINGTON

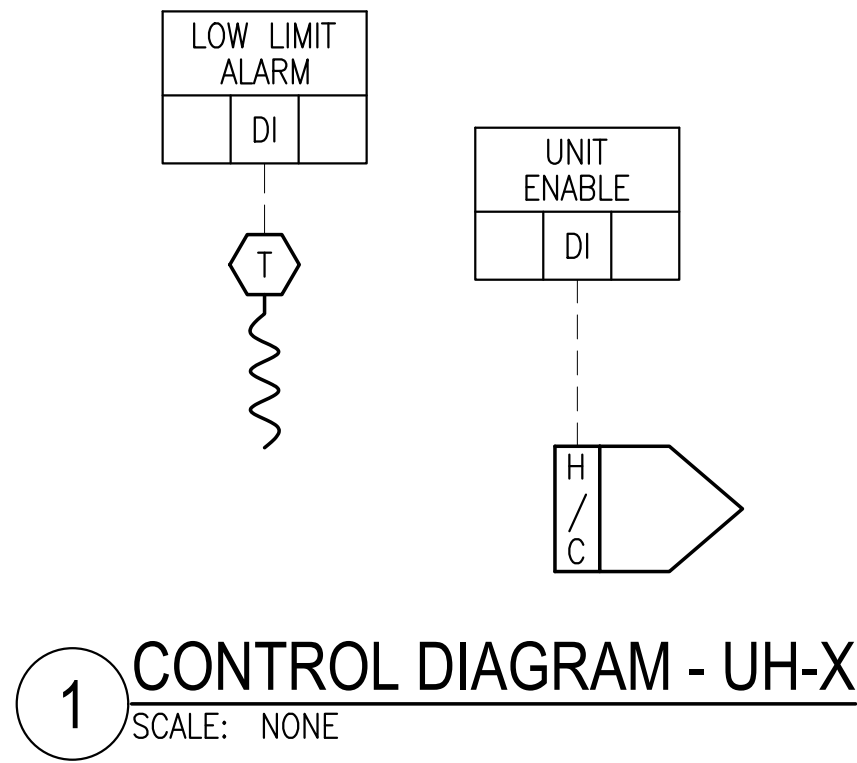


WTA PROJECT #: 2023-046 RFQ  
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SUBMITTAL DATE: 10/16/2024

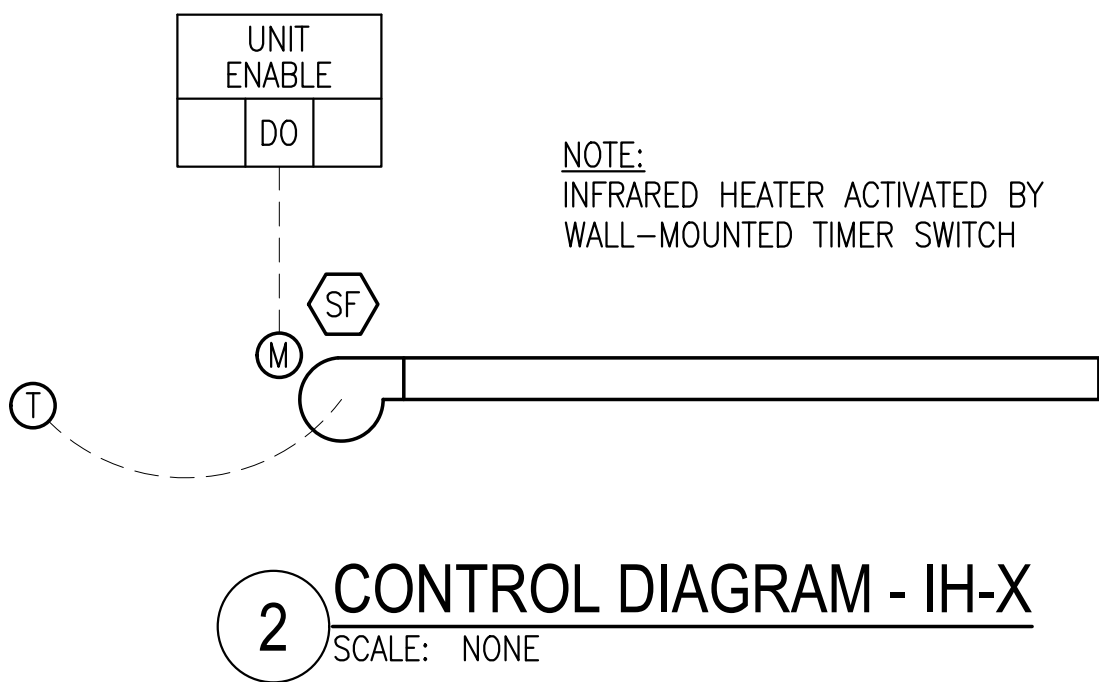
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WTA MOAB DDC UPGRADE  
CONTROL DIAGRAM & POINTS LIST

DWG # M7.08  
SHEET # 17 of 18



SYSTEM NAME: GAS-FIRED UNIT HEATERS						
DESCRIPTION:	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS (DI)	NOTES
UH-1, UH-2, UH-3						
UNIT ENABLE	1					
LOW-LIMIT ALARM					1	UH-3 ALARM GENERATED BY T-STAT ON EF-7
TOTAL NUMBER OF POINTS:	1				1	
GRAND TOTAL NUMBER OF POINTS:	6					



SYSTEM NAME: INFRARED HEATERS						
DESCRIPTION:	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS	NOTES
IH-1 - IH-8 (IH-3 NOT USED)						
UNIT ENABLE	1					
THERMOSTAT OVERRIDE LOCKOUT	1					
TOTAL NUMBER OF POINTS:	2					
GRAND TOTAL NUMBER OF POINTS:	14					

SYSTEM NAME: MISC.						
DESCRIPTION:	DIGITAL OUTPUTS	DIGITAL INPUTS	ANALOG OUTPUTS	ANALOG INPUTS	ALARMS	NOTES
ROOM TEMPERATURE SENSOR				3		WASHDOWN RECLAIM, WASH BAYS, SPRINKLER ROOM LOW ROOM TEMP. ALARMS. REPLACE EXISTING DEVICES
PAINT BOOTH FAN INTERLOCK				1		INTERLOCK W/MAH-2
FIRE/SMOKE DAMPERS				3		MONITORED FOR STATUS
TOTAL NUMBER OF POINTS:				7		
GRAND TOTAL NUMBER OF POINTS:	7					

Date	No	Revision	By

DESIGNED BY: BAO  
DRAWN BY: KH  
CHECKED BY: BAO



WHATCOM COUNTY  
TRANSPORTATION AUTHORITY  
BELLINGHAM, WASHINGTON



WTA PROJECT #: 2023-046 RFQ  
CONSULTANT #:  
SUBMITTAL DATE: 10/16/2024

ISSUED FOR BID

WTA MOAB DDC UPGRADE  
CONTROL DIAGRAMS & POINTS LIST

DWG # M7.09  
SHEET # 18 of 18