Drawing Designation: Update

Webster University ISB - HVAC Controls

470 E. Lockwood Ave.

Webster Groves, MO 63119

As Prepared By:

Automatic Controls Equipment Systems, Inc.

11088 Gravois Industrial Court

St. Louis, MO, 63128

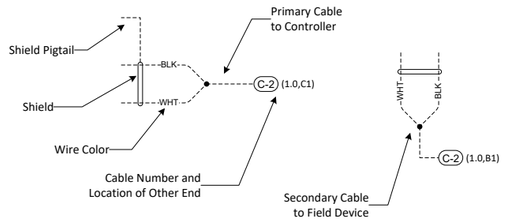
T: (314) 722-2727 F: (314) 722-2728

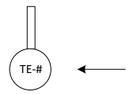
PROJECT TEAM

Client Name:	Webster University
Owner:	Webster University
Architect:	KWA Architects
MEP Engineer:	William Tao & Associates
Mechanical Contractor:	icon Mechanical
Electrical Subcontractor:	Precision Electrical Automation Services

ALC Design Engineer:	Paul Lane
ALC Project Manager:	Mike Manzelli
Project Number:	WU-01-16
Drawing Date:	1/5/2017

LEGEND





Field Mounted Instrument
Note: Devices shown without an associated tag number identify reused devices.

Pneumatic Tubing

Line Voltage Wire

Ethernet (Cat 6 RJ45 Cable)

18/2 NS White (unless noted otherwise for 18/4, 18/6, etc)

22/2 SH Green ARC156/Modbus/BACNet MS/TP

14/2 SH Yel/Wht Power Wiring

18/4 SH Blue R-Net Wiring

120 Ω — 120 Ohm End of Line Resistor, 1/4 Watt, +/- 1%

BT485 — Plug-In EOL Terminator & Bias Amplifier for ARC156 Network

L — High Voltage Terminal

T1 — Low Voltage Terminal

A — Low Voltage 24V DC Connection

24V H — Low Voltage 24V AC Connection

Miscellaneous Notations

FLP = Fails At Last Position
FC = Fails Closed
FO = Fails Open

TAG DESCRIPTIONS

AA	Remote Annunciator Module & Auto Dialer	PDS	Pressure Differential Switch
ALC	Automated Logic Controller	PDT	Pressure Differential Transmitter
ASA	Smoke Detector	PS	Pressure Switch
CR	Control Relay	PT	Pressure Transmitter
ENC	Enclosure	QT	Gas Transmitter
ES	Direct Current Power Supply	RK	Retrofit Kit
FCV	Flow Control Valve / Damper Actuator	RP	Relay Panel
FE	Flow Element	SC	Satellite Controller
FS	Flow Switch	ST	Speed Transmitter
FT	Flow Transmitter	SUB	Subpanel
G	Generic Device	TE	Temperature Element
IP	Electro-Pneumatic Transducer	TS	Temperature Switch
IS	Current Switch	TSH	Temperature Switch High
ISE	Circuit Breaker	TSL	Temperature Switch Low
IT	Current Transducer	TT	Temperature Transmitter
JT	BTU Meter	TY	Dew Pt./Enthaply/Wet Bulb Transducer
JY	Power Meter	V	Valve
KS	Electronic Timeclock	VT	Vibration Transmitter / Switch
LS	Level Switch	X	Unclassified
LT	Level Transmitter	XF	Transformer
MS	Humidistat	YKS	Position Transmitter
MT	Humidity Transmitter	YL	Position Transmitter
MTE	Humidity Transmitter w/ Temperature Element	YS	Leak Detector
MTT	Humidity Transmitter w/ Temperature Transmitter	YSE	Emergency Stop
N	Accessories	YY	Transducer
NY	Network Device	ZC	Zone Controller
P	Pressure Probe	ZS	Position Indicating Switch
		ZT	Position Transmitter

DRAWING NO.: SYM.1

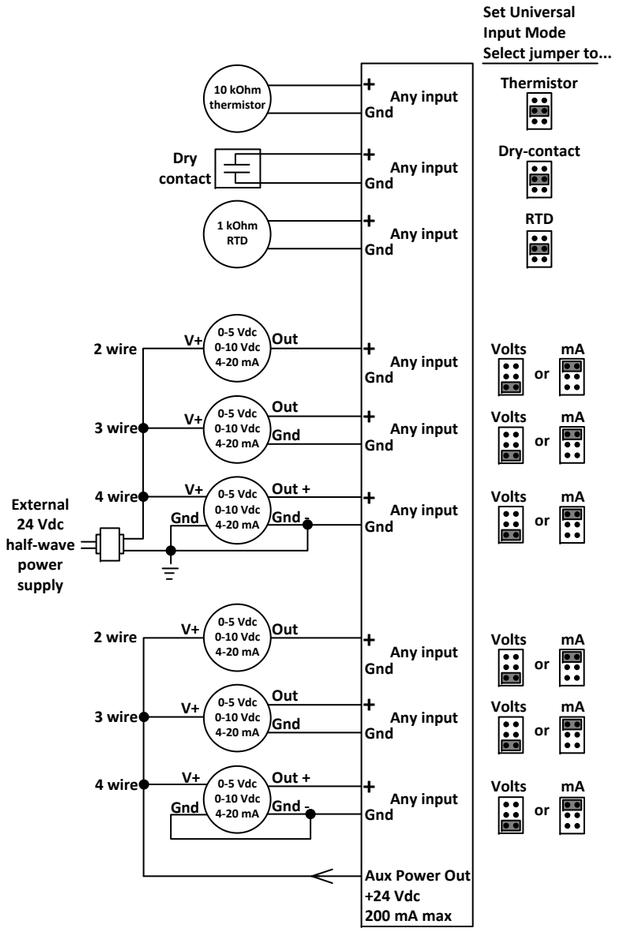
Input/Output Wiring Details & Specifications

Input Wiring Specifications

Input Wiring

Input	Maximum length	Minimum gauge	Shielding
0-5 Vdc 0-10 Vdc	1000 feet (305 meters)	See Cable Specification Chart	
0-20 mA	3000 feet (914 meters)	See Cable Specification Chart	
Thermistor Dry contact Pulse counter TLO	1000 feet (305 meters)	See Cable Specification Chart	
RTD	100 feet (30 meters)	See Cable Specification Chart	

Input Wiring Details



Output Wiring Specifications

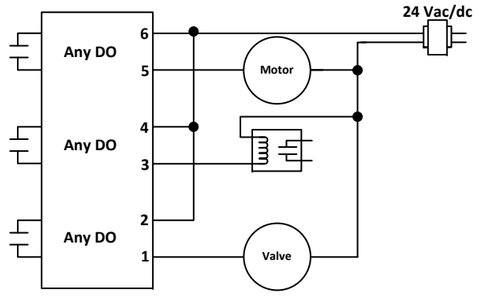
Output Wiring

To size output wiring, consider the following:

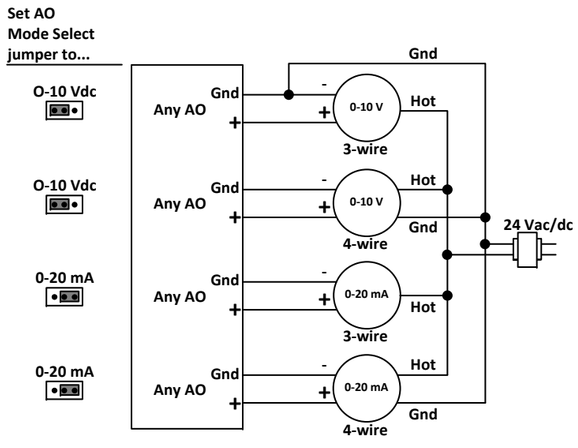
- Total loop distance from the power supply to the control module, and then to the controlled device

  NOTE Include the total distance of actual wire. For 2-conductor wires, this is twice the cable length
- Acceptable voltage drop in the wire from the control module to the controlled device
- Resistance (Ohms) of the chosen wire gauge
- Maximum current (Amps) the controlled device requires to operate

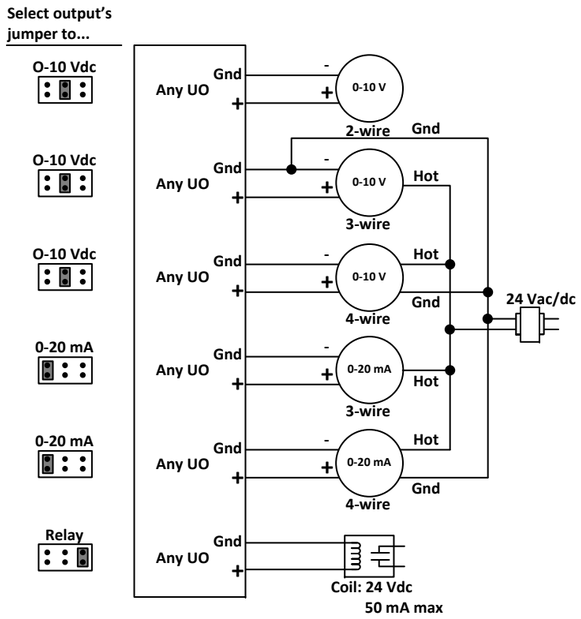
Digital Output Wiring Details



Analog Output Wiring Details



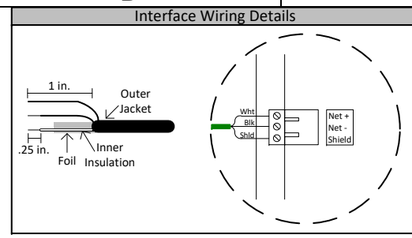
Universal Output Wiring Details

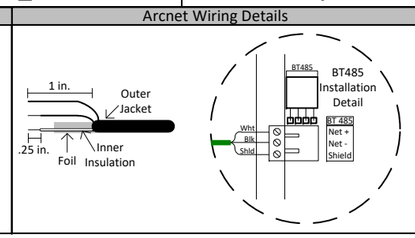


DRAWING NO.: WIRE.1

DRAWING#	DRAWING NAME
14.4	Exhaust Fans Sequence of Operations
15.1	IT/MDF Room Temperature Monitoring (Typ. of 5)
16.1	Building Power Meter & Generator Monitoring
17.1	Phoenix Controls: BACnet IP Wiring
17.2	Phoenix Controls: LON Network
17.3	Phoenix Controls: LON Network Continued
17.4	Phoenix Controls: Celers 2 Lab Detail 1
17.5	Phoenix Controls: Celers 2 Lab Detail 3
17.6	Phoenix Controls: Celers 2 Lab Detail 5
17.7	Phoenix Controls: Traccel Tracking Pair Detail 6
17.8	Phoenix Controls: Hood Valve with Fume Hood Display Wiring
17.9	Phoenix Controls: Space Temperature Sensor
17.10	Phoenix Controls: Wiring
17.11	Phoenix Controls: Vantage Specifications
17.12	Laboratory Controls Sequence of Operations
17.13	Laboratory Controls Sequence of Operations
17.14	Integration Points List
17.15	1st Level Room Schedule Sheet
17.16	2nd Level Room Schedule Sheet
17.17	3rd Level Room Schedule Sheet
17.18	4th Level Room Schedule Sheet
18.1	Variable Air Volume Unit Schedule
18.2	Variable Air Volume Unit Schedule
18.3	Air Handling Unit Valve Schedules
18.4	Unit Heater/Cabinet Unit Heater Valve Schedules
18.5	Fin Tube Radiation Valve Schedule
18.6	Supply Air Valve Schedule
18.7	Variable Air Volume Valve Schedule
18.8	Variable Air Volume Valve Schedule
18.9	Belimo Characterized Control Valve Installation Details
18.10	Master Material List

Primary ARCnet Network Riser



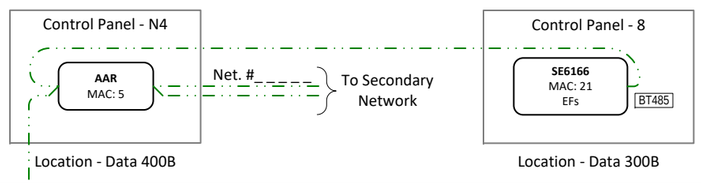


Instrument List

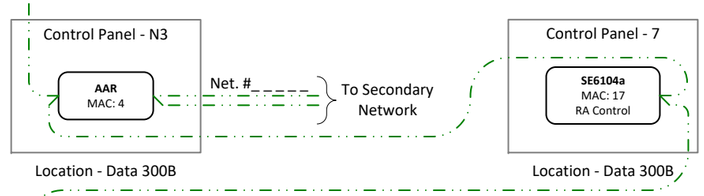
Tag	*Product Description*	*Manufacturer*	*Part Number*	*Quantity*
ALC-12	ARCNET156 Terminating and Biasing plug in board	Automated Logic	BT485	2

Notes:

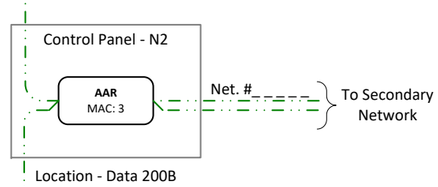
1. The BMS Riser is intended only to provide an overview of the system architecture. DDC devices are not intended to be wired in exactly the order shown. Optimal wiring runs to be determined in field.
2. All devices are to be wired in a daisy chain configuration.



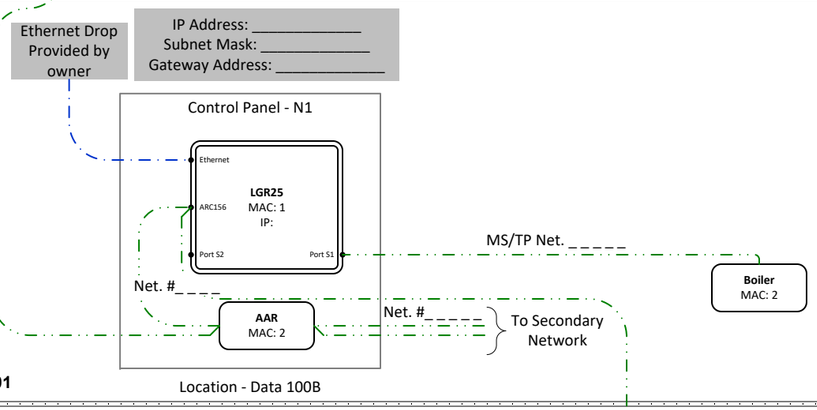
Level 04



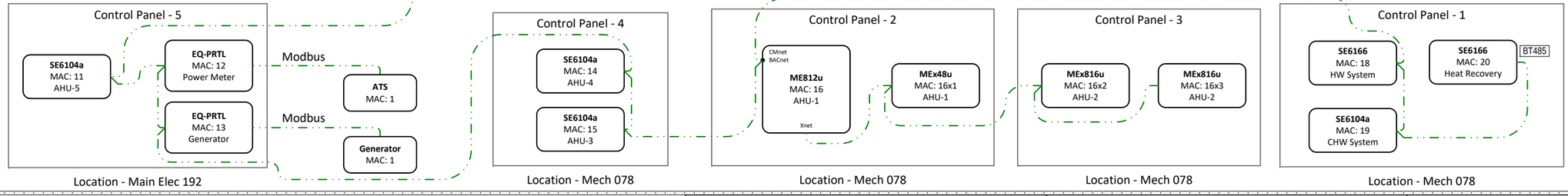
Level 03



Level 02



Level 01



Level 00

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (1) Network Riser

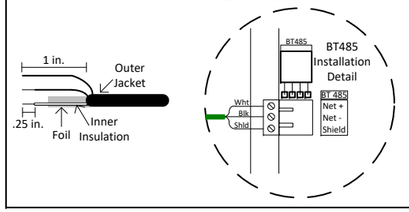
DRAWING NAME: Primary ARCnet Network Riser

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 1.1

Level 01 Secondary ARCnet Network Riser

Arcnet Wiring Details

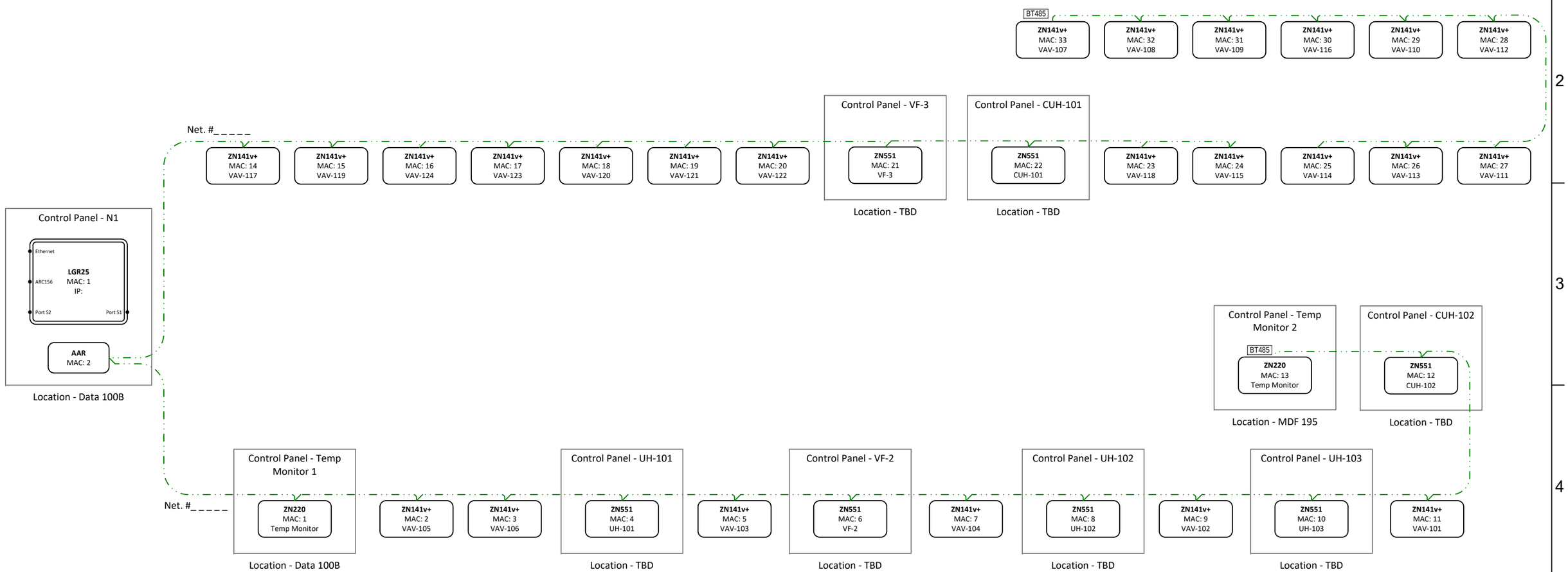


Instrument List

Tag	*Product Description*	*Manufacturer*	*Part Number*	*Quantity*
ALC-12	ARCNET156 Terminating and Biasing plug in board	Automated Logic	BT485	2

Notes:

1. The BMS Riser is intended only to provide an overview of the system architecture. DDC devices are not intended to be wired in exactly the order shown. Optimal wiring runs to be determined in field.
2. All devices are to be wired in a daisy chain configuration.



Level 01

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Webster Groves, MO 63119

FILENAME: (1) Network Riser

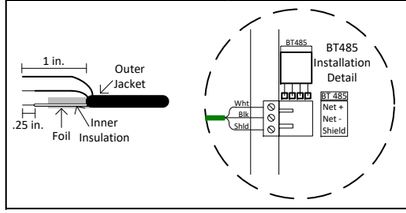
DRAWING NAME: Level 01 Secondary ARCnet Network Riser

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 1.2

Level 02 Secondary ARCnet Network Riser

Arcnet Wiring Details

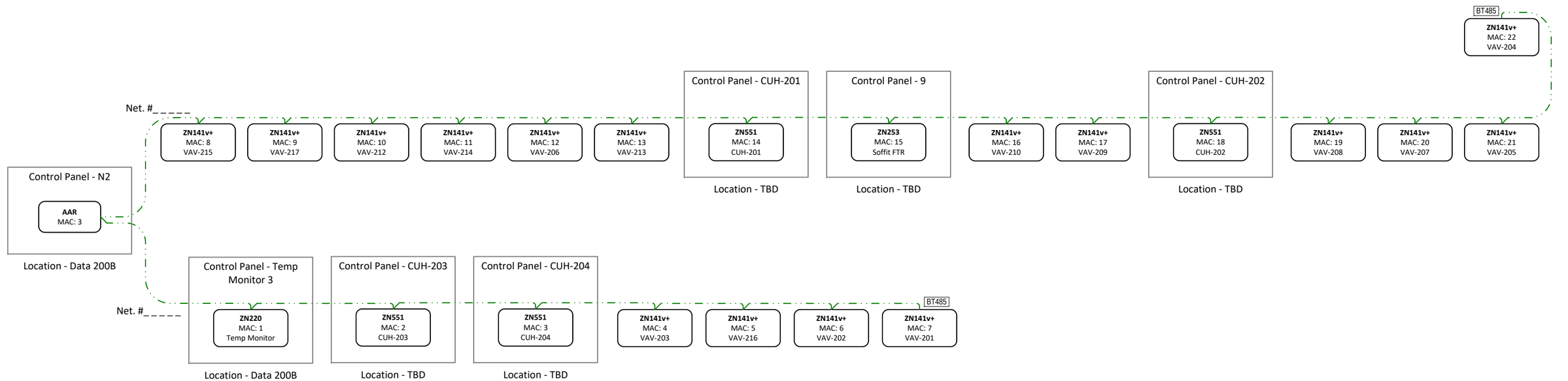


Instrument List

Tag	*Product Description*	*Manufacturer*	*Part Number*	*Quantity*
ALC-12	ARCNET156 Terminating and Biasing plug in board	Automated Logic	BT485	2

Notes:

1. The BMS Riser is intended only to provide an overview of the system architecture. DDC devices are not intended to be wired in exactly the order shown. Optimal wiring runs to be determined in field.
2. All devices are to be wired in a daisy chain configuration.



Level 02

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Webster Groves, MO 63119

FILENAME: (1) Network Riser

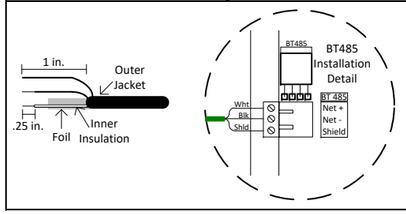
DRAWING NAME: Level 02 Secondary ARCnet Network Riser

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 1.3

Level 03 Secondary ARCnet Network Riser

Arcnet Wiring Details

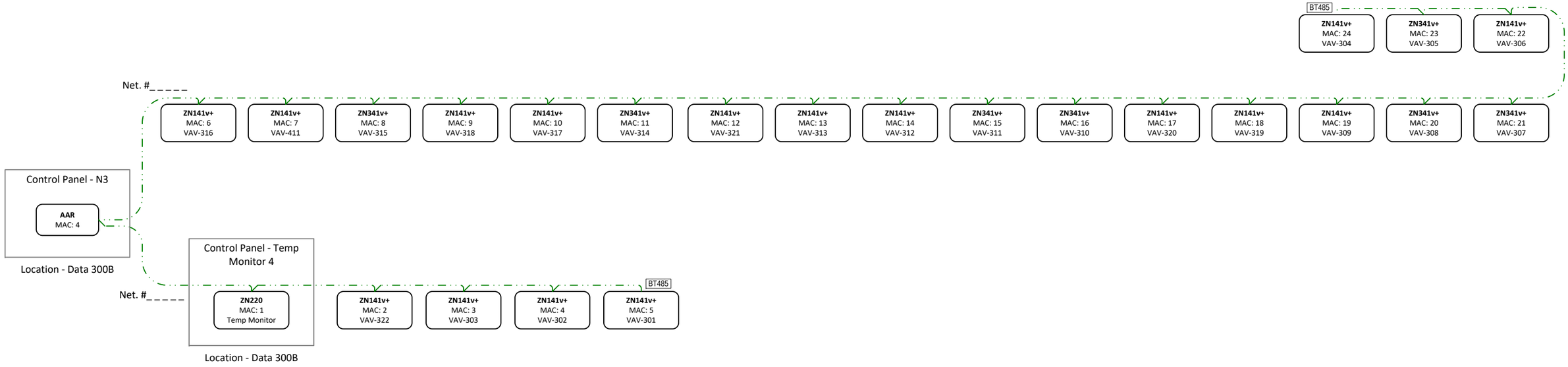


Instrument List

Tag	*Product Description*	*Manufacturer*	*Part Number*	*Quantity*
ALC-12	ARCNET156 Terminating and Biasing plug in board	Automated Logic	BT485	2

Notes:

1. The BMS Riser is intended only to provide an overview of the system architecture. DDC devices are not intended to be wired in exactly the order shown. Optimal wiring runs to be determined in field.
2. All devices are to be wired in a daisy chain configuration.



Level 02

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470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (1) Network Riser

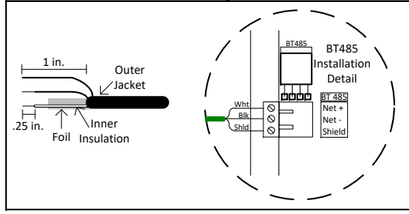
DRAWING NAME: Level 03 Secondary ARCnet Network Riser

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 1.4

Level 04 Secondary ARCnet Network Riser

Arcnet Wiring Details

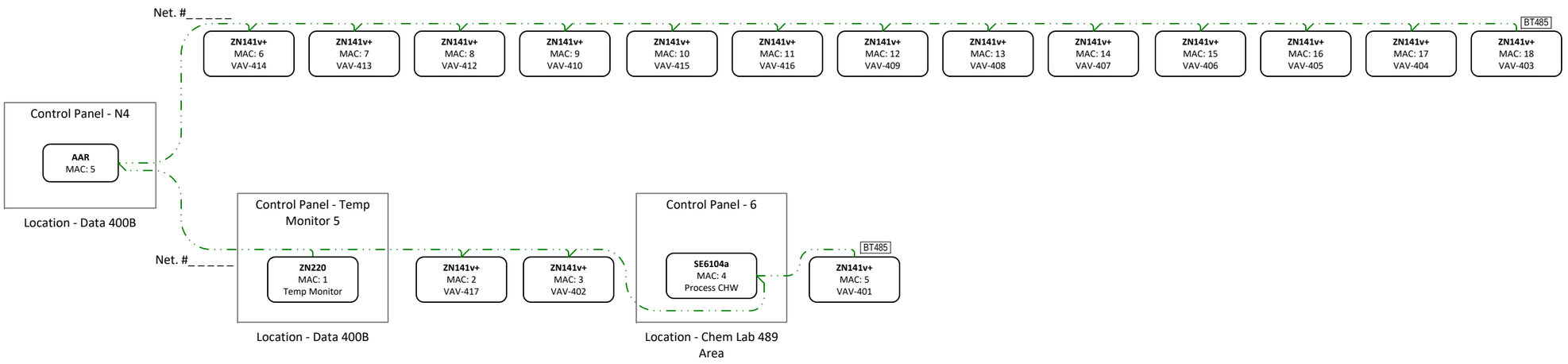


Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-12	ARCNET156 Terminating and Biasing plug in board	Automated Logic	BT485	2

Notes:

1. The BMS Riser is intended only to provide an overview of the system architecture. DDC devices are not intended to be wired in exactly the order shown. Optimal wiring runs to be determined in field.
2. All devices are to be wired in a daisy chain configuration.



Level 02

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Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (1) Network Riser

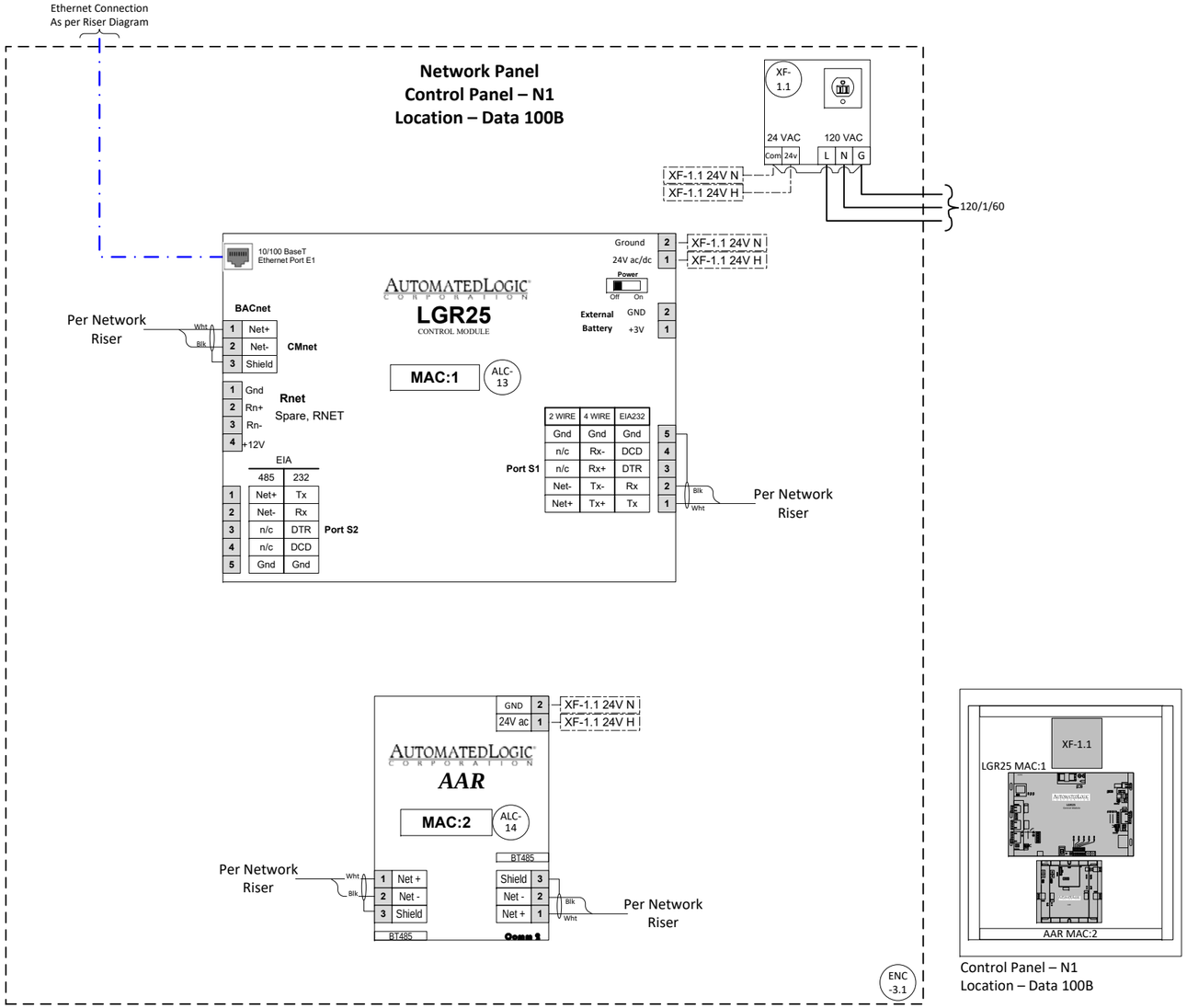
DRAWING NAME: Level 04 Secondary ARCnet Network Riser

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 1.5

LGR25 Details

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
ALC-13	BACnet Router, 25 Point Gateway	Automated Logic	LGR25	1
ALC-14	ARCNET to ARCNET Router	Automated Logic	AAR	1
XF-1.#	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	Functional Devices	PSB100AB10	1
ENC-3.#	20" x 24" (Medium) Control Panel	Saginaw	SCE-24N2006NKT	1



Control Panel – N1
Location – Data 100B

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Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (1) Network Riser

DRAWING NAME: LGR25 Details

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

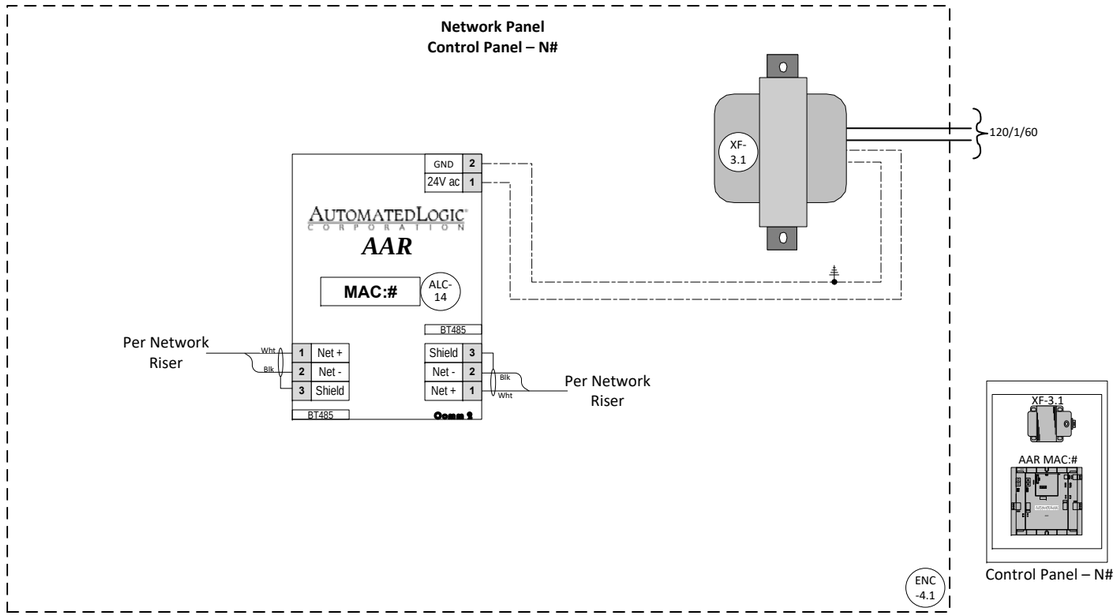
DRAWING NO.: 1.6

AAR Details (Typ. of 3)

Control Panel	Location
N2	Data 200B
N3	Data 300B
N4	Data 400B

Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
ENC-4.#	10"x15" (small) Control Panel With Lexan Door	ALPS	YM9050	3
ALC-14	ARCNET to ARCNET Router	Automated Logic	AAR	3
XF-3.#	24V Transformer, 40VA	Core Lectro	LE11300	3



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FILENAME: (1) Network Riser

DRAWING NAME: AAR Details (Typ. of 3)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 1.7

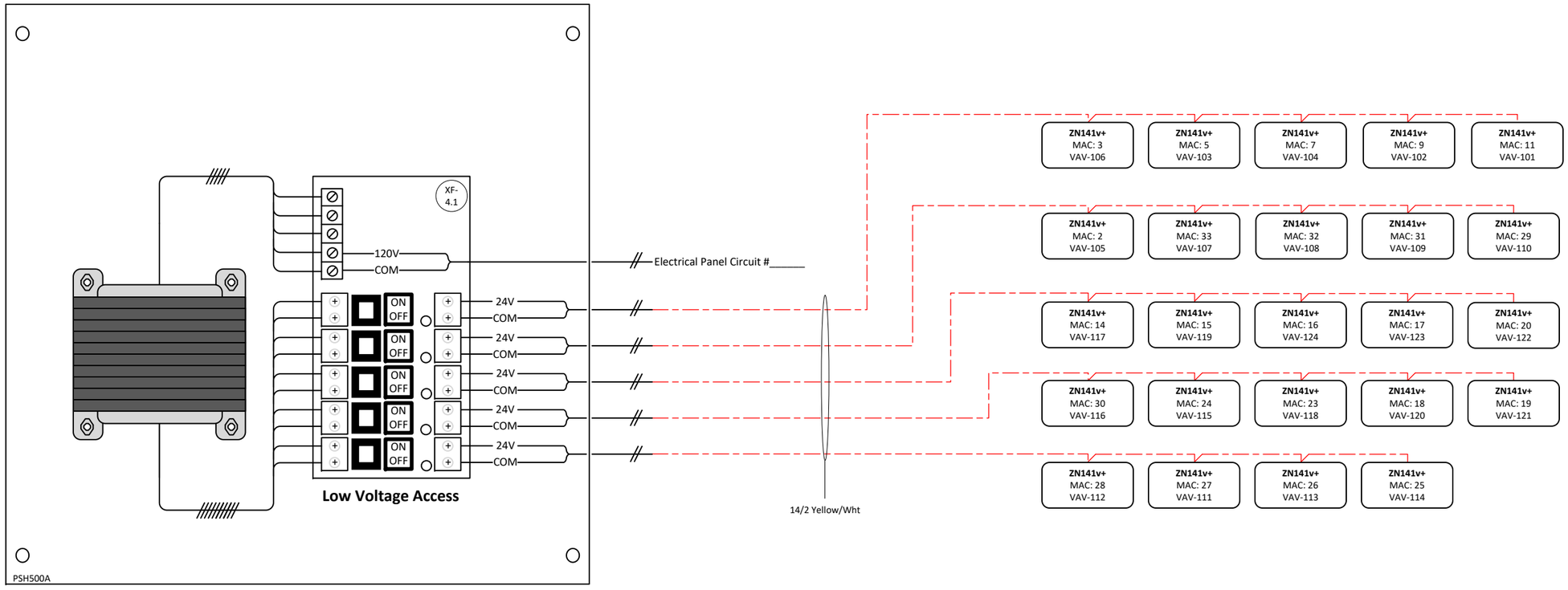
Level 01 24V Power Riser

Instrument List				
Tag	Product Description	Manufacturer	Part Number	Quantity
XF-4.#	Enclosed 500VA Pwr Supply, 5x100VA Circuits	Functional Devices	PSH500A	1

Notes:

1. This power riser shows the wiring in a daisy chained configuration. It is best to run the power wiring the shortest distance possible to the transformer. You can star the power cable. Keep the maximum length from the transformer to VAV at 200' or less. The maximum number of VAV's per circuit is 5. The wiring runs will need to documented for As-Built documentation.

Power Distribution Panel - Wiring Detail
Location: TBD



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Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (2) 24V Power Riser

DRAWING NAME: Level 01 24V Power Riser

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 2.1

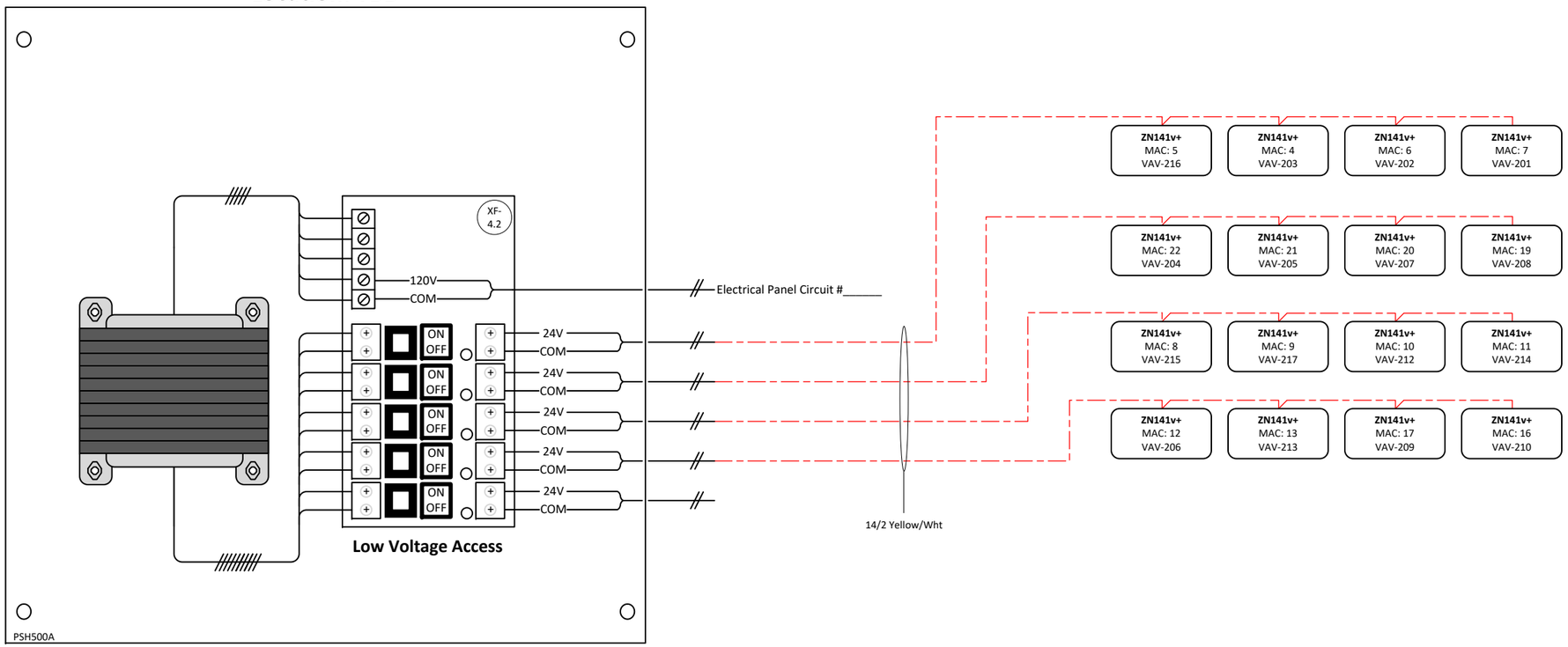
Level 02 24V Power Riser

Instrument List				
Tag	Product Description	Manufacturer	Part Number	Quantity
XF-4.#	Enclosed 500VA Pwr Supply, 5x100VA Circuits	Functional Devices	PSH500A	1

Notes:

1. This power riser shows the wiring in a daisy chained configuration. It is best to run the power wiring the shortest distance possible to the transformer. You can star the power cable. Keep the maximum length from the transformer to VAV at 200' or less. The maximum number of VAV's per circuit is 5. The wiring runs will need to documented for As-Built documentation.

Power Distribution Panel - Wiring Detail
Location: TBD



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Webster Groves, MO 63119

FILENAME: (2) 24V Power Riser

DRAWING NAME: Level 02 24V Power Riser

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 2.2

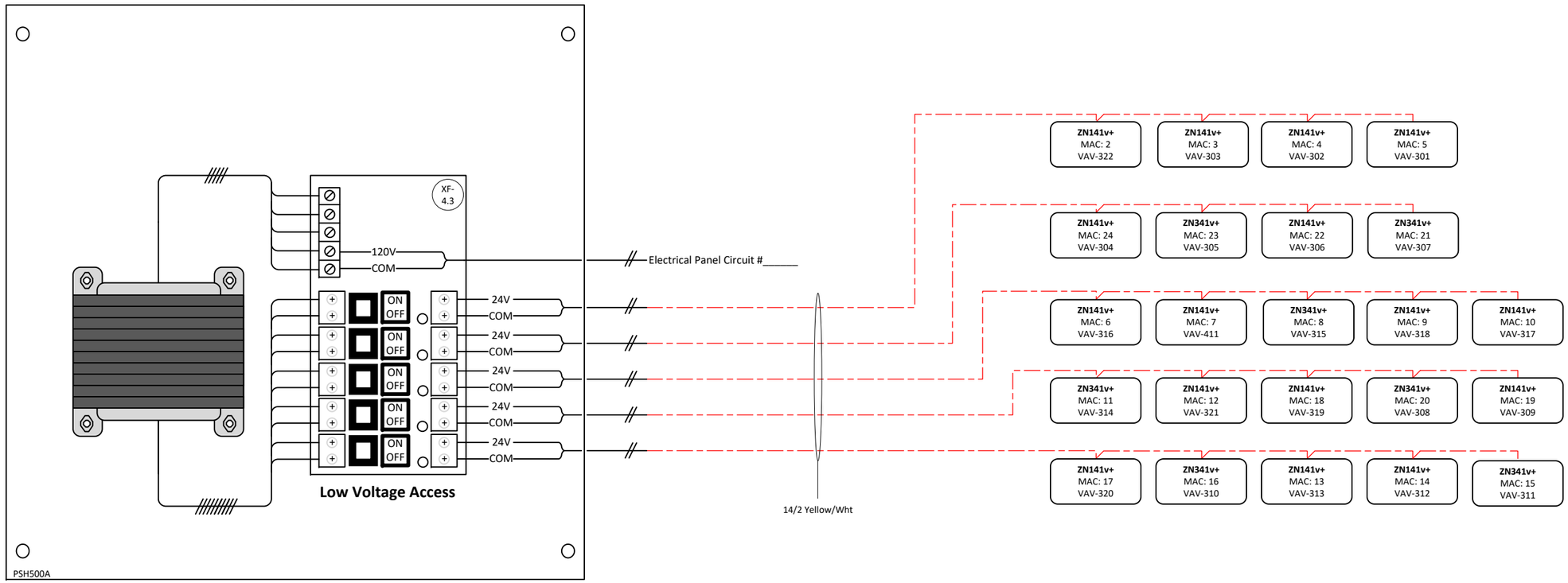
Level 03 24V Power Riser

Instrument List				
Tag	Product Description	Manufacturer	Part Number	Quantity
XF-4.#	Enclosed 500VA Pwr Supply, 5x100VA Circuits	Functional Devices	PSH500A	1

Notes:

1. This power riser shows the wiring in a daisy chained configuration. It is best to run the power wiring the shortest distance possible to the transformer. You can star the power cable. Keep the maximum length from the transformer to VAV at 200' or less. The maximum number of VAV's per circuit is 5. The wiring runs will need to documented for As-Built documentation.

Power Distribution Panel - Wiring Detail
Location: TBD



Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (2) 24V Power Riser

DRAWING NAME: Level 03 24V Power Riser

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 2.3

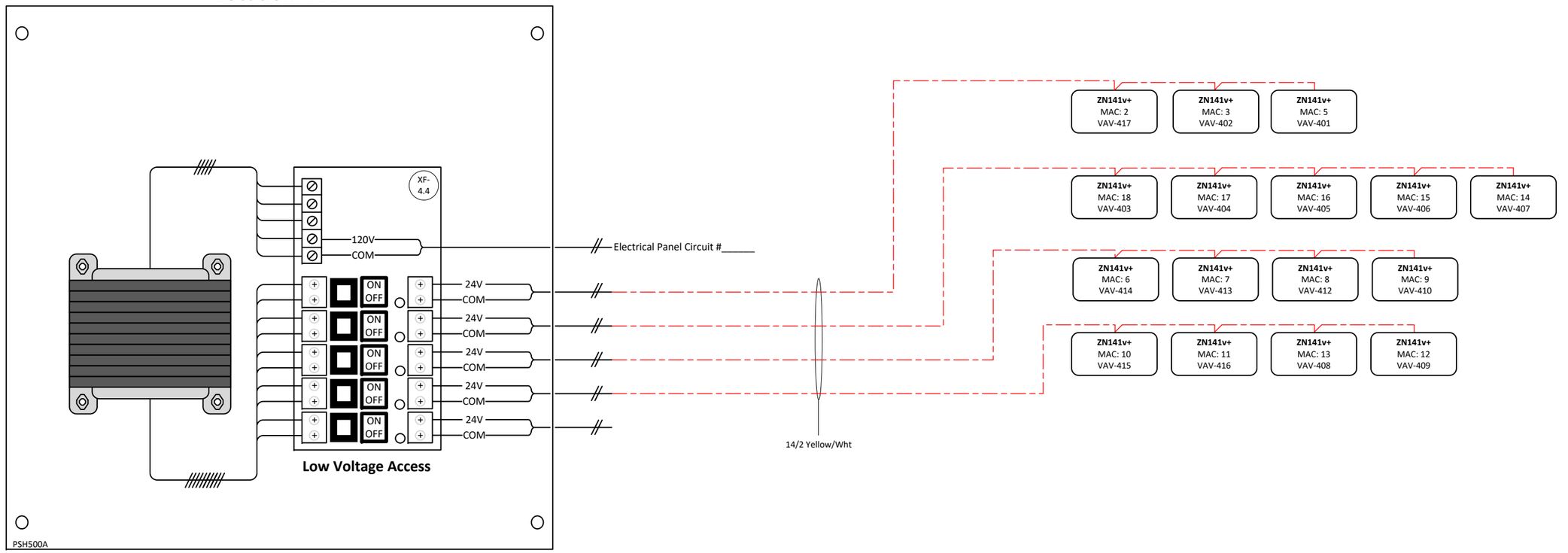
Level 04 24V Power Riser

Instrument List				
Tag	Product Description	Manufacturer	Part Number	Quantity
XF-4.#	Enclosed 500VA Pwr Supply, 5x100VA Circuits	Functional Devices	PSH500A	1

Notes:

1. This power riser shows the wiring in a daisy chained configuration. It is best to run the power wiring the shortest distance possible to the transformer. You can star the power cable. Keep the maximum length from the transformer to VAV at 200' or less. The maximum number of VAV's per circuit is 5. The wiring runs will need to documented for As-Built documentation.

Power Distribution Panel - Wiring Detail
Location: TBD



Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (2) 24V Power Riser

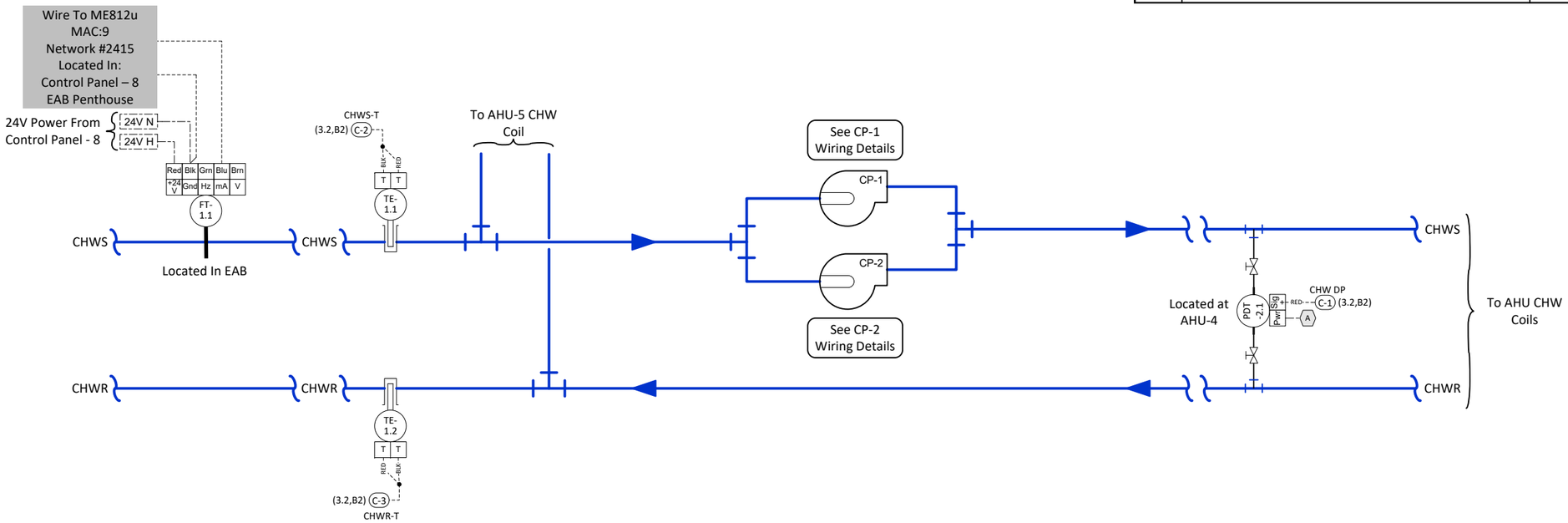
DRAWING NAME: Level 04 24V Power Riser

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

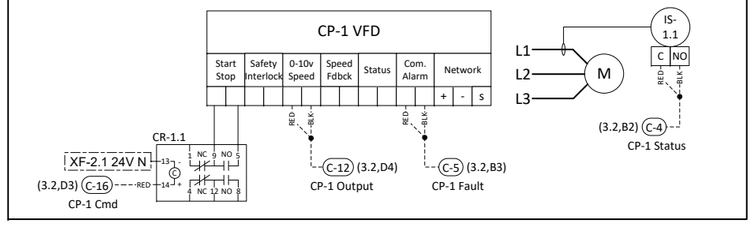
DRAWING NO.: 2.4

Chilled Water System

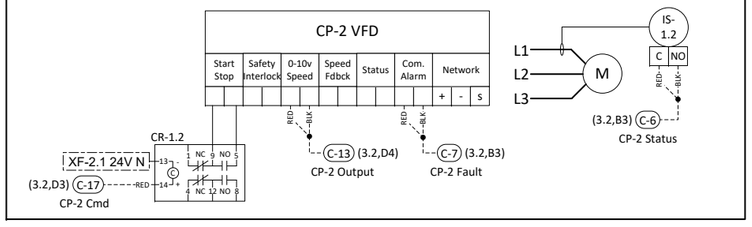
Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
TE-1.#	Immersion 4" Insertion, BAPI Box 4 IP44, w/304 Stainless Thermowell	BAPI	ALC/10K-2-I-4"-BB4 + BA/4" M304	2
IS-1.#	Current Switch, Split Core, Adj. Setpoint to 0.5A	Functional Devices	RIBXGTA	2
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	2
FT-1.#	Insertion Flow Meter, Analog Output	Onicon	F-1210	1
PDT-2.#	Differential Pressure Sensor (wet), 0-100 PSIG, 0-100 PSID	Veris	PW2XX04S	1



CP-1 Wiring Details



CP-2 Wiring Details



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Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (3) Chilled Water System

DRAWING NAME: Chilled Water System

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

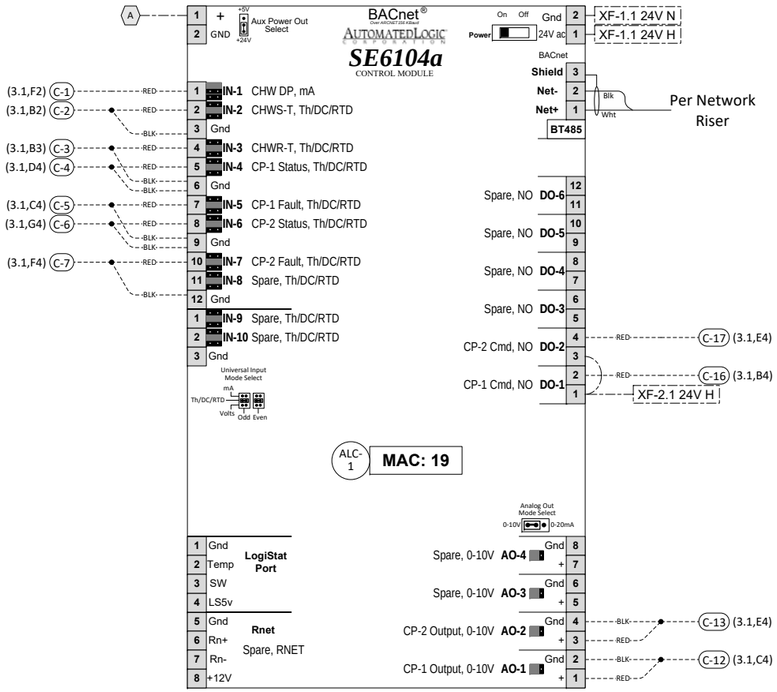
DRAWING NO.: 3.1

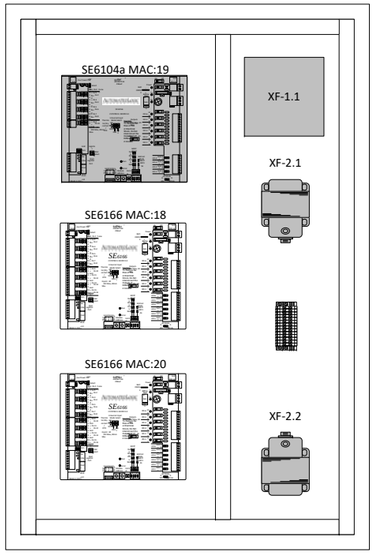
Chilled Water System Controller Details

Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-1	Control Module, 6DO, 10UI, 4AO	Automated Logic	SE6104a	1
XF-2.#	24V Transformer, 96VA	Core Lectro	LE12100	2
XF-1.#	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	Functional Devices	PSB100AB10	1
ENC-1.#	24" x 36" (Large) Control Panel	Saginaw	SCE-36N2406NKT	1

CHW/HW/HR System Control Panel
Control Panel - 1
Location – Mech 078





Control Panel - 1
Location – Mech 078

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FILENAME: (3) Chilled Water System

DRAWING NAME: Chilled Water System Controller Details

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 3.2

Chilled Water System Sequence of Operations

Building/Booster Chilled Water Pumps CP-1 and CP-2

Run Conditions:
The chilled water pumps will be enabled whenever a definable number of chilled water coils need cooling and we are not meeting the differential pressure set point.

To prevent short cycling, the chilled water pump system will run for and be off for minimum adjustable times (both user definable).

Chilled Water Pump Lead/Lag Operation:
The two (2) variable speed chilled water pumps will operate in a lead/lag fashion.

The lead pump will run first. On failure of the lead pump, the lag pump will run and the lead pump will turn off. On decreasing chilled water differential pressure, the lag pump will stage on and run in unison with the lead pump to maintain chilled water differential pressure set point.

The designated lead pump will rotate upon one of the following conditions (user selectable):

- manually through a software switch
- if pump runtime (adj.) is exceeded
- daily
- weekly
- monthly

Alarms will be provided as follows:

- Chilled Water Pump 1:
  - Failure: Commanded on, but the status is off.
  - Running in Hand: Commanded off, but the status is on.
  - Runtime Exceeded: Status runtime exceeds a user definable limit.
  - VFD Fault.
- Chilled Water Pump 2:
  - Failure: Commanded on, but the status is off.
  - Running in Hand: Commanded off, but the status is on.
  - Runtime Exceeded: Status runtime exceeds a user definable limit.
  - VFD Fault.

Chilled Water Differential Pressure Control:
The controller will measure chilled water differential pressure and modulate the chilled water pump VFDs in sequence to maintain its chilled water differential pressure set point reset based on valve positions. All set points will be field adjusted during the commissioning period to meet the requirements of actual field conditions.

The controller will modulate chilled water pump speeds to maintain a chilled water differential pressure of 10 psi (adj.) when a user definable amount of chilled water valves are above 90% (adj.). The differential pressure setpoint will reset downwards as the valves close. The VFDs minimum speed will not drop below 20 percent (adj.). On dropping chilled water differential pressure, the VFDs will stage on and run to maintain set point as follows:

The controller will modulate the lead VFD to maintain set point. If the lead VFD speed is greater than a set point of 66 percent (adj.), the lag VFD will stage on.

The lag VFD will ramp up to match the lead VFD speed and then run in unison with the lead VFD to maintain set point.

On rising chilled water differential pressure, the VFDs will stage off as follows:

If the VFDs speed then drops back to 50 percent (adj.), the lag VFD will stage off.

The lead VFD will continue to run to maintain set point.

Alarms will be provided as follows:

- High Chilled Water Differential Pressure: If the chilled water differential pressure is 25 percent (adj.) greater than set point.
- Low Chilled Water Differential Pressure: If the chilled water differential pressure is 25 percent (adj.) less than set point.

Chilled Water Flow Control:
The controller will monitor the chilled water flow and use it to calculate load.

Chilled Water Temperature Monitoring:
The following temperatures will be monitored:

- Chilled water supply.
- Chilled water return.

Alarms will be provided as follows:

- High Chilled Water Supply Temp: If the chilled water supply temperature is greater than 55°F (adj.).
- Low Chilled Water Supply Temp: If the chilled water supply temperature is less than 38°F (adj.).

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FILENAME: (3) Chilled Water System

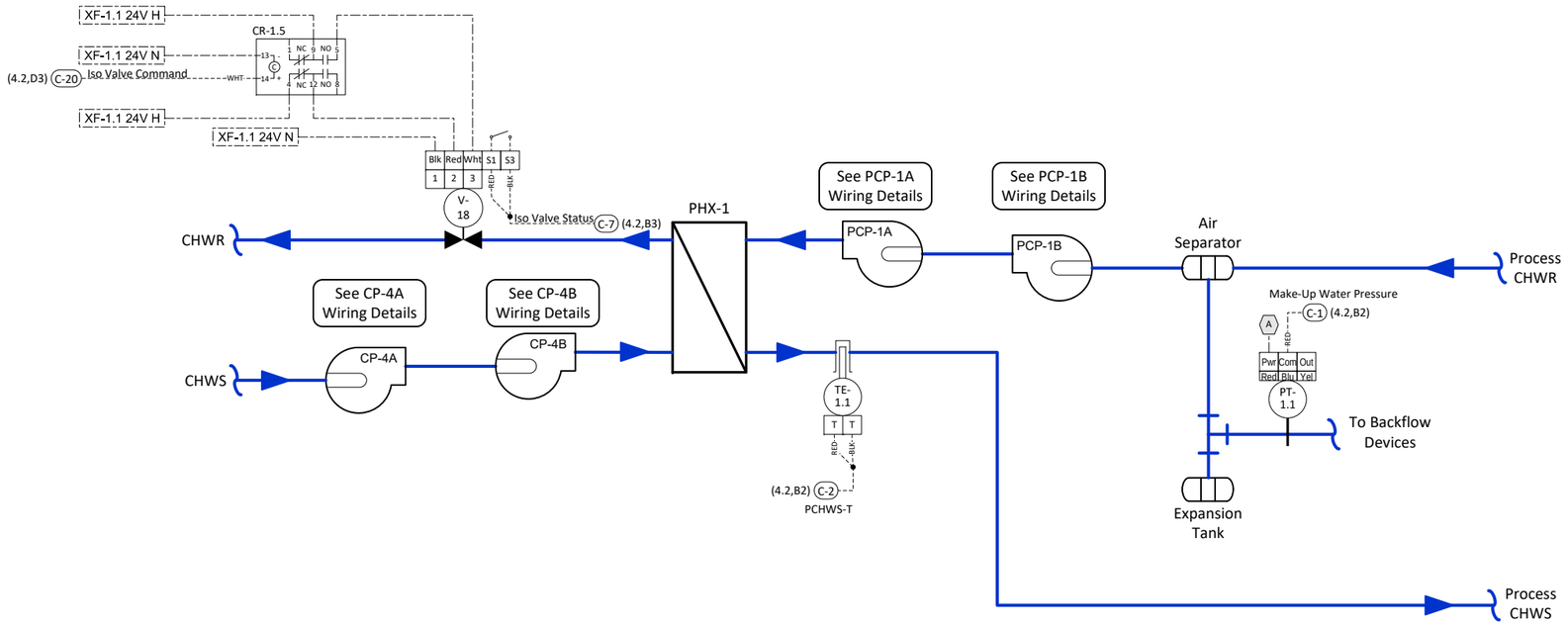
DRAWING NAME:
Chilled Water System Sequence of Operations

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

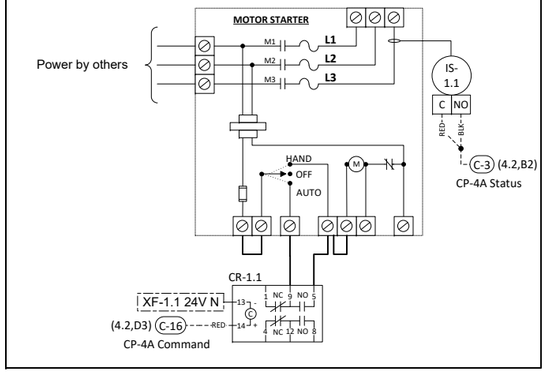
DRAWING NO.: 3.3

Process Chilled Water Loop

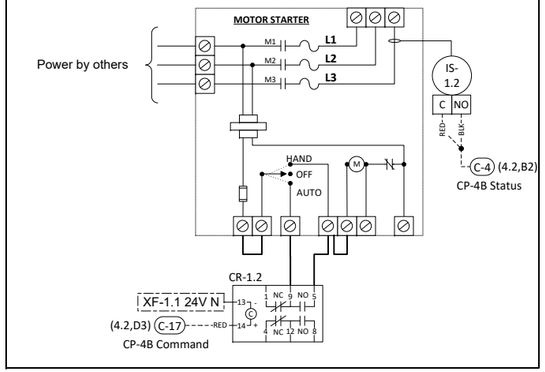
Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
TE-1.1	Immersion 4" Insertion, BAPI Box 4 IP44, w/304 Stainless Thermowell	BAPI	ALC/10K-2-I-4"-BB4 + BA/4" M304	1
V-18	CCV, 1 1/2", 2 Way, 19 CV, w/ Non-Spring, 24V, ON/OFF	Belimo	B238+NC+ARB24-3-S	1
IS-1.#	Current Switch, Split Core, Adj. Setpoint to 0.5A	Functional Devices	RIBXGTA	4
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	5
PT-1.1	Gauge Press Sensor, 0-100psig, 4-20mA	Veris	PG07AM	1



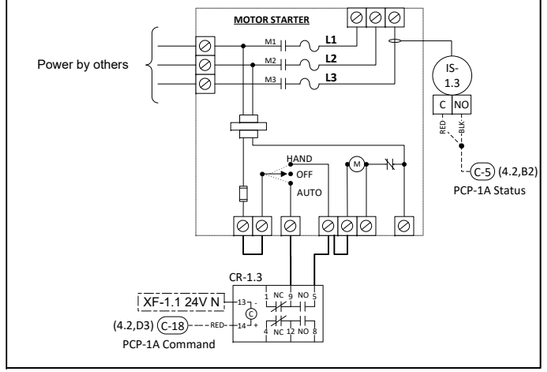
CP-4A Wiring Details



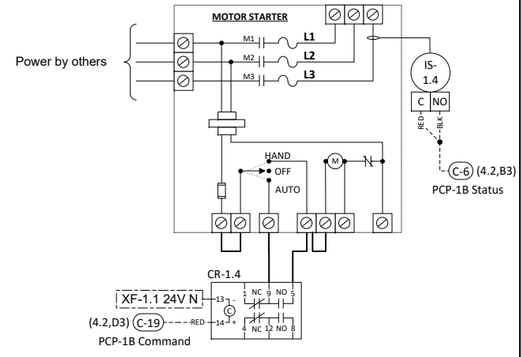
CP-4B Wiring Details



PCP-1A Wiring Details



PCP-1B Wiring Details



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Webster Groves, MO 63119

FILENAME: (4) Process Chilled Water Loop

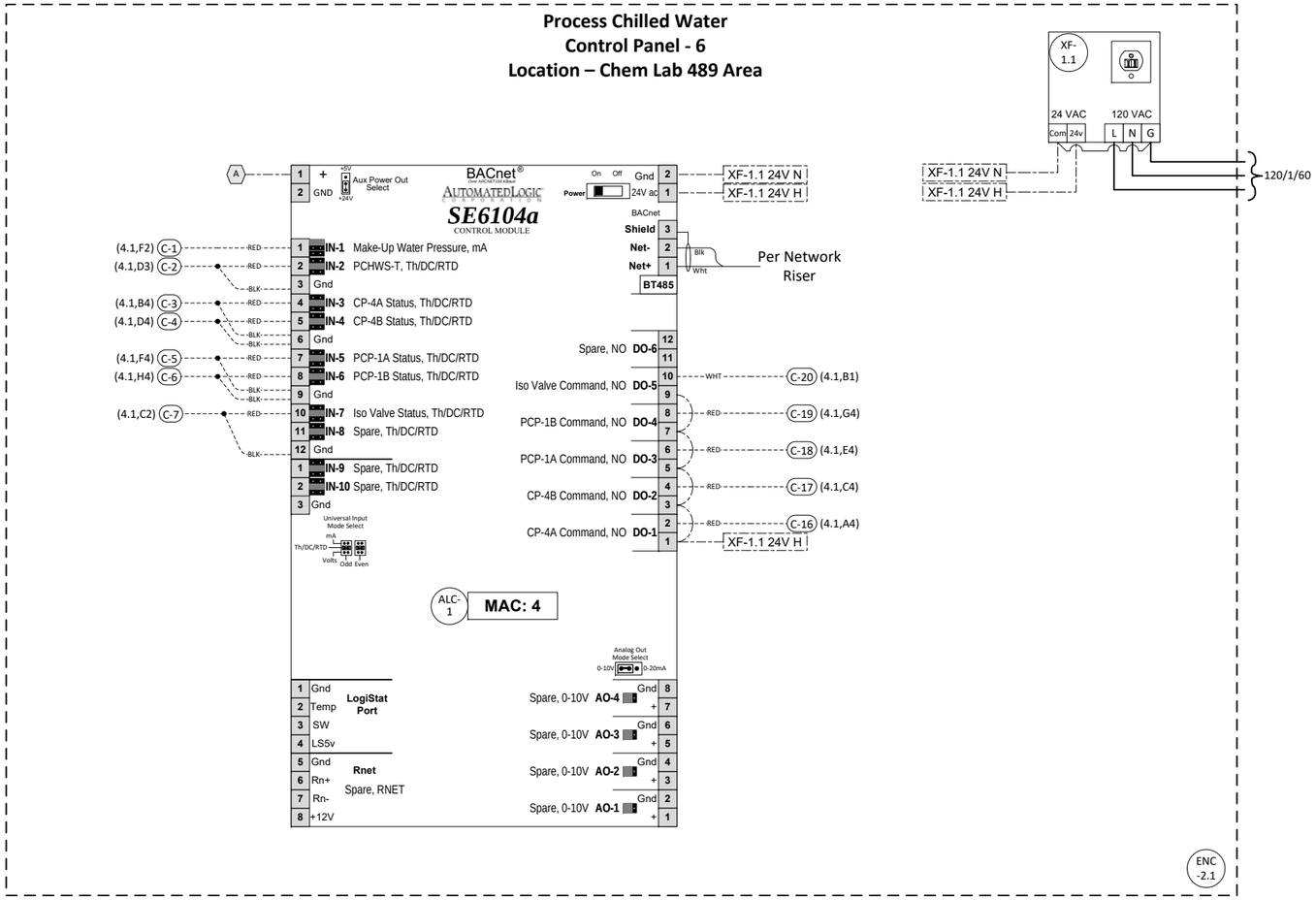
DRAWING NAME: Process Chilled Water Loop

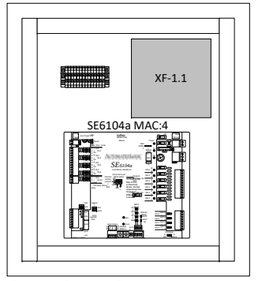
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 4.1

Process Chilled Water Loop Controller Details

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
ALC-1	Control Module, 6DO, 10UI, 4AO	Automated Logic	SE6104a	1
XF-1.#	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	Functional Devices	PSB100AB10	1
ENC-2.#	16" x 18" (Small) Control Panel	Saginaw	SCE-18N1606NKT	1





Control Panel - 6
Location – Chem Lab 489 Area

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FILENAME: (4) Process Chilled Water Loop

DRAWING NAME:
Process Chilled Water Loop Controller Details

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 4.2

Process Chilled Water Loop Sequence of Operations

Process Cooling System

Run Conditions:
The process cooling system will be enabled to run by user definable schedule or it will be manually enabled by a selector switch located on the equipment graphics.

Chilled Water Pump Run Conditions: CP-4A & CP-4B
Once the system is enabled, the chilled water pumps will cycle to maintain a chilled water supply temperature. The following setpoints are recommended values. All setpoints will be filed adjusted during the commissioning period to meet the requirements of actual field conditions.

The controller will enable the pumps to maintain a chilled water supply temperature less than 70°F. As the temperature drops below 60°F, the chilled water pumps will cycle off.

Isolation Control Valve:
The isolation control valve will open anytime the chilled water pumps are called to run.

The isolation valve will open prior to the chilled water pumps being enabled and will close only after the chilled water pumps have been disabled. The isolation valve will therefore have:

- A user adjustable delay on start.
- AND a user adjustable delay on stop.

Process Water Pump Run Conditions: PCP-1A & PCP-1B
The process water pumps will run continuously whenever the system is enabled.

Alarms and Monitoring:

Alarms will be provided as follows:
- Failure: Commanded on, but the status is off.
- Running in Hand: Commanded off, but the status is on.

The following temperatures will be monitored:
- Process chilled water loop supply.

Alarms will be provided as follows:
- High chilled water supply temperature: If the chilled water supply temperature is greater than 80°F (adj.).

The following pressures will be monitored:
- Make-up water pressure.

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FILENAME: (4) Process Chilled Water Loop

DRAWING NAME:
Process Chilled Water Loop Sequence of Operations

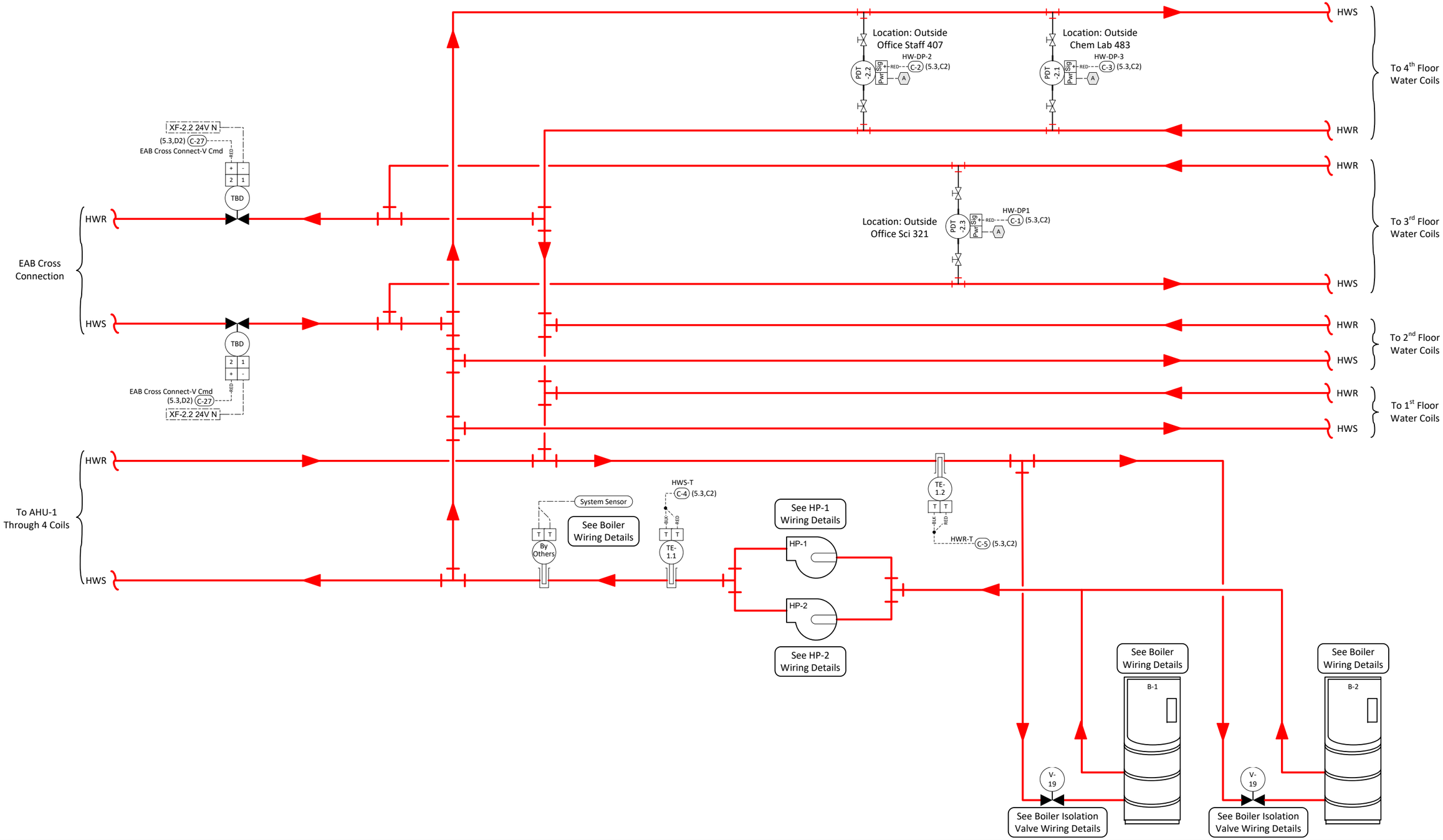
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 4.3

Hot Water System

Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
TE-1.#	Immersion 4" Insertion, BAPI Box 4 IP44, w/304 Stainless Thermowell	BAPI	ALC/10K-2-I-4"-BB4 + BA/4" M304	2
V-19	BFV, 6", 2 Way, CV90=1579 CV60=605, Non-Spring, 120V, ON/OFF	Belimo	F6150HD+NO+SY3-120	2
PDT-2.#	Differential Pressure Sensor (wet), 0-100 PSIG, 0-100 PSID	Veris	PW2XX04S	3



INSTALLATION NOTES:
1.) A water flow switch is to be installed by others in the outlet piping on all heating boilers and hot water supply boilers.
2.) The flow switch is wired in series with the 24VAC safety control circuit by ACES.

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FILENAME: (5) Hot Water System

DRAWING NAME: **Hot Water System**

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

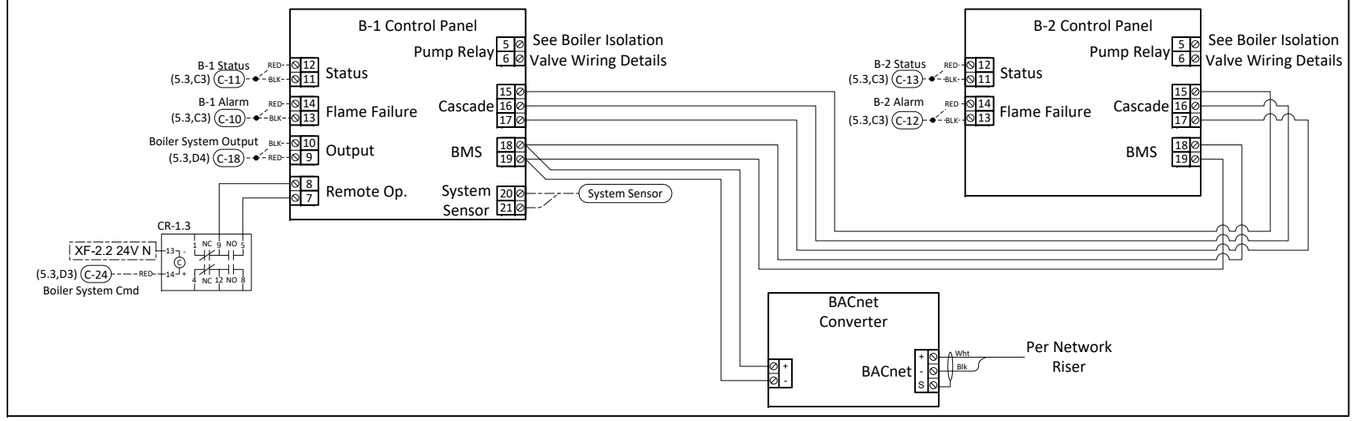
DRAWING NO.: 5.1

Hot Water System Wiring Details

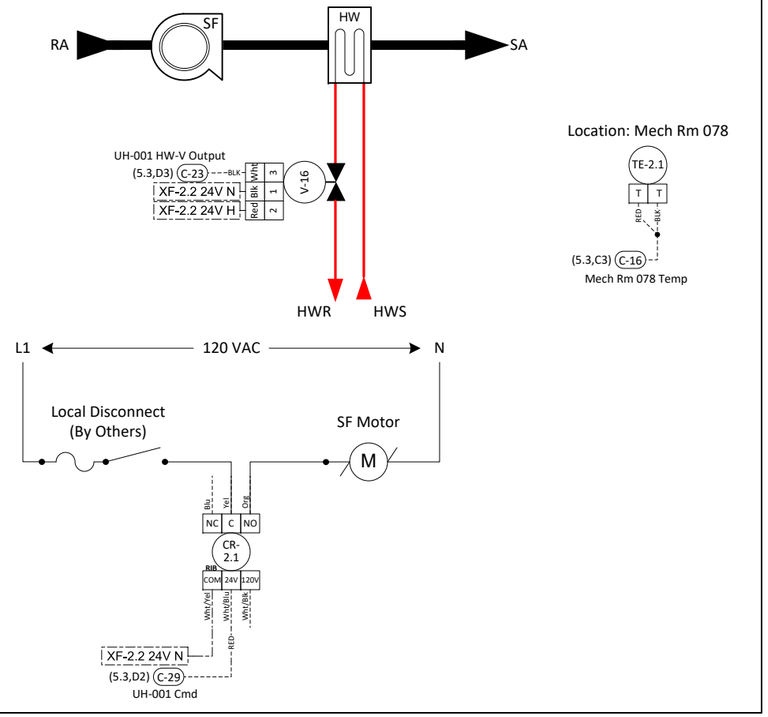
Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
TE-2.#	Room Temp Delta Style	BAPI	ALC/10K-2-R-Z-CG	1
V-16	CCV,0.5",2 Way,0.8 Cv,w/ Non-Spring,24V,Modulating	Belimo	B209B+NO+TR24-SR-T	1
IS-1.#	Current Switch, Split Core, Adj. Setpoint to 0.5A	Functional Devices	RIBXGTA	2
CR-2.#	Enclosed Relay 20 Amp SPDT with 24 Vac/DC/208-277 Vac Coil	Functional Devices	RIB2401B	1
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	3
CR-4	Power Relay | Compact | Blade | DPDT | 10A | 120 VAC	Idec	RH2B-UAC110-120V+SH2B-05	2

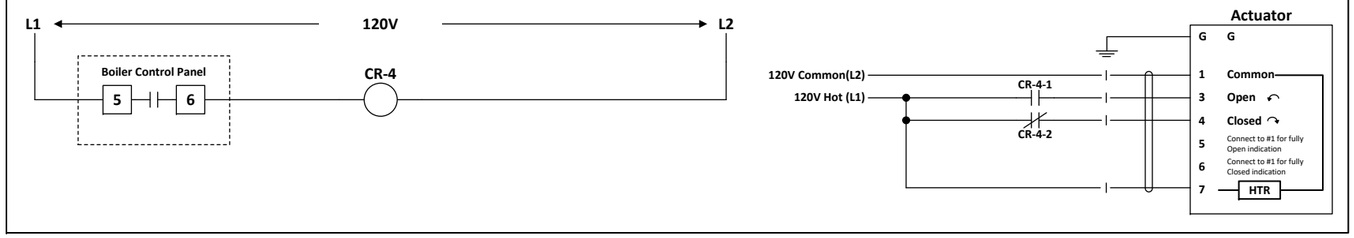
Boiler Wiring Details



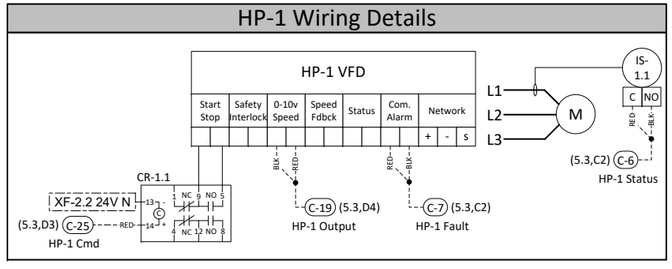
UH-001 Details



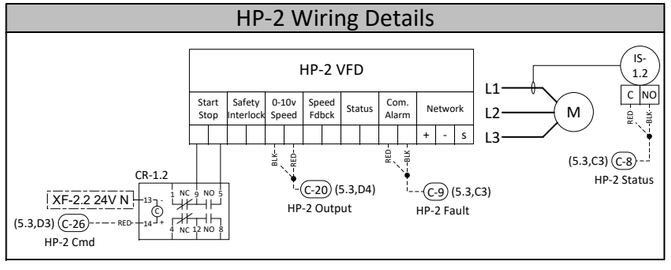
Boiler Isolation Valve Wiring Details



HP-1 Wiring Details



HP-2 Wiring Details



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FILENAME: (5) Hot Water System

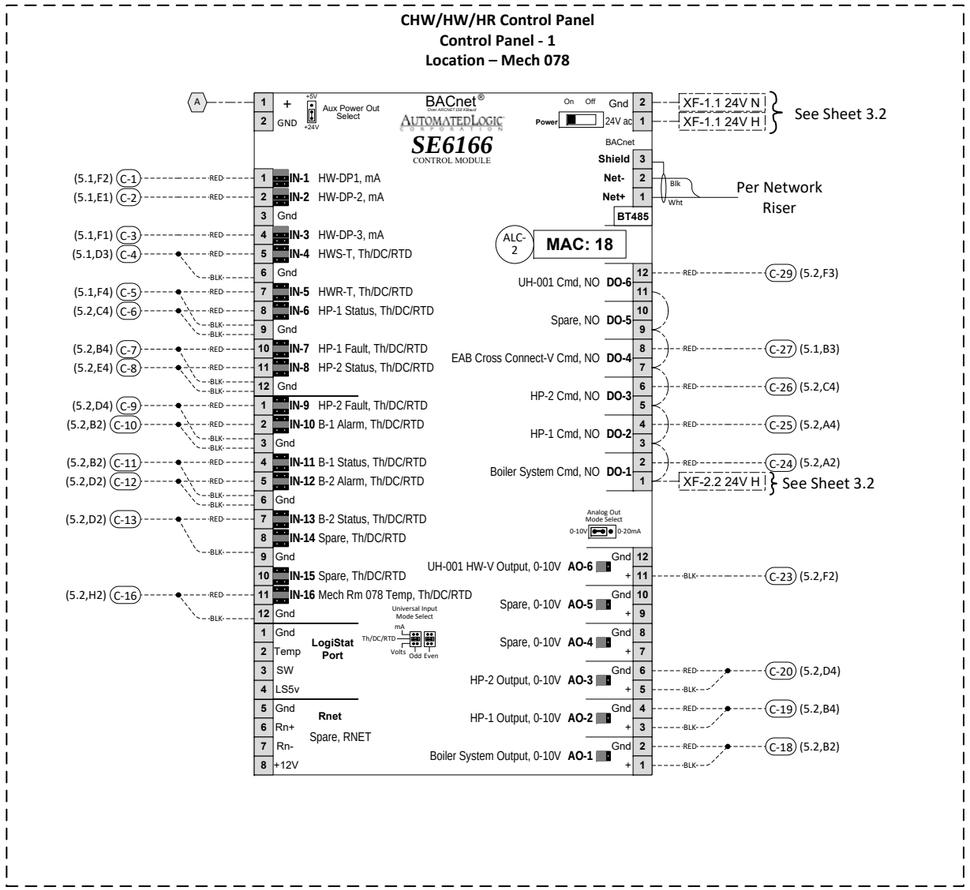
DRAWING NAME: Hot Water System Wiring Details

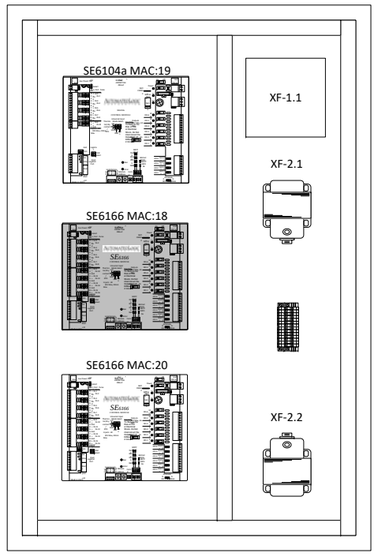
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 5.2

Hot Water System Controller Details

Instrument List				
Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-2	Control Module, 6DO, 16UI, 6AO	Automated Logic	SE6166	1





Control Panel - 1
Location – Mech 078

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FILENAME: (5) Hot Water System

DRAWING NAME: Hot Water System Controller Details

CONTRACT NO: WU-01-16 | SE:JV | DE: PL | PR: RV

DRAWING NO.: 5.3

Hot Water System Sequence of Operations

Heating Water System

Boiler System (B-1 and B-2) Run Conditions:
The boiler system will be enabled to run based on a user definable schedule.
- To prevent short cycling, the boiler system will run for and be off for minimum adjustable times (both user definable), unless shutdown on safeties or outside air conditions.
- The boiler will run subject to its own internal safeties and controls.

Boiler Safeties: The following safeties will be monitored and alarmed:
- Boiler alarm.

Boiler Operation:
The boilers will be staged by their own cascading controls. ACES to reset the supply temperature and enable the boiler system only.

Boiler Heating Water Temperature Control and Monitoring:
The heating water supply temperature reset will be based on outside air temperature.

The supply temperature will be reset as follows:
- Heating water supply temperature setpoint will be 140°F (adj.) at an outside air temperature of 0°F (adj.).
- Heating water supply temperature setpoint will be 90°F (adj.) at an outside air temperature of 60°F (adj.).

Alarms will be provided as follows:
- High Heating Water Supply Temp: If greater than 160 deg. F. (adj.).
- Low Heating Water Supply Temp: If less than 70 deg. F. (adj.).

Heating Water Loop Pumps (HP-1 and HP-2)

Heating Water Pump Run Conditions:
The heating water pumps will be enabled whenever:
- A definable number of heating water coils need heating.
- The pumps will run for freeze protection anytime outside air temperature is less than 38 deg. F. (adj.).
- To prevent short cycling, the pump will run for a minimum time and be off for a minimum time (both user adjustable).

Heating Water Pump Lead/Lag Operation:
The two (2) variable speed heating water pumps will operate in a lead/lag fashion.

The lead pump will run first. On failure of the lead pump, the lag pump will run and the lead pump will turn off. On decreasing heating water differential pressure, the lag pump will stage on and run in unison with the lead pump to maintain heating water differential pressure set point.

The designated lead pump will rotate upon one of the following conditions (user selectable):
- manually through a software switch
- if pump runtime (adj.) is exceeded
- daily
- weekly
- monthly

Alarms will be provided as follows:
- Failure: Commanded on, but the status is off.
- Running in Hand: Commanded off, but the status is on.
- Runtime Exceeded: Status runtime exceeds a user definable limit.
- VFD Fault.

Heating Water Differential Pressure Control:
The controller will measure heating water differential pressure in (3) locations and modulate the heating water pump VFD s in sequence to maintain its heating water differential pressure set point based off the lowest reading of the (3) sensors. The following set points are recommended values. All set points will be field adjusted during the commissioning period to meet the requirements of actual field conditions.

The controller will modulate heating water pump speeds to maintain a heating water differential pressure of 12 psi (adj.). The VFD s minimum speed will not drop below 15 percent (adj.). On dropping heating water differential pressure, the VFDs will stage on and run to maintain set point as follows:

The controller will modulate the lead VFD to maintain set point. If the lead VFD speed is greater than a set point of 90 percent (adj.), the lag VFD will stage on.

The lag VFD will ramp up to match the lead VFD speed and then run in unison with the lead VFD to maintain set point.

On rising heating water differential pressure, the VFD s will stage off as follows:

If the VFDs speeds drops back to 60 percent (adj.) below set point, the lag VFD will stage off.

The lead VFD will continue to run to maintain set point.

Alarms will be provided as follows:
- High Heating Water Differential Pressure: If the heating water differential pressure is 25 percent (adj.) greater than set point.
- Low Heating Water Differential Pressure: If the heating water differential pressure is 25 percent (adj.) less than set point.

Heating Water Loop Temperature Monitoring:

The following temperatures will be monitored:
- Heating water loop supply.
- Heating water loop return.

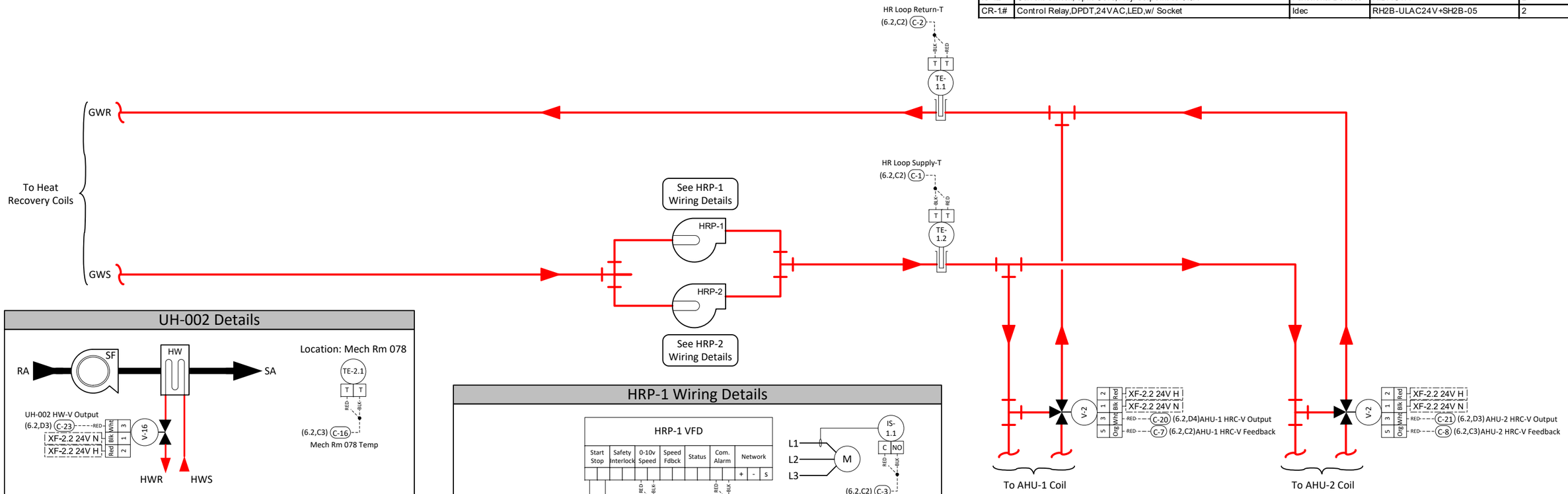
Alarms will be provided as follows:
- High Heating Water Loop Supply Temp: If the heating water supply temperature is greater than 160 deg. F. (adj.).
- Low Heating Water Loop Supply Temp: If the heating water supply temperature is less than 60 deg. F. (adj.).

East Academic Building (EAB) cross-connection valves:
Provide normally closed, two position, control valves in the supply and return cross-connection lines. Valves will only open on a manual command from the workstation.

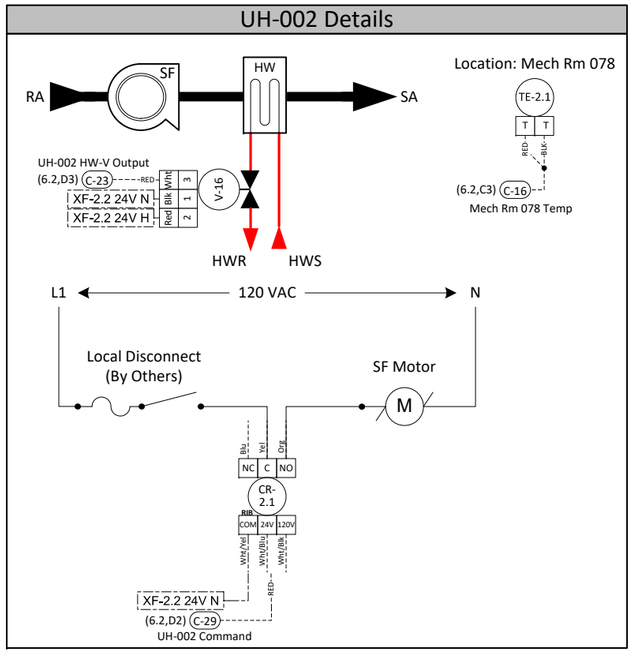
Heat Recovery System

Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
TE-1.#	Immersion 4" Insertion, BAPI Box 4 IP44, w/304 Stainless Thermowell	BAPI	ALC/10K-2-I-4"-BB4 + BA/4" M304	2
TE-2.#	Room Temp Delta Style	BAPI	ALC/10K-2-R-Z-CG	1
V-2	Globe Valve,2.5",3 Way,68 Cv,w/ Spring Return,24V,MFT	Belimo	G765+AFX24-MFT-X1P-10001	2
V-16	CCV,0.5",2 Way,0.8 Cv,w/ Non-Spring,24V,Modulating	Belimo	B209B+NO+TR24-SR-T	1
CR-2.#	Enclosed Relay 20 Amp SPDT with 24 Vac/DC/208-277 Vac Coil	Functional Devices	RIB2401B	1
IS-1.#	Current Switch, Split Core, Adj. Setpoint to 0.5A	Functional Devices	RIBXGTA	2
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	2

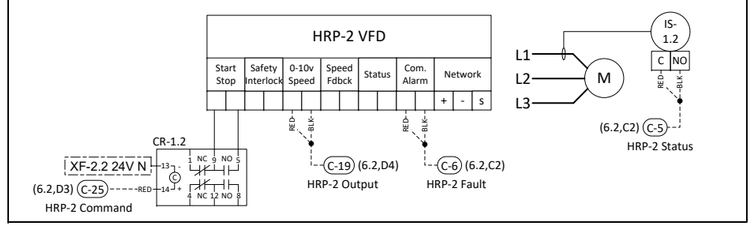


UH-002 Details



HRP-1 Wiring Details

HRP-2 Wiring Details



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Webster Groves, MO 63119

FILENAME: (6) Heat Recovery System

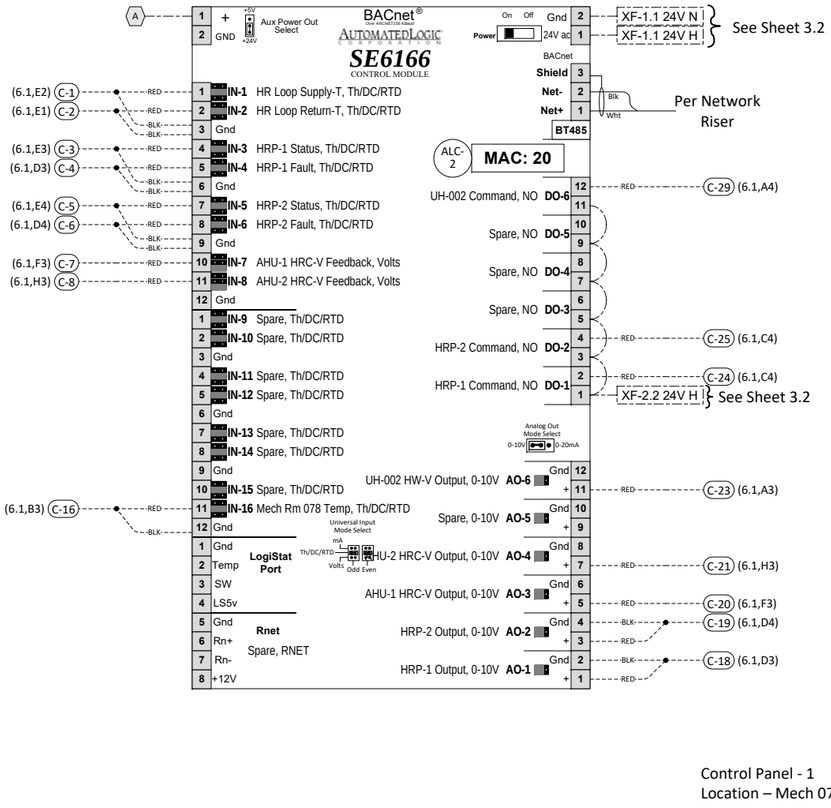
DRAWING NAME: Heat Recovery System

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

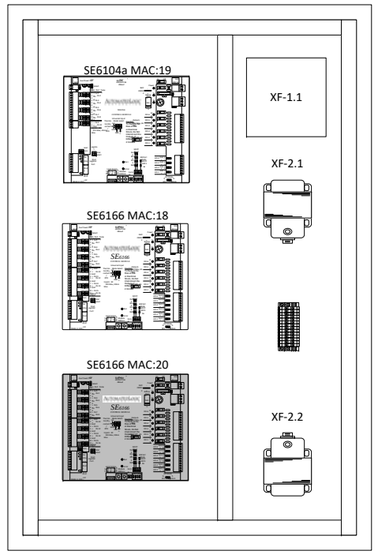
DRAWING NO.: 6.1

Heat Recovery System Controller Details

Instrument List				
Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-2	Control Module, 6DO, 16UI, 6AO	Automated Logic	SE6166	1



Control Panel - 1
Location – Mech 078



Control Panel - 1
Location – Mech 078

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (6) Heat Recovery System

DRAWING NAME: Heat Recovery System Controller Details

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 6.2

Heat Recovery System Sequence of Operations

Heat Recovery Loop System - HRP-1 and HRP-2 with coils in AHU-1, AHU-2, and HEF-1

Heat Recovery Pump Run Conditions:
The heat recovery pumps will be enabled whenever:

- AHU-1 and/or AHU-2 are operating.
- Anytime outside air temperature is less than 55 deg. F. (adj.) and above 75 deg. F. (adj.).

To prevent short cycling, the pump will run for a minimum time and be off for a minimum time (both user adjustable).

Heat Recovery Pump Lead/Lag Operation:
The two (2) variable speed heating recovery pumps will operate in a lead/lag fashion.
The lead pump will run first. On failure of the lead pump, the lag pump will run and the lead pump will turn off.

The designated lead pump will rotate upon one of the following conditions (user selectable):

- manually through a software switch
- if pump runtime (adj.) is exceeded
- daily
- weekly
- monthly

Alarms will be provided as follows:

- Failure: Commanded on, but the status is off.
- Running in Hand: Commanded off, but the status is on.
- Runtime Exceeded: Status runtime exceeds a user definable limit.
- AFC Fault.

Heat Recovery Loop Temperature Monitoring:

- Heat recovery loop supply.
- Heat recovery loop return.

Alarms will be provided as follows:
Low Heat Recovery Loop Return to Exhaust Coil Temp: If the heating water supply temperature is less than 34 deg. F. (adj.).

AHU three-way Control Valve:
The controller will measure the Heat Recovery Return Temp to exhaust coil and modulate the three-way valve to maintain set point above 38 deg. F (adj.).

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

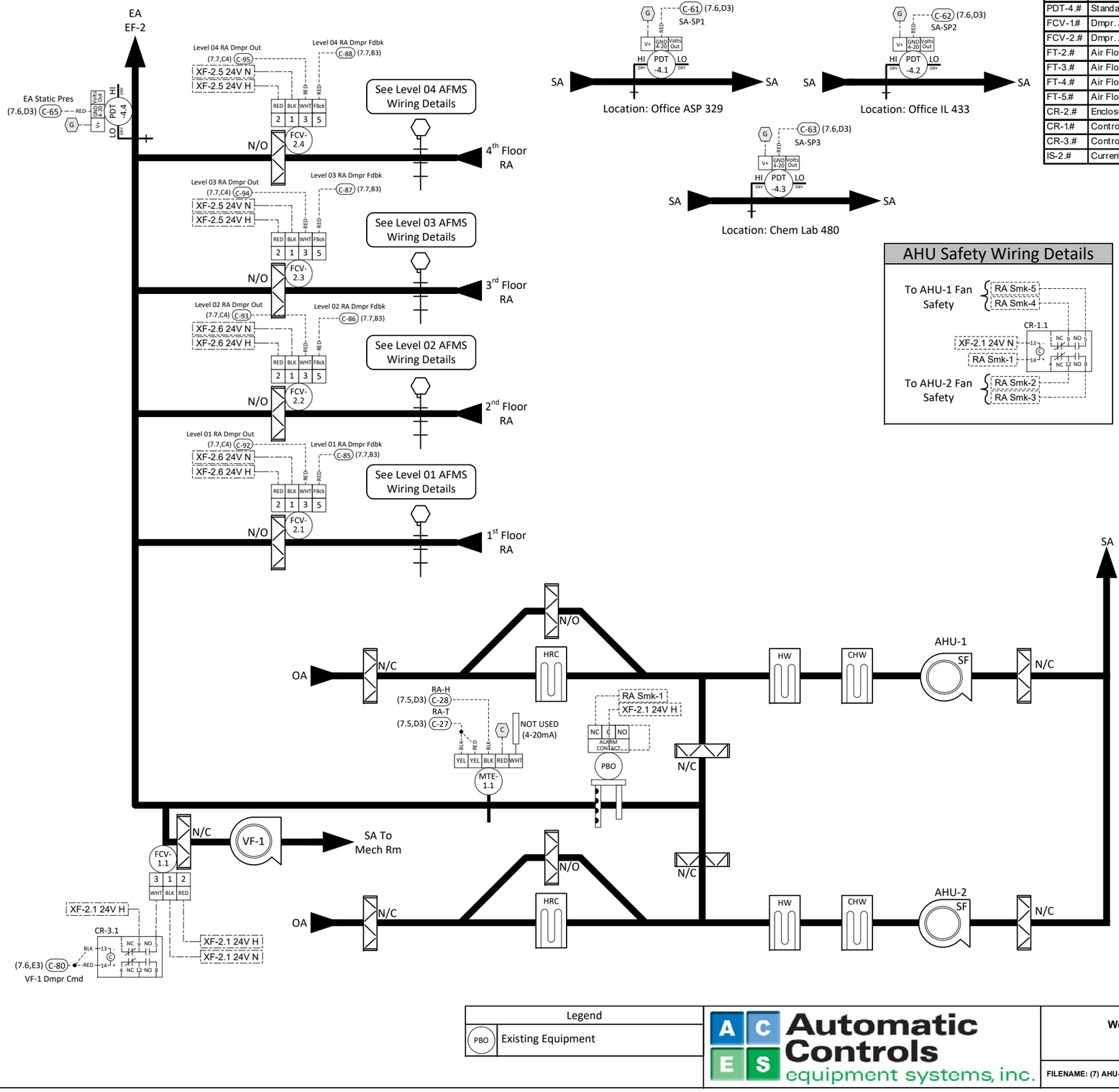
FILENAME: (6) Heat Recovery System

DRAWING NAME:
Heat Recovery System Sequence of Operations

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 6.3

Air Handling Units Building Flow Diagram (AHU-1 & AHU-2)

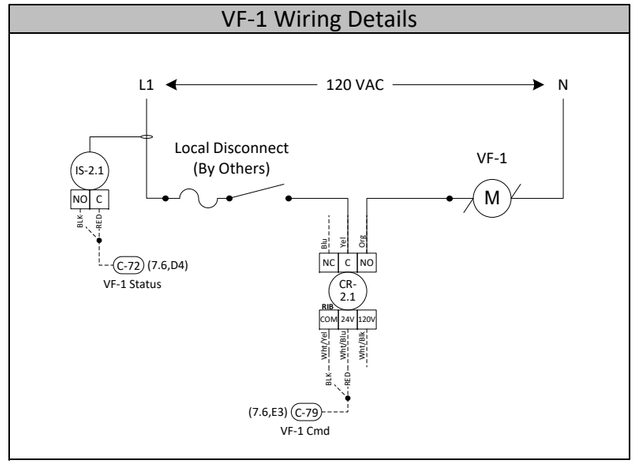


Instrument List

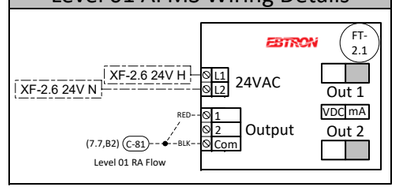
Tag	Product Description	Manufacturer	Part Number	Quantity
MTE-1.#	Humidity, Duct, 2%w/Temperature Sensor, BAPI BOX 2 NEMA 4X	BAPI	ALC/10K-2-H200-D-BB2	1
PDT-4.#	Standard Range Pressure Sensor, 0-5" w.c., Bapi Box, Attached Static Probe w/ Display	BAPI	ZPT-20-SR75-BB-AT-D	4
FCV-1.#	Dmpr. Act. 90 in-lbs, Non-Spring Return, Floating, 24 VAC,	Belimo	NMB24-3	1
FCV-2.#	Dmpr. Act. 90 in-lbs, Spring Return, 2-10 V, 24 VAC,	Belimo	NFB24-SR	4
FT-2.#	Air Flow Station	Ebtron	GTC116P+70 x 20-1-2-10	1
FT-3.#	Air Flow Station	Ebtron	GTC116P+36 x 20-1-2-10	1
FT-4.#	Air Flow Station	Ebtron	GTC116P+56 x 26-1-2-10	1
FT-5.#	Air Flow Station	Ebtron	GTC116P+48 x 20-1-2-10	1
CR-2.#	Enclosed Relay 20 Amp SPDT with 24 Vac/DC/208-277 Vac Coil	Functional Devices	RIB2401B	1
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	1
CR-3.#	Control Relay,DPDT,24VDC,LED,w/ Socket	Idec	RH2B-ULDC24V+SH2B-05	1
IS-2.#	Current Switch, Split Core, Fixed Setpoint 0.15A, Micro	Veris	H300	1

AHU Safety Wiring Details

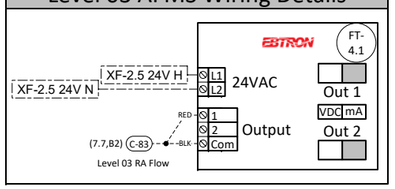
VF-1 Wiring Details



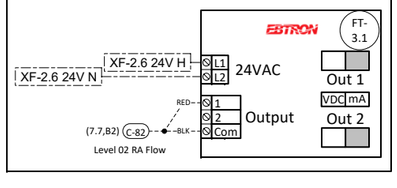
Level 01 AFMS Wiring Details



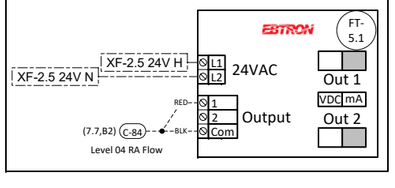
Level 03 AFMS Wiring Details



Level 02 AFMS Wiring Details



Level 04 AFMS Wiring Details



Legend	
PBO	Existing Equipment

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (7) AHU-1 & AHU-2

DRAWING NAME: Air Handling Units Building Flow Diagram (AHU-1 & AHU-2)

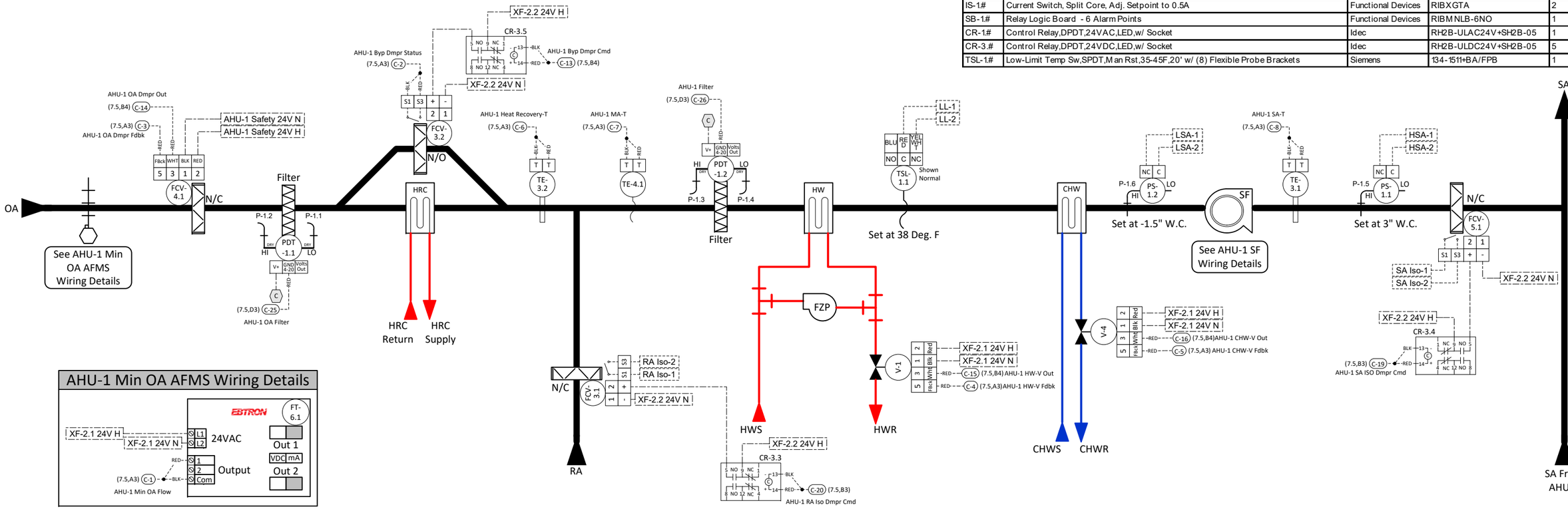
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 7.1

Air Handling Unit (AHU-1)

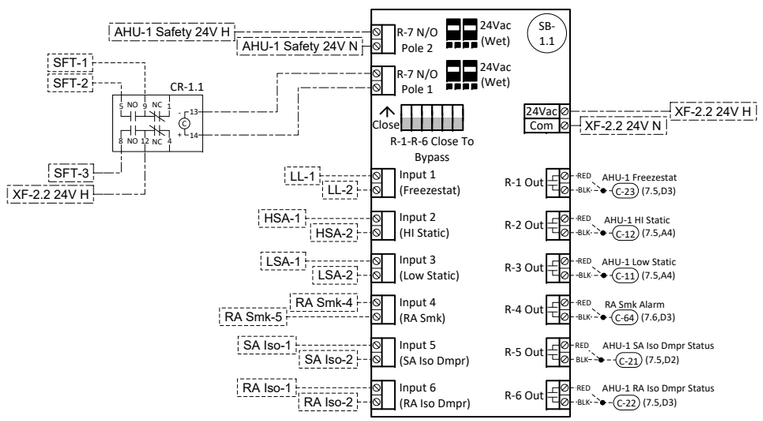
Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
PDT-1.#	Standard Range Pressure Sensor, 0-2"w.c., Bapi Box, Remote Static Probe w/ Display	BAPI	ZPT-20-SR73-BB-ST-D	2
P-1.#	Zone Pressure Pickup Port, 6" Static Pressure Probe Assembly	BAPI	ALC/ZPS-ACC07	6
TE-3.#	Duct, 8" Insertion, BAPI Box 4 IP44	BAPI	ALC/10K-2-D-8"-BB4	2
TE-4.#	Continuous Averaging, 24' Length, BAPI Box 4 IP44	BAPI	ALC/10K-2-A-24'-BB4	1
FCV-3.#	Dmpr. Act. 180 in-lbs, Spring Return, On/Off, 24 VAC, 2 Aux Switch	Belimo	AFB24-S	2
FCV-4.#	Dmpr. Act. 270 in-lbs, Spring Return, 2-10 V, 24 VAC,	Belimo	EFB24-SR	1
FCV-5.#	Dmpr. Act. 270 in-lbs, Spring Return, On/Off, 24 VAC, 2 Aux Switch	Belimo	EFB24-S	1
V-1	Globe Valve,2",2 Way,40 Cv,w/ Spring Return,24 -240V,Modulating	Belimo	G250+NO/FO+AFB24-SR-X1	1
V-4	Globe Valve,4",2 Way,170 Cv,w/ Non-Spring,24V,Modulating	Belimo	G6100C+NC+EVB24-SR	1
PS-1.#	Differential Pressure Switch, 0-12 in. WC, SPST, Man. Reset (NC), 1/4" Barbed Fittings	Cleveland	AFS-460-112	2
FT-6.#	Air Flow Station	Ebtron	GTC116P+69x60-1-2-15	1
IS-1.#	Current Switch, Split Core, Adj. Setpoint to 0.5A	Functional Devices	RIBXGTA	2
SB-1.#	Relay Logic Board - 6 Alarm Points	Functional Devices	RIBMNLB-6NO	1
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	1
CR-3.#	Control Relay,DPDT,24VDC,LED,w/ Socket	Idec	RH2B-ULDC24V+SH2B-05	5
TSL-1.#	Low-Limit Temp Sw,SPDT,Man Rst,35-45F,20' w/ (8) Flexible Probe Brackets	Siemens	134-1511+BA/FPB	1

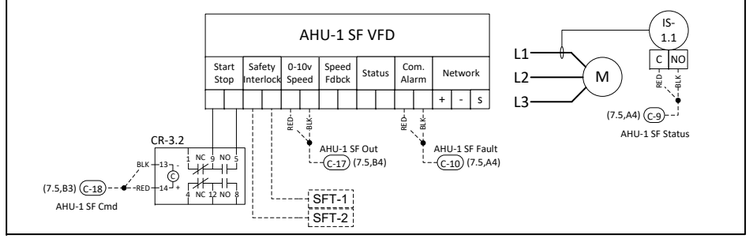


AHU-1 Min OA AFMS Wiring Details

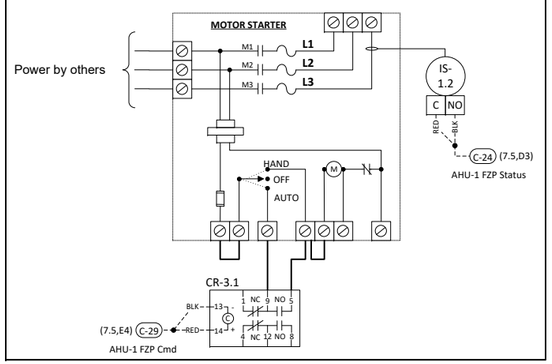
Fan Safety Board



AHU-1 SF Wiring Details



AHU-1 FZP Wiring Details

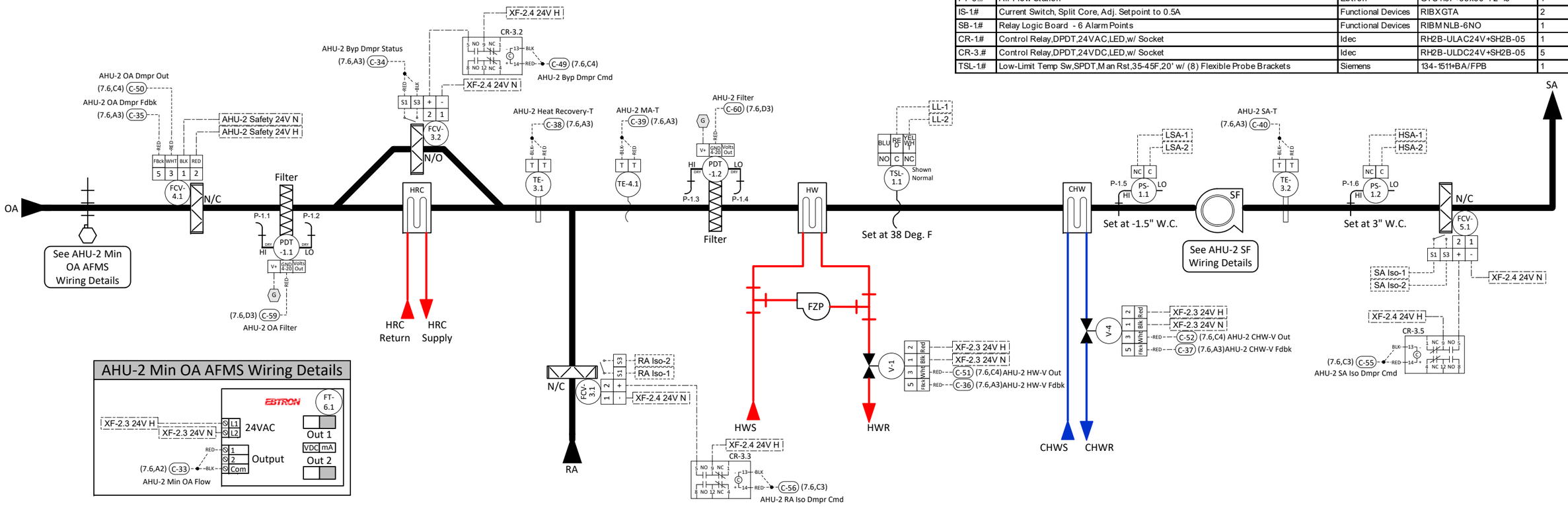


Automatic Controls equipment systems, inc.	Webster University ISB - HVAC Controls 470 E. Lockwood Ave. Webster Groves, MO 63119	DRAWING NAME: Air Handling Unit (AHU-1)	
	FILENAME: (7) AHU-1 & AHU-2	CONTRACT NO: WU-01-16	SE:JV / DE: PL / PR: RV
		DRAWING NO.: 7.2	

Air Handling Unit (AHU-2)

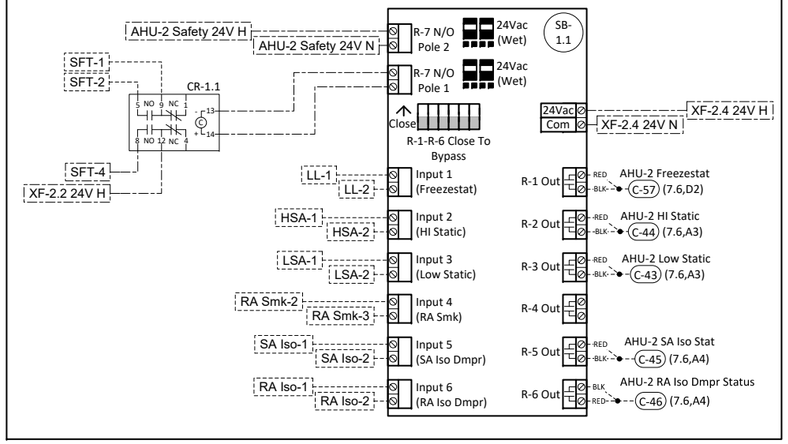
Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
PDT-1.#	Standard Range Pressure Sensor, 0-2"w.c., Bapi Box, Remote Static Probe w/ Display	BAPI	ZPT-20-SR73-BB-ST-D	2
P-1.#	Zone Pressure Pickup Port, 6" Static Pressure Probe Assembly	BAPI	ALC/ZPS-ACC07	6
TE-3.#	Duct, 8" Insertion, BAPI Box 4 IP44	BAPI	ALC/10K-2-D-8"-BB4	2
TE-4.#	Continuous Averaging, 24' Length, BAPI Box 4 IP44	BAPI	ALC/10K-2-A-24'-BB4	1
FCV-3.#	Dmpr. Act. 180 in-lbs, Spring Return, On/Off, 24 VAC, 2 Aux Switch	Belimo	AFB24-S	2
FCV-4.#	Dmpr. Act. 270 in-lbs, Spring Return, 2-10 V, 24 VAC,	Belimo	EFB24-SR	1
FCV-5.#	Dmpr. Act. 270 in-lbs, Spring Return, On/Off, 24 VAC, 2 Aux Switch	Belimo	EFB24-S	1
V-1	Globe Valve,2",2 Way,40 Cv,w/ Spring Return,24 -240V,Modulating	Belimo	G250+NO/FO+AFB24-SR-X1	1
V-4	Globe Valve,4",2 Way,170 Cv,w/ Non-Spring,24V,Modulating	Belimo	G6100C+NC+EVB24-SR	1
PS-1.#	Differential Pressure Switch, 0-12 in. WC, SPST, Man. Reset (NC), 1/4" Barbed Fittings	Cleveland	AFS-460-112	2
FT-6.#	Air Flow Station	Ebtron	GTC116P+69x60-1-2-15	1
IS-1.#	Current Switch, Split Core, Adj. Setpoint to 0.5A	Functional Devices	RIBXGTA	2
SB-1.#	Relay Logic Board - 6 Alarm Points	Functional Devices	RIBMNLB-6NO	1
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	1
CR-3.#	Control Relay,DPDT,24VDC,LED,w/ Socket	Idec	RH2B-ULDC24V+SH2B-05	5
TSL-1.#	Low-Limit Temp Sw,SPDT,Man Rst,35-45F,20' w/ (8) Flexible Probe Brackets	Siemens	134-1511+BA/FPB	1

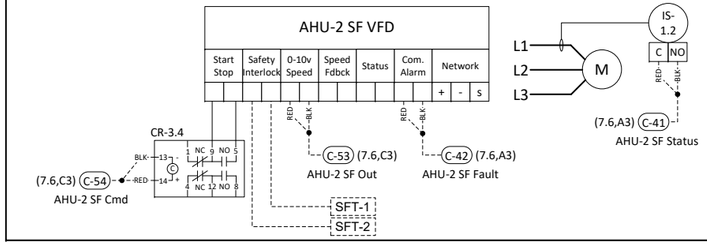


AHU-2 Min OA AFMS Wiring Details

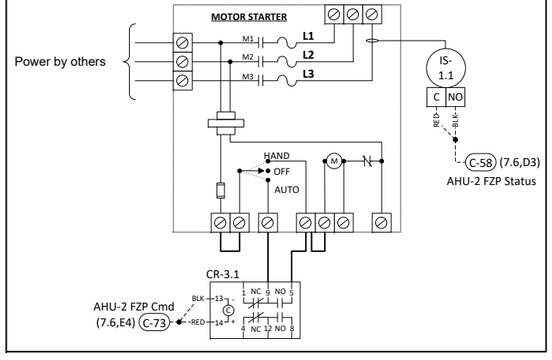
Fan Safety Board



AHU-2 SF Wiring Details



AHU-2 FZP Wiring Details



Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (7) AHU-1 & AHU-2

DRAWING NAME: Air Handling Unit (AHU-2)

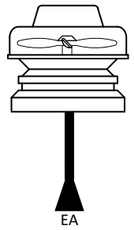
CONTRACT NO: WU-01-16 | SE:JV | DE: PL | PR: RV

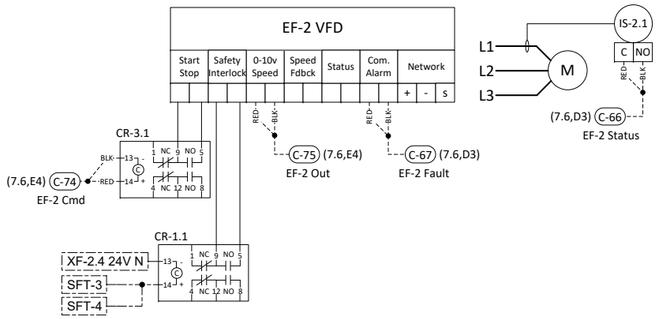
DRAWING NO.: 7.3

Exhaust Fan Details (EF-2)

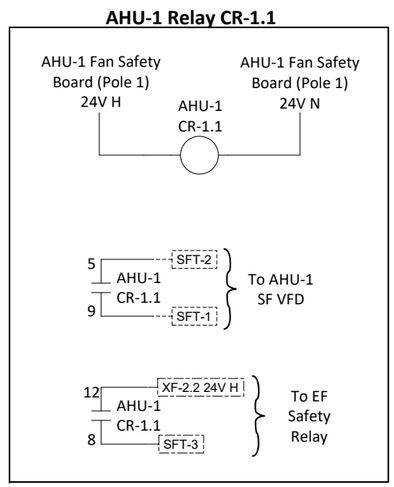
Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	1
CR-3.#	Control Relay,DPDT,24VDC,LED,w/ Socket	Idec	RH2B-ULDC24V+SH2B-05	1
IS-2.#	Current Switch, Split Core, Fixed Setpoint 0.15A, Micro	Veris	H300	1

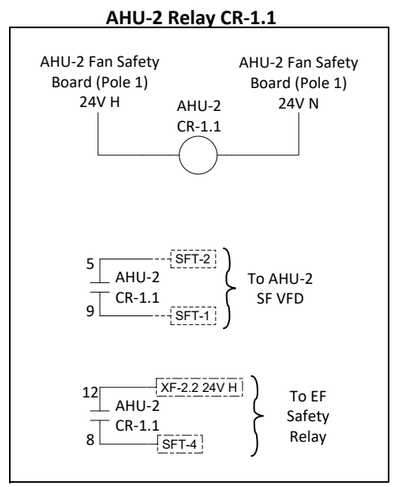
EF-2 Details

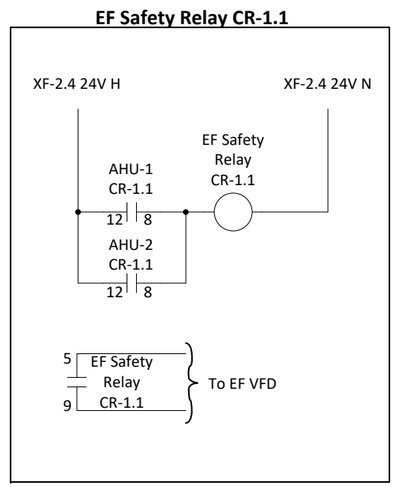




EF-2 Safety Wiring Details







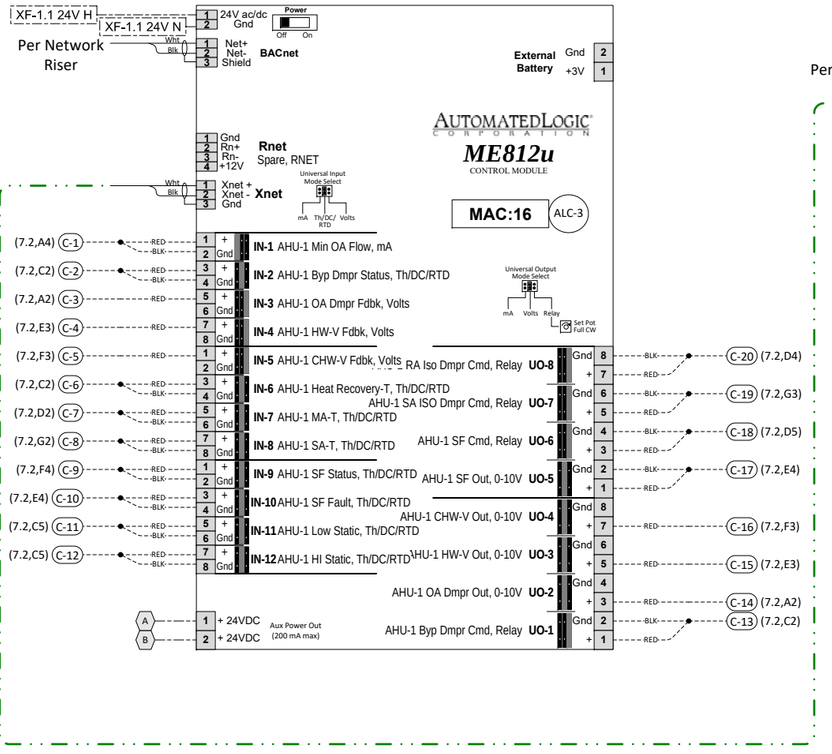
Automatic Controls equipment systems, inc.	Webster University ISB - HVAC Controls 470 E. Lockwood Ave. Webster Groves, MO 63119	DRAWING NAME: Exhaust Fan Details (EF-2)	
	FILENAME: (7) AHU-1 & AHU-2	CONTRACT NO: WU-01-16 / SE:JV / DE: PL / PR: RV	DRAWING NO.: 7.4

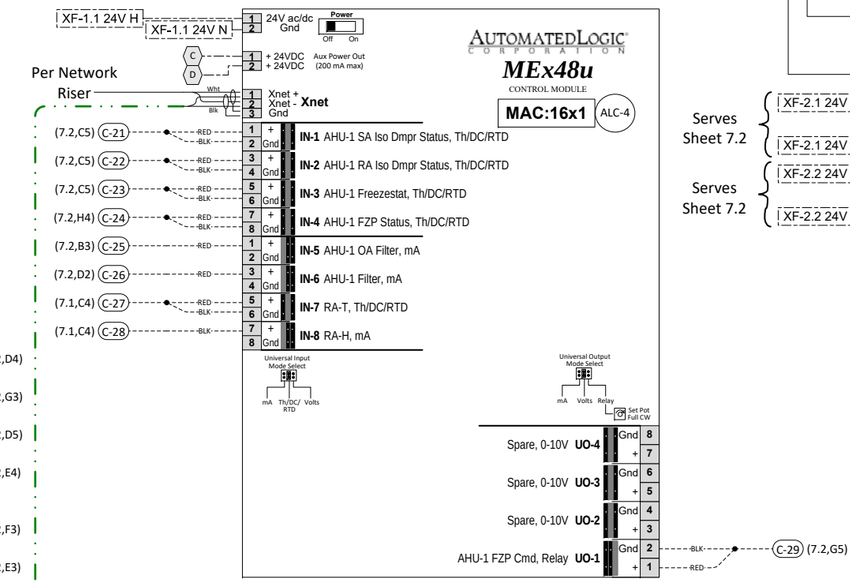
Air Handling Units Controller Details (AHU-1 & AHU-2)

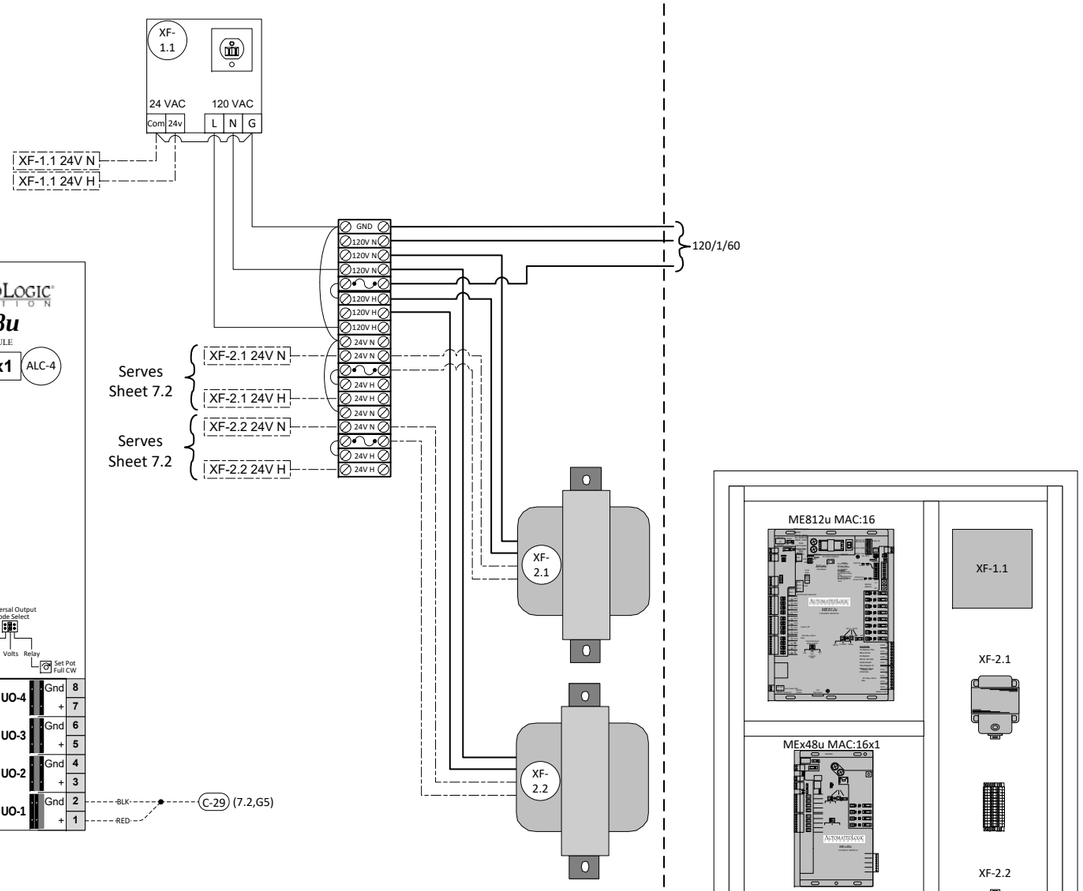
Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-3	Control Module, 8UO, 12UI, Supports 5 expanders	Automated Logic	ME812U	1
ALC-4	Point Expander, 4UO, 8UI	Automated Logic	MEX48U	1
XF-2.#	24V Transformer, 96VA	Core Lectro	LE12100	2
XF-1.#	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	Functional Devices	PSB100AB10	1
ENC-1.#	24" x 36" (Large) Control Panel	Saginaw	SCE-36N2406NKT	1

AHU-1
Control Panel - 2
Location – Mech Rm 078







Control Panel - 2
Location – Mech Rm 078

ENC -1.1

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (7) AHU-1 & AHU-2

DRAWING NAME: Air Handling Units Controller Details (AHU-1 & AHU-2)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

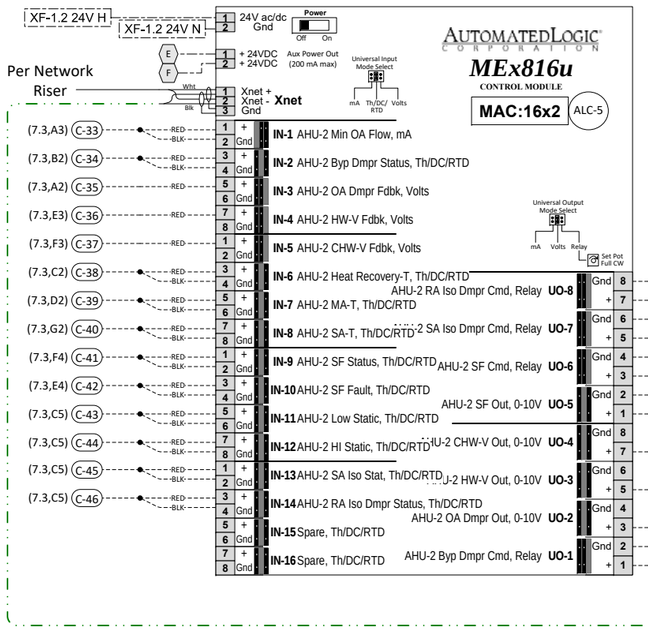
DRAWING NO.: 7.5

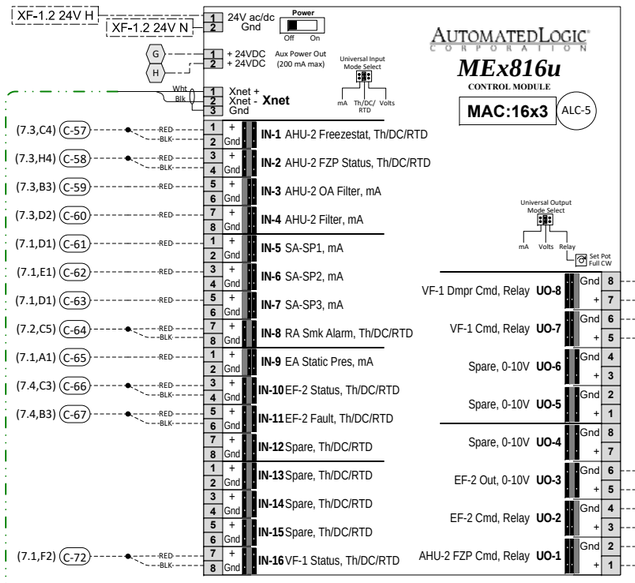
Air Handling Units Controller Details (AHU-1 & AHU-2)

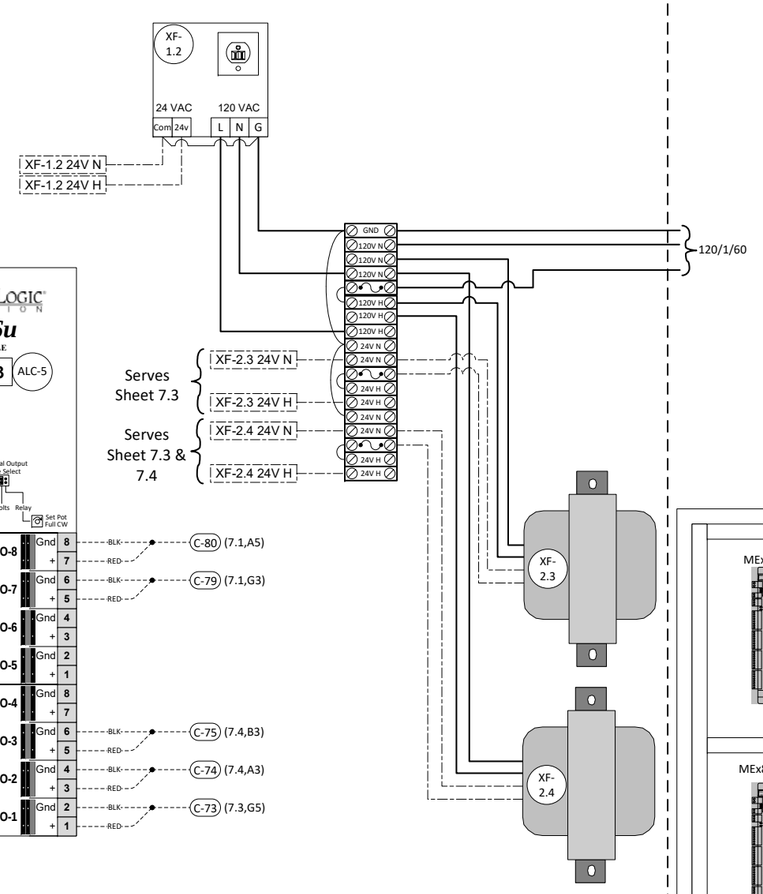
Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-5	Point Expander, 8UO, 16UI	Automated Logic	MEX816U	2
XF-2.#	24V Transformer, 96VA	Core Lectro	LE12100	2
XF-1.#	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	Functional Devices	PSB100AB10	1
ENC-1.#	24" x 36" (Large) Control Panel	Saginaw	SCE-36N2406NKT	1

AHU-2
Control Panel - 3
Location – Mech Rm 078







ENC -1.1

Control Panel - 3
Location – Mech Rm 078

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (7) AHU-1 & AHU-2

DRAWING NAME: Air Handling Units Controller Details (AHU-1 & AHU-2)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

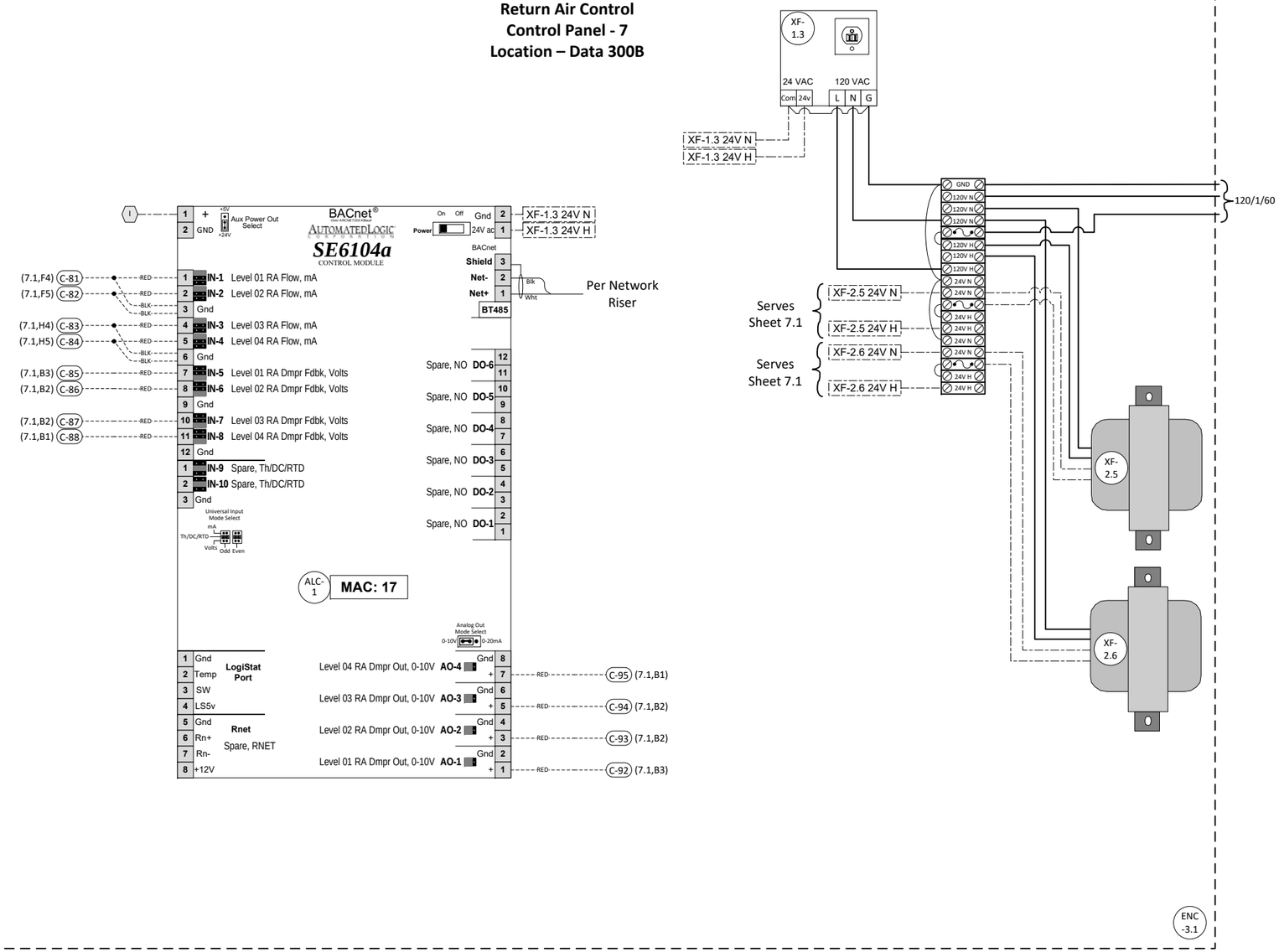
DRAWING NO.: 7.6

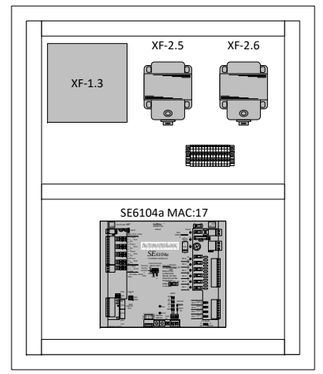
Return Air Controller Details

Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-1	Control Module, 6DO, 10UI, 4AO	Automated Logic	SE6104a	1
XF-2.#	24V Transformer, 96VA	Core Lectro	LE12100	2
XF-1.#	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	Functional Devices	PSB100AB10	1
ENC-3.#	20" x 24" (Medium) Control Panel	Saginaw	SCE-24N2006NKT	1

Return Air Control
Control Panel - 7
Location – Data 300B





Control Panel - 7
Location – Data 300B

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (7) AHU-1 & AHU-2

DRAWING NAME: Return Air Controller Details

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 7.7

Air Handling Units Sequence of Operations (AHU-1 & AHU-2)

Central Air Handling System - AHU-1, FZP-1, AHU-2, FZP-2, and EF-2

This system serves all spaces except for the Cadaver lab suite. Both AHUs are required to meet building loads. Provide isolation dampers at the inlet and outlets of each air handling unit for individual unit operations during low loads or unit maintenance.

Run Conditions - Requested:
The unit will run whenever:
- Any zone is occupied.
- OR a definable number of unoccupied zones need heating or cooling.

Freeze Protection:
The unit will shutdown and generate an alarm upon receiving a freezestat status.

High/Low Static Shutdown:
The unit will shutdown and generate an alarm upon receiving a high or low static shutdown signal.

Return Air Smoke Detection:
The unit will shutdown and generate an alarm upon receiving a return air smoke detector status.

Supply and Return Isolation Dampers:
The dampers will open anytime the supply fan starts. The dampers will be sequenced so that they operate in parallel to prevent recirculation if one AHU is already operating.

Supply Fan:
The supply fan will run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan will have a user definable (adj.) minimum runtime.

Alarms will be provided as follows:
- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Supply Air Duct Static Pressure Control:
The controller will measure duct static pressure at multiple locations and modulate the supply fan VFD speed to maintain a duct static pressure set point. The speed will not drop below 15 percent (adj.). The static pressure set point will be reset based on zone cooling requirements or discharge duct static pressure set point optimization described below:

The building automation system (BAS) will continually monitor the damper position of all VAV terminal units.

The discharge duct static pressure will be sensed directly at the discharge of each air handler. Mount the sensor in a non- turbulent location.

When any VAV damper is more than 75 percent (adj.) open, the supply fan discharge duct static pressure set point will be reset upward by 0.1 in w.c. (adj.), at a frequency of 15 minutes (adj.), until no damper is more than 75 percent open or the static pressure set point has reset upward to the system maximum duct static pressure set point or the AHU adjustable frequency controller is at the maximum speed setting.

When all VAV dampers are less than 65 percent (adj.) open, the supply fan discharge duct static pressure set point will be reset downward by 0.1 in w.c. (adj.), at a frequency of 15 minutes (adj.), until at least one damper is more than 65 percent open or the static pressure set point has reset downward to the system minimum duct static pressure set point or the AHU adjustable frequency controller is at the minimum speed setting.

The control bands, set point increment values, set point decrement values and adjustment frequencies will be adjusted to maintain maximum static pressure optimization with stable system control and maximum comfort control.

The initial discharge static pressure set point will be 2.0 in H2O (adj.). As cooling demand increases, the set point will incrementally reset up to a maximum of 3.5 in H2O (adj.). As cooling demand decreases, the set point will incrementally reset down to a minimum of 1.5 in H2O (adj.).

The BAS will have the capability to allow the operator to exclude “problem” zones that should not be considered when determining the optimized set point.

The BAS will also read the status of the supply air static pressure sensor and display the active duct static pressure reading on the status screen. Locate supply air duct static pressure sensor as shown on drawings. Mount the sensors in a non-turbulent location.

The BAS will have the ability to identify, and display to the user, the VAV terminal unit that serves the Critical Zone (that is, the zone with the most wide-open VAV damper). This information will update dynamically as the location of the Critical Zone changes based on building load, and duct static pressure set point optimization control.

Alarms will be provided as follows:
- High Supply Air Static Pressure: If the supply air static pressure is 25 percent (adj.) greater than set point.
- Low Supply Air Static Pressure: If the supply air static pressure is 2 5 percent (adj.) less than set point.
- Supply Fan VFD Fault.

During the commissioning process, the Controls Contractor will demonstrate the performance of fan pressure optimization.

Exhaust Fan EF-02:
The exhaust fan will run anytime the air handling units are operating and will control building pressurization. The controller will measure duct static pressure and modulate the exhaust fan VFD speed to maintain a duct static pressure set point, -0.25 in. H2O (adj.). The speed will not drop below 15 percent (adj.).

Alarms will be provided as follows:
- Exhaust Fan Failure: Commanded on, but the status is off.
- Exhaust Fan in Hand: Commanded off, but the status is on.
- Exhaust Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).
- Exhaust Fan VFD Fault.

Supply Air Temperature Set point - Optimized:
The controller will monitor the supply air temperature, main return air relative humidity, and will maintain a supply air temperature set point reset based on outside air temperature.

The supply air temperature set point will be reset for cooling as follows:
- The initial supply air temperature set point will be 55 deg. F (adj.).
- As the outside air temperature increases above 55 deg. F. (adj.), the set point will incrementally reset down to a minimum of 52 deg. F (adj.).
- As the outside air temperature decreases below 45 deg. F. (adj.), the set point will incrementally reset up to a maximum of 60 deg. F (adj.).
- Override supply air reset optimization if main return air relative humidity increases above 60 percent RH at 75 deg. F. (adj.) and incrementally reset supply air down to a minimum of 52 deg. F. (adj.).

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FILENAME: (7) AHU-1 & AHU-2

DRAWING NAME: Air Handling Units Sequence of Operations (AHU-1 & AHU-2)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 7.8

Air Handling Units Sequence of Operations (AHU-1 & AHU-2)

Cooling Coil Valve:
The controller will measure the supply air temperature and modulate the cooling coil valve to maintain its cooling set point.

The cooling will be enabled whenever:
- Outside air temperature is greater than 60 deg. F (adj.).
- AND the economizer is disabled or fully open.
- AND the supply fan status is on.
- AND the heating is not active.
- The cooling coil valve will open to 50 percent (adj.) whenever the freezestat is on.

Alarms will be provided as follows:
- High Supply Air Temp: If the supply air temperature is 5 deg. F. (adj.) greater than set point.

Heating Coil Valve:
The controller will measure the supply air temperature and modulate the heating coil valve to maintain its heating set point.

The heating will be enabled whenever:
- Outside air temperature is less than 65 deg. F. (adj.).
- AND the supply fan status is on.
- AND the cooling is not active.

The heating coil valve will open whenever:
- Supply air temperature drops from 40 deg. F. to 35 deg. F. (adj.).
- OR the freezestat is on.

Alarms will be provided as follows:
- Low Supply Air Temp: If the supply air temperature is 5 deg. F. (adj.) less than set point.

Heating Coil Freeze Prevention Pump (FZP):
The recirculation pump will run whenever the outside air temperature is below 38 deg. F (adj.) or if the freezestat is on.

Alarms will be provided as follows:
- Heating Coil Pump Failure: Commanded on, but the status is off.
- Heating Coil Pump in Hand: Commanded off, but the status is on.
- Heating Coil Pump Runtime Exceeded: Status runtime exceeds a user definable limit.

Economizer:
The controller will measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a set point 2 deg. F. (adj.) less than the supply air temperature set point. The outside air dampers will maintain a minimum adjustable position of 20 percent (adj.) open whenever occupied.

The economizer will be enabled whenever:
- Outside air temperature is less than 65 deg. F. (adj.)
- AND the outside air enthalpy is less than 22 Btu/lb (adj.)
- AND the outside air temperature is less than the return air temperature.
- AND the outside air enthalpy is less than the return air enthalpy.
- AND the supply fan status is on.

The economizer will close whenever:
- Mixed air temperature drops from 40 deg. F. to 35 deg. F. (adj.)
- OR the freezestat is on.
- OR on loss of supply fan status.

The heat recovery bypass damper will open anytime the unit is in economizer mode.

The outside air, supply air, and return air dampers will close when the unit is off. If Optimal Start Up is available, the supply and return air damper will open as described in the occupied mode and the outside air damper will remain fully closed.

Demand Ventilation Optimization:
The AHU minimum outdoor-air damper will be controlled to deliver required outdoor airflow at all occupied load conditions and to makeup exhaust airflow. The outdoor airflow setpoint for space other than laboratory areas will be determined according to ASHRAE Standard 62.1-2007, Equation 6-8 and Appendix A.

Provide an alarm at the workstation if the minimum airflow should deviate from set point by more than 10 percent.

The outdoor airflow set point will primarily be determined by the total exhaust airflow plus building pressurization, see Building Pressurization Control section. The occupied minimum outside airflow will not drop below 20,000 cfm (adj.) and the unoccupied minimum airflow will match the unoccupied exhaust airflow plus 2,000 cfm (adj.) for building pressurization, but not less than 15,000 cfm. The actual minimum outdoor airflow will be sensed at the outdoor air intake via an airflow measuring station.

The BAS will include three methods for determining space occupancy:
- Time of Day (TOD) scheduling
- Occupancy (OCC) sensors,
- AND Carbon dioxide (CO_2) sensors.

TOD spaces will include public spaces not included in other methods. The time-of-day schedule will indicate whether a zone is normally occupied or unoccupied. When the schedule indicates that the zone is normally unoccupied, the required outdoor airflow for the zone will be zero. When the schedule indicates that the zone is normally occupied, the required outdoor airflow for the zone will equal the design outdoor airflow (based on design occupancy).

Private offices will be equipped with an occupancy sensor, provided by Division 26 Contractor. The required outdoor airflow for the zone will be continuously determined based on whether people are present or n o t . When the occupancy sensor indicates that people are present in the zone, the required outdoor airflow will equal the design outdoor airflow. When the occupancy sensor indicates that no people are present in the zone, the required outdoor airflow will equal the “unoccupied” outdoor airflow.

Large occupancy spaces with more than 500 square foot floor area and occupancy greater than 25 people per 1000 square foot of floor area, as listed below, will be equipped with a CO_2 sensor.

As the CO_2 concentration in the space rises, increase the AHU minimum outside airflow by what’s listed below:
- VAV-110; 131 Health Assessment Lab, 260 cfm (100 cfm to 360 cfm)
- VAV-113; 135 Dry Skills Lab, 260 cfm (110 cfm to 370 cfm)
- VAV-115; 140 Conference Room, 130 cfm (50 cfm to 180 cfm)
- VAV-123 and VAV-124; 160 Lecture Hall, 930 cfm (130 cfm to 1060 cfm)
- VAV-209; 231 Computer Lab/General Clrm, 260 cfm (80 cfm to 340 cfm)
- VAV-210; 233 General Classroom, 260 cfm (80 cfm to 340 cfm)
- VAV-321; 353 Quantitative/Interview Lab, 260 cfm (100 cfm to 360 cfm)

The required outdoor-air fraction will be continuously calculated for each VAV terminal zone. Outdoor-air fraction is defined, as the current required outdoor airflow for the zone divided by the current primary airflow to the zone.

Air Handling Units Sequence of Operations (AHU-1 & AHU-2)

The BAS will regularly determine the highest zone outdoor-air fraction, sum the outdoor airflow requirements for all VAV zones, and sum the current primary airflows for all VAV zones to determine the total system primary airflow. This information will be used in Equation 6-8 and Appendix A of ASHRAE Standard 62.1-2007 to calculate the minimum required outdoor airflow for the system. This minimum outdoor airflow set point will be recalculated every 15 minutes (adj.).

The VAV Air System will not request a higher percentage of outdoor air than the AHU is able to provide. This Ventilation Ratio Limit (adj.) of the AHU is dependent on the capacity of the AHU and the current outdoor air temperature and humidity conditions.

Prior to final system acceptance, a Contractor will provide a trend log of actual system operation to the engineer and Owner. Operating conditions to be logged include:

- Highest zone outdoor-air fraction
- Total system primary airflow
- Calculated outdoor airflow set point for the system
- AND the actual measured outdoor airflow

These conditions must be logged at 15-minute intervals over a typical 24-hour period.

Prefilter Differential Pressure Monitor:
The controller will monitor the differential pressure across the prefilter.

Alarms shall be provided as follows:

- Prefilter Runtime Exceeded: Status runtime exceeds a user definable limit.

Final Filter Differential Pressure Monitor:
The controller will monitor the differential pressure across the final filter.

Alarms shall be provided as follows:

- Final Filter Runtime Exceeded: Status runtime exceeds a user definable limit.

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FILENAME: (7) AHU-1 & AHU-2

DRAWING NAME:
Air Handling Units Sequence of Operations (AHU-1 & AHU-2)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 7.10

Return Air Dampers & Ventilation Fan Sequence of Operations

Return Air Damper Control: Building Pressurization
The controller will measure, calculate, and gather airflow information from building system, including Lab airflow control system. BAS will also include exhaust airflow quantities from operating constant flow fans in building pressurization calculations.

The BAS will continually monitor total supply and exhaust airflow for each floor and modulate the associated return air damper to maintain positive pressure.

Total floor return airflow (RA) will equal the total floor supply airflow (SA) minus the total floor exhaust airflow (EA) minus the floor pressurization (PRZ) 500-cfm (adj.):

- 01SA - 01EA - 01PRZ (adj.) = 01RA
- 02SA - 02EA - 02PRZ (adj.) = 02RA
- 03SA - 03EA - 03PRZ (adj.) = 03RA
- 04SA - 04EA - 04PRZ (adj.) = 04RA

Ventilation Airflow:
Reset the minimum outside airflow to meet the total building exhaust airflow plus building pressurization, 2,000-cfm (adj.).

Ventilation Fans - VF-1 (L0 Mech Rm)

Run Conditions - Scheduled:
The fan will run according to a user definable schedule.

Fan:
The fan will have a user definable (adj.) minimum runtime.

Zone Temp:
If the zone temperature is above set point 80 deg. F (adj.) by a user definable amount (adj.) the fan will start.

Fan Air Damper:
The air damper will open once the fan status is proven and will close anytime the fan stops. The exhaust air damper will close 30 sec (adj.) after the fan stops.

Alarms will be provided as follows:

- Damper Failure: Commanded open, but the status is closed.
- Damper in Hand: Commanded closed, but the status is open.
- Damper Status: The fan will be enabled after the damper status has proven. Alarms will be provided as follows:
- Damper Failure: Commanded open, but the status is closed.
- Damper in Hand: Commanded closed, but the status is open.
- Fan Status: The controller will monitor the fan status. Alarms will be provided as follows:
- Fan Failure: Commanded on, but the status is off.
- Fan in Hand: Commanded off, but the status is on.

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FILENAME: (7) AHU-1 & AHU-2

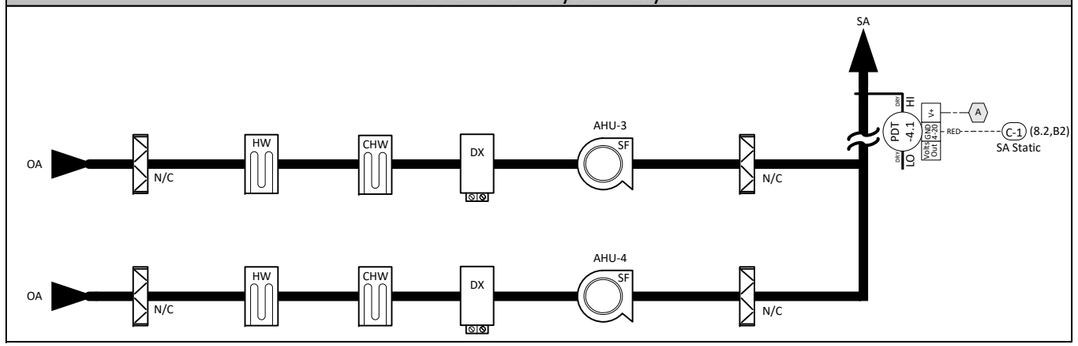
DRAWING NAME:
Return Air Dampers & Ventilation Fan Sequence of Operations

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 7.11

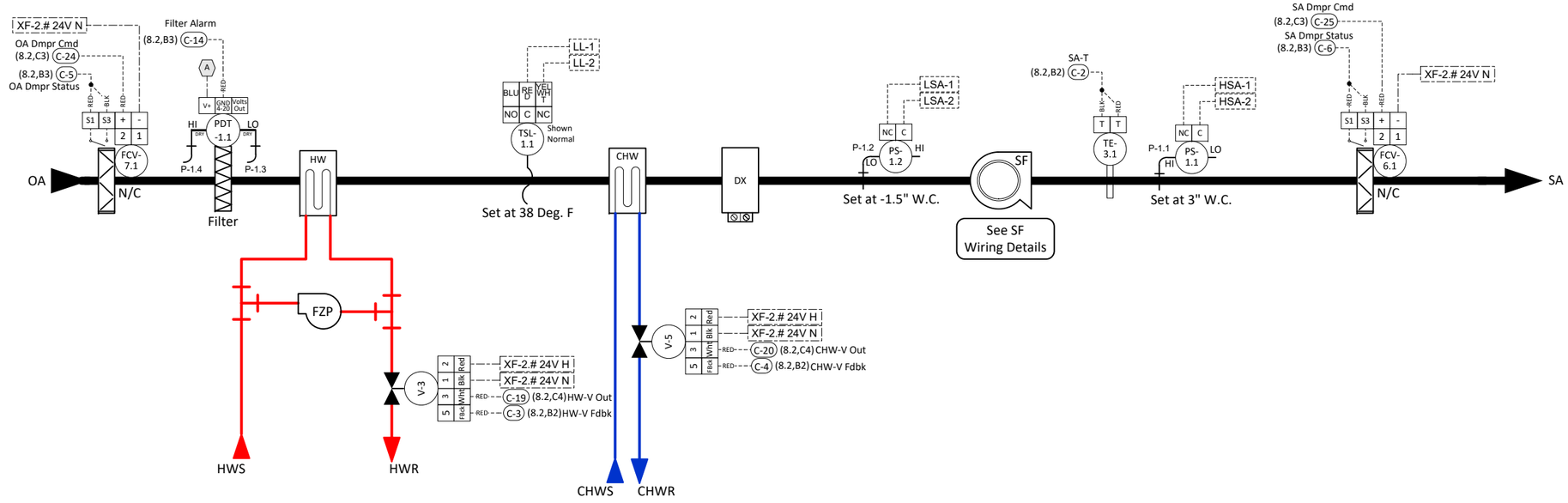
Air Handling Units (Typ. of 2: AHU-3 & AHU-4)

AHU-3 & AHU-4 System Layout

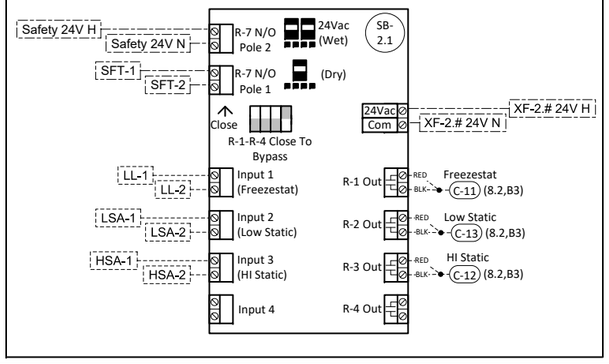


Instrument List

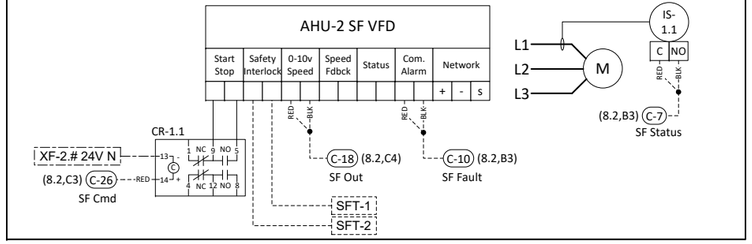
Tag	Product Description	Manufacturer	Part Number	Quantity
PDT-1.#	Standard Range Pressure Sensor, 0-2"w.c., Bapi Box, Remote Static Probe w/ Display	BAPI	ZPT-20-SR73-BB-ST-D	2
PDT-4.#	Standard Range Pressure Sensor, 0-5"w.c., Bapi Box, Attached Static Probe w/ Display	BAPI	ZPT-20-SR75-BB-AT-D	2
P-1.#	Zone Pressure Pickup Port, 6" Static Pressure Probe Assembly	BAPI	ALC/ZPS-ACC07	8
TE-3.#	Duct, 8" Insertion, BAPI Box 4 IP44	BAPI	ALC/10K-2-D-8"-BB4	2
FCV-6.#	Dmpr. Act. 35 in-lbs, Spring Return, On/Off, 24 VAC, 1Aux Switch	Belimo	LF24-S US	2
FCV-7.#	Dmpr. Act. 90 in-lbs, Spring Return, On/Off, 24 VAC, 2 Aux Switch	Belimo	NFB24-S	2
V-3	Globe Valve,0.75",2 Way,7.5 Cv,w/ Spring Return,24V,Modulating	Belimo	G220+LF24-SR US	2
V-5	Globe Valve,1.25",2 Way,20 Cv,w/ Non-Spring,24V,Modulating	Belimo	G232+NC+SVB24-SR	2
PS-1.#	Differential Pressure Switch, 0-12 in. WC, SPST, Man. Reset (NC), 1/4" Barbed Fittings	Cleveland	AFS-460-112	4
IS-1.#	Current Switch, Split Core, Adj. Setpoint to 0.5A	Functional Devices	RIBXGTA	6
SB-2.#	Relay Logic Board - 6 Alarm Points	Functional Devices	RIBMNLB-6NO	2
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	4
TSL-1.#	Low-Limit Temp Sw,SPDT,Man Rst,35-45F,20' w/ (8) Flexible Probe Brackets	Siemens	134-1511+BA/FPB	2



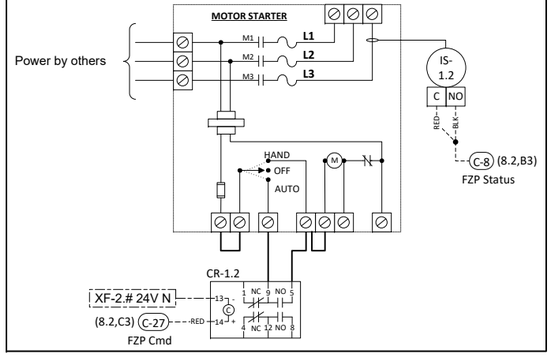
Fan Safety Board



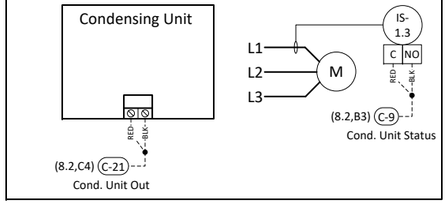
SF Wiring Details



FZP Wiring Details



Condensing Unit Wiring Details



INSTALLATION NOTES:
1.) XF-2.# - XF-2.1 Powers AHU-3 Devices and XF-2.2 Powers AHU-4 Devices

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FILENAME: (8) AHU-3 & 4

DRAWING NAME:
Air Handling Units (Typ. of 2: AHU-3 & AHU-4)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

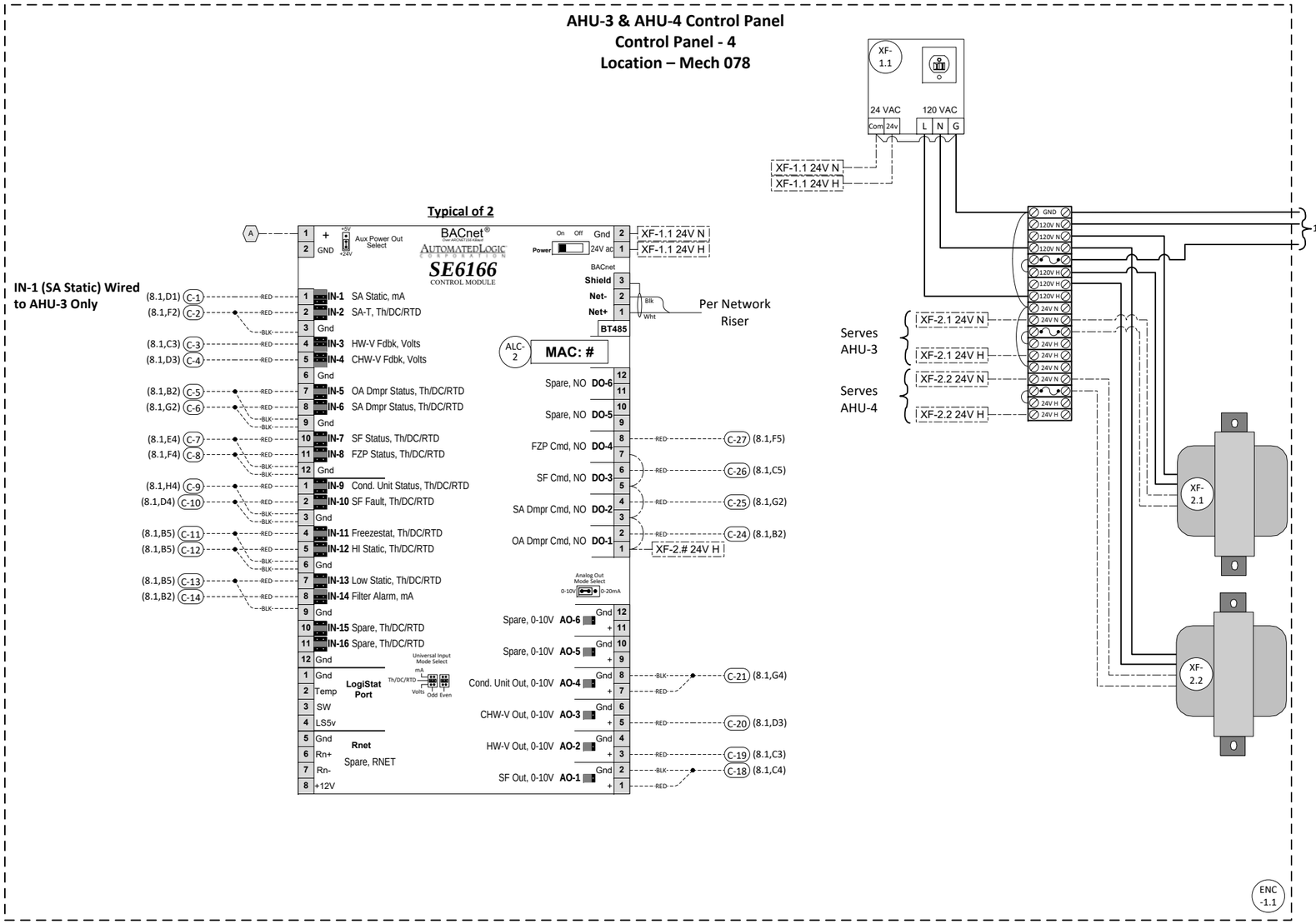
DRAWING NO.: 8.1

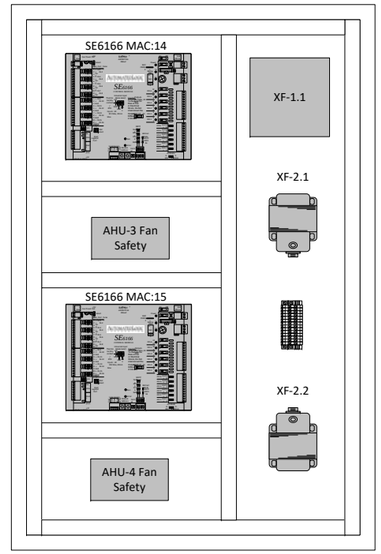
Air Handling Units Controller Details (AHU-3 & AHU-4)

Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-2	Control Module, 6DO, 16UI, 6AO	Automated Logic	SE6166	2
XF-2.#	24V Transformer, 96VA	Core Lectro	LE12100	2
XF-1.#	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	Functional Devices	PSB100AB10	1
ENC-1.#	24" x 36" (Large) Control Panel	Saginaw	SCE-36N2406NKT	1

AHU-3 & AHU-4 Control Panel
Control Panel - 4
Location – Mech 078





Control Panel - 4
Location – Mech 078

INSTALLATION NOTES:
1.) XF-2.# - XF-2.1 Powers AHU-3 Devices and XF-2.2 Powers AHU-4 Devices

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FILENAME: (8) AHU-3 & 4

DRAWING NAME: Air Handling Units Controller Details (AHU-3 & AHU-4)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 8.2

Air Handling Units Sequence of Operations (AHU-3 & AHU-4)

Cadaver Lab Air Handling Units - AHU-3, CU-1, FZP-3, AHU-4, CU-2, and FZP-4

This system serves the Cadaver Lab Suite. The system is designed for full redundancy; one AHU is required for the Cadaver Lab Suite loads and the DX condensing units are backup to the campus chilled water. Provide isolation dampers at the inlet and outlets of each air handling unit for individual unit operations.

Run Conditions:
The system will run continuously unless commanded off from the workstation.

Freeze Protection:
The unit will shutdown and generate an alarm upon receiving a freezestat status.

High/Low Static Shutdown:
The unit will shutdown and generate an alarm upon receiving a high or low static shutdown signal.

Supply Air Smoke Detection:
The unit will shutdown and generate an alarm upon receiving a supply air smoke detector status.

Discharge and Inlet Isolation Dampers:
The dampers will open anytime the supply fan starts. Coordinate damper speed with fan starting speed to prevent recirculation if one AHU is already operating.

Supply Fan:
The supply fan will run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan will have a user definable (adj.) minimum runtime.

Alarms will be provided as follows:
- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Supply Air Duct Static Pressure Control:
The controller will measure duct static pressure at multiple locations and modulate the supply fan VFD speed to maintain a fixed duct static pressure set point. The speed will not drop below 15 percent (adj.).

Alarms will be provided as follows:
- High Supply Air Static Pressure: If the supply air static pressure is 25 percent (adj.) greater than set point.
- Low Supply Air Static Pressure: If the supply air static pressure is 25 percent (adj.) less than set point.
- Supply Fan VFD Fault.

Supply Air Temperature Set Point:
The supply air temperature set point will be 50 deg. F (adj.).

Cooling Coil Valve:
The controller will measure the supply air temperature and modulate the cooling coil valve to maintain its cooling set point.

The cooling will be enabled whenever:
- Outside air temperature is greater than 50 deg. F (adj.).
- AND the supply fan status is on.
- AND the heating is not active.

The cooling coil valve will open to 50 percent (adj.) whenever the freezestat is on.

Alarms will be provided as follows:
- High Supply Air Temp: If the supply air temperature is 5 deg. F. (adj.) greater than set point.
- Heating Coil Valve: The controller will measure the supply air temperature and modulate the heating coil valve to maintain its heating set point.

Heating Coil Valve:
The controller will measure the supply air temperature and modulate the heating coil valve to maintain its heating set point.

The heating will be enabled whenever:
- Outside air temperature is less than 50 deg. F. (adj.).
- AND the supply fan status is on.
- AND the cooling is not active.

The heating coil valve will open whenever:
- Supply air temperature drops from 40 deg. F. to 35 deg. F. (adj.).
- OR the freezestat is on.

Alarms will be provided as follows:
- Low Supply Air Temp: If the supply air temperature is 5 deg. F. (adj.) less than set point.

Heating Coil Freeze Prevention Pump (FZP):
The recirculation pump will run whenever the outside air temperature is below 38 deg. F (adj.) or if the freezestat is on.

Alarms will be provided as follows:
- Heating Coil Pump Failure: Commanded on, but the status is off.
- Heating Coil Pump in Hand: Commanded off, but the status is on.
- Heating Coil Pump Runtime Exceeded: Status runtime exceeds a user definable limit.

Condensing Units:
The (DX) cooling system will be enabled and control discharge air temperature if the campus chilled water system fails or the chilled water temperature rises above set point by 5 deg. F (adj.) for a period of time longer than 15 minutes (adj.).

Air Handling Unit Lead/Lag Operation:
The two (2) variable speed air handling units will operate in a lead/lag fashion. The lead unit will run first. On failure of the lead unit, the lag unit will run and the lead unit will turn off.

The designated lead unit will rotate upon one of the following conditions (user selectable):
- manually through a software switch
- if unit runtime (adj.) is exceeded
- daily
- weekly
- monthly

Alarms will be provided as follows:
- Failure: Commanded on, but the status is off.
- Running in Hand: Commanded off, but the status is on.
- Runtime Exceeded: Status runtime exceeds a user definable limit.
- VFD Fault.

Filter Differential Pressure Monitor:
The controller will monitor the differential pressure across the filter.

Alarms shall be provided as follows:
- Filter Runtime Exceeded: Status runtime exceeds a user definable limit.

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FILENAME: (8) AHU-3 & 4

DRAWING NAME: Air Handling Units Sequence of Operations (AHU-3 & AHU-4)

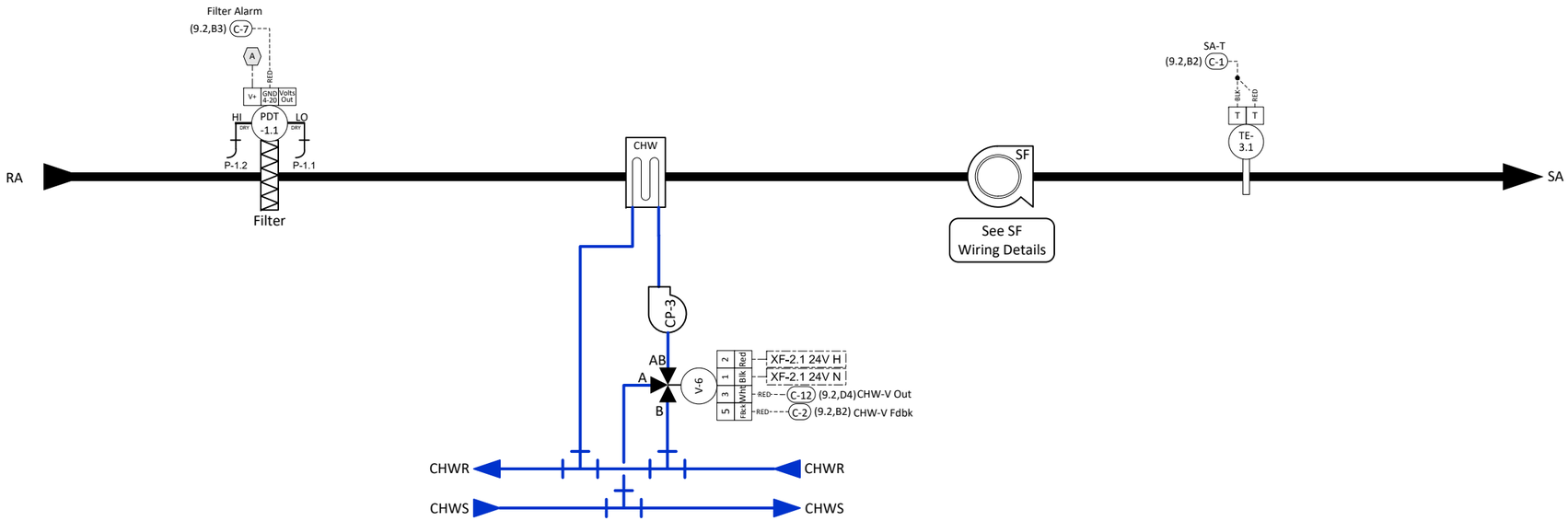
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 8.3

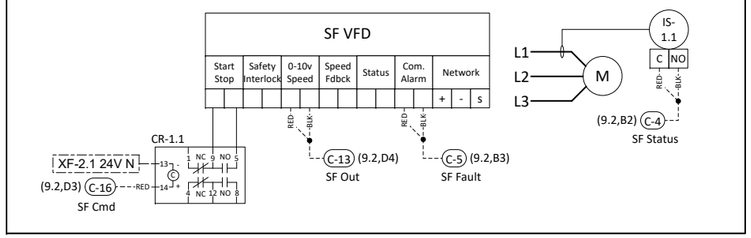
Air Handling Unit (AHU-5)

Instrument List

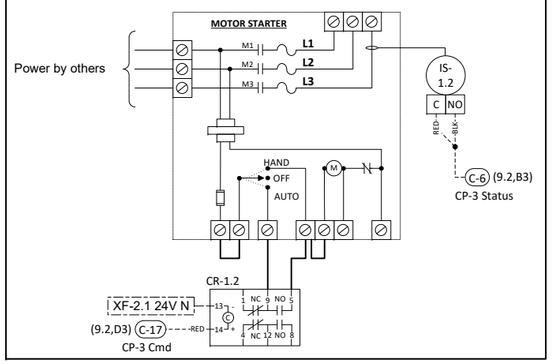
Tag	Product Description	Manufacturer	Part Number	Quantity
TE-1	ZS Std Space Temp Sensor, Rnet	Automated Logic	ZS-ALC	1
TE-3.1	Duct, 8" Insertion, BAPI Box 4 IP44	BAPI	ALC/10K-2-D-8"-BB4	1
P-1.#	Zone Pressure Pickup Port, 6" Static Pressure Probe Assembly	BAPI	ALC/ZPS-ACC07	2
PDT-1.1	Standard Range Pressure Sensor, 0-2"w.c., Bapi Box, Remote Static Probe w/ Display	BAPI	ZPT-20-SR73-BB-ST-D	1
V-6	Globe Valve,1.5",3 Way,28 Cv,w/ Non-Spring,24V,Modulating	Belimo	G340+NC+SVB24-SR	1
IS-1.#	Current Switch, Split Core, Adj. Setpoint to 0.5A	Functional Devices	RIBXGTA	2
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	2



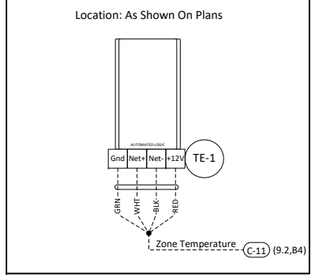
SF Wiring Details



Circulation Pump CP-3 Wiring Details



Zone Temperature Sensor



Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (9) AHU-5

DRAWING NAME: Air Handling Unit (AHU-5)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

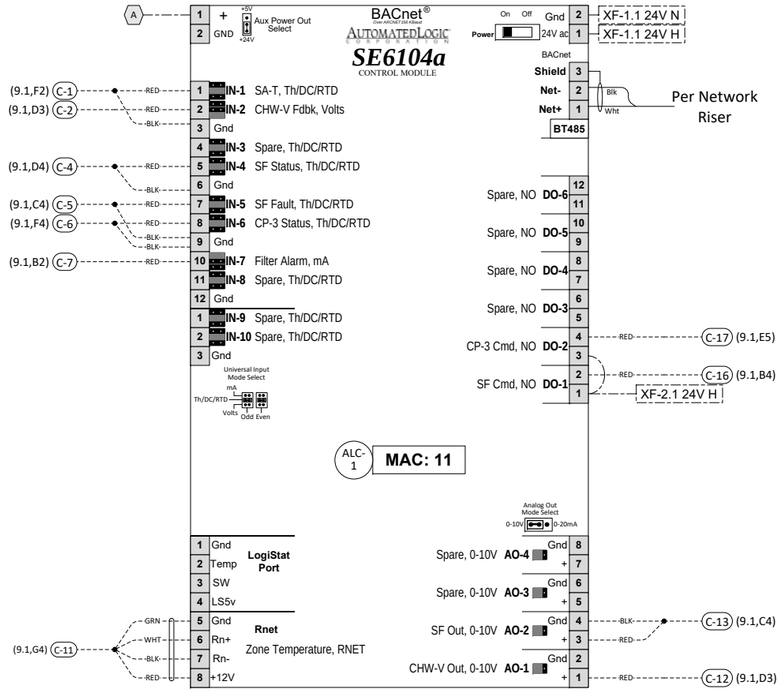
DRAWING NO.: 9.1

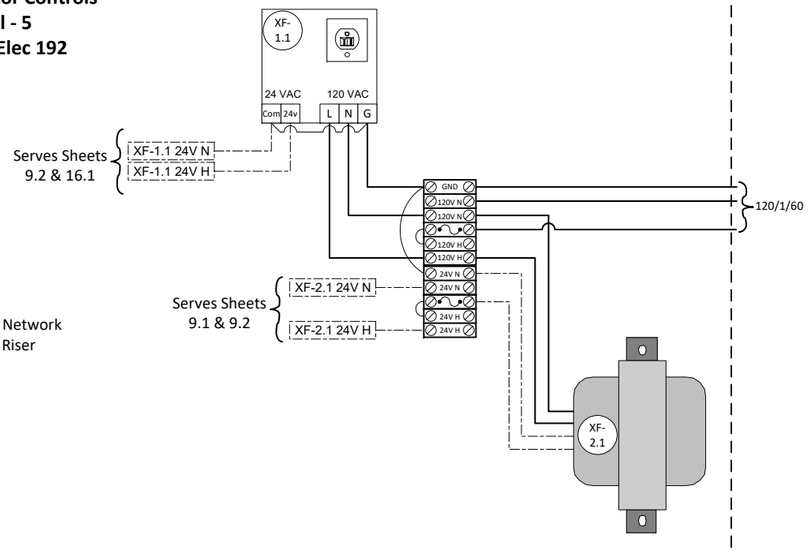
Air Handling Unit Controller Details (AHU-5)

Instrument List

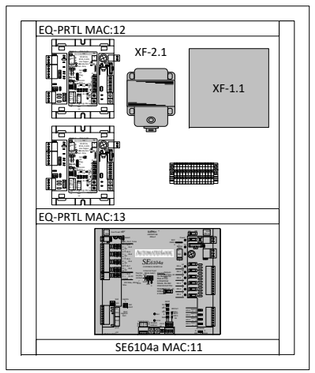
Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-1	Control Module, 6DO, 10UI, 4AO	Automated Logic	SE6104a	1
XF-2.#	24V Transformer, 96VA	Core Lectro	LE12100	1
XF-1.#	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	Functional Devices	PSB100AB10	1
ENC-3.#	20" x 24" (Medium) Control Panel	Saginaw	SCE-24N2006NKT	1

AHU-5/ATS/Generator Controls
Control Panel - 5
Location – Main Elec 192





ENC -3.1



Control Panel - 5
Location – Main Elec 192

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Webster Groves, MO 63119

FILENAME: (9) AHU-5

DRAWING NAME: **Air Handling Unit Controller Details (AHU-5)**

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 9.2

Air Handling Unit Sequence of Operations (AHU-5)

Main Electrical Room Ventilation Air Handling Unit - AHU-5 and CP-3

Run Conditions:
The system will run continuously unless commanded off from the workstation.

Supply Fan:
The supply fan will run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan will have a user definable (adj.) minimum runtime.

Alarms will be provided as follows:
- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Supply Air Temperature Set Point:
The supply air temperature set point will be 60 deg. F (adj.). Reset supply air set point up if VFD is at minimum airflow and the space is below set point.

Supply Airflow:
The supply fan VFD will modulate airflow to meet space temperature setting, 80 deg. F (adj.).

Cooling Coil Valve:
The controller will measure the supply air temperature and modulate the cooling coil valve to maintain its cooling set point.

The cooling will be enabled whenever:
- The supply fan status is on.

Recirculation Pump:
The recirculation pump will run whenever there is a call for cooling.

Alarms will be provided as follows:
- Pump Failure: Commanded on, but the status is off.
- Pump in Hand: Commanded off, but the status is on.
- Pump Runtime Exceeded: Status runtime exceeds a user definable limit.

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FILENAME: (9) AHU-5

DRAWING NAME:
Air Handling Unit Sequence of Operations (AHU-5)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

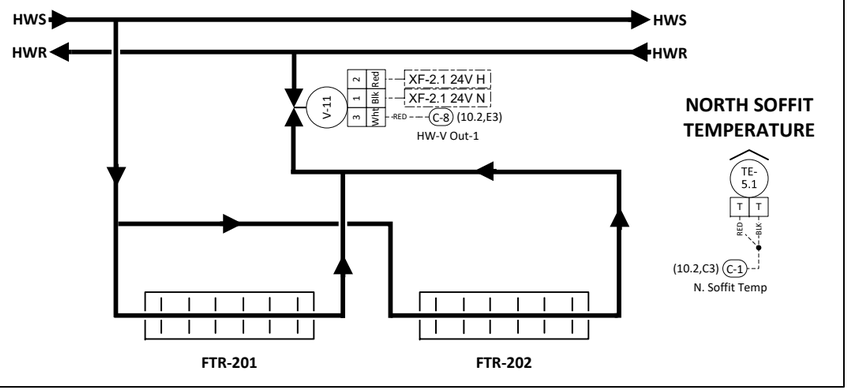
DRAWING NO.: 9.3

Soffit Finned Tube Radiation

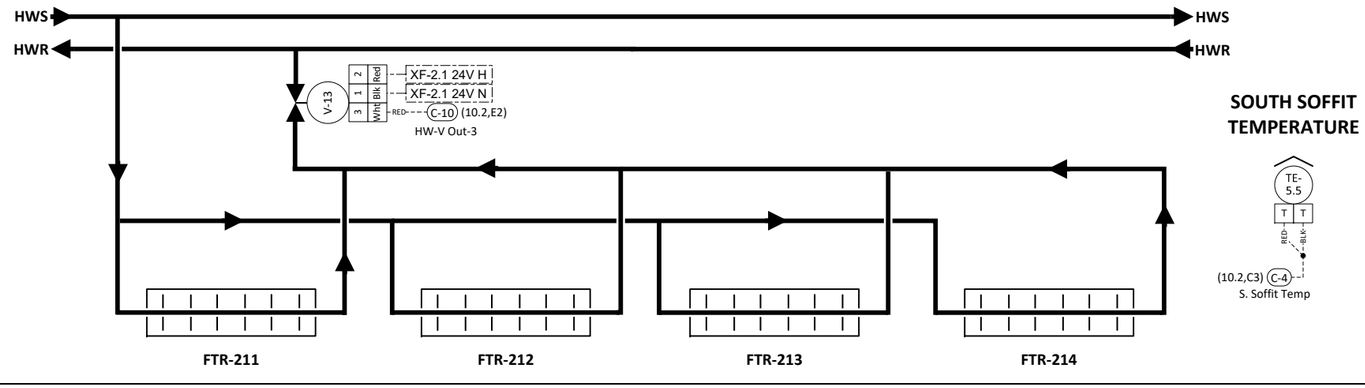
Instrument List

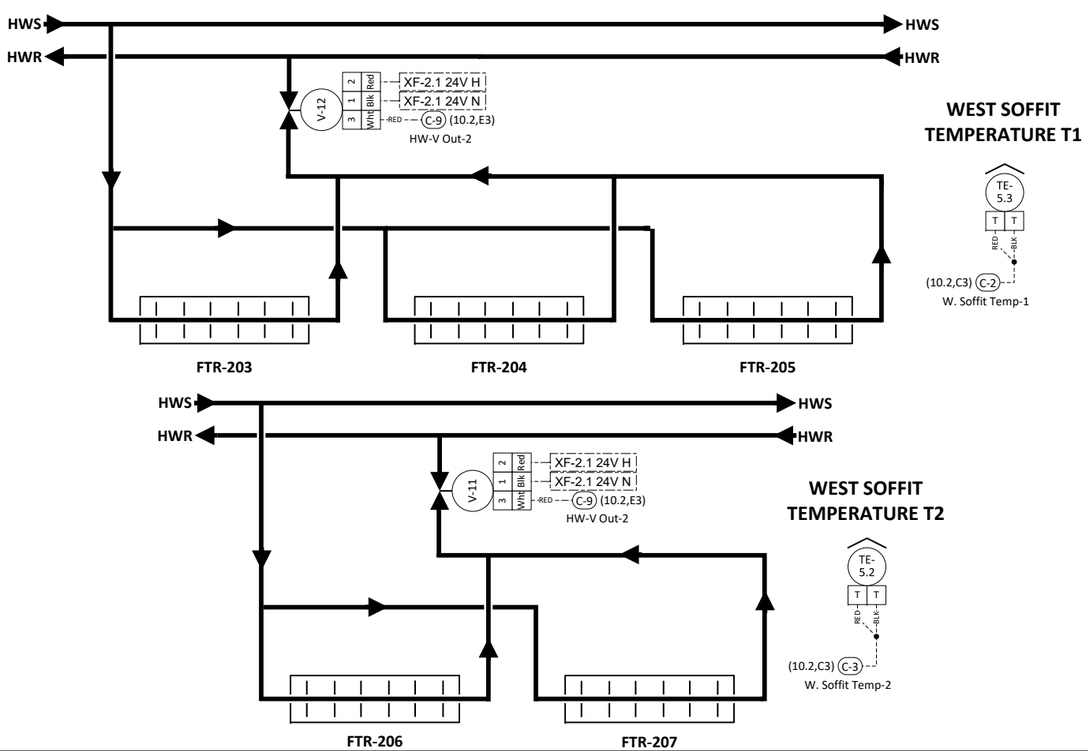
Tag	Product Description	Manufacturer	Part Number	Quantity
TE-5.#	Outside Air in BAPI BOX 2, 1/2 Size BB NEMA 4X	BAPI	ALC/10K-2-O-BB2	5
V-11	CCV,0.5",2 Way,1.2 Cv,w/ Spring Return,24V,Modulating	Belimo	B210B+NO/FO+TFRB24-SR	2
V-12	CCV,0.5",2 Way,1.9 Cv,w/ Spring Return,24V,Modulating	Belimo	B211B+NO/FO+TFRB24-SR	2
V-13	CCV,0.5",2 Way,3 Cv,w/ Spring Return,24V,Modulating	Belimo	B212B+NO/FO+TFRB24-SR	1

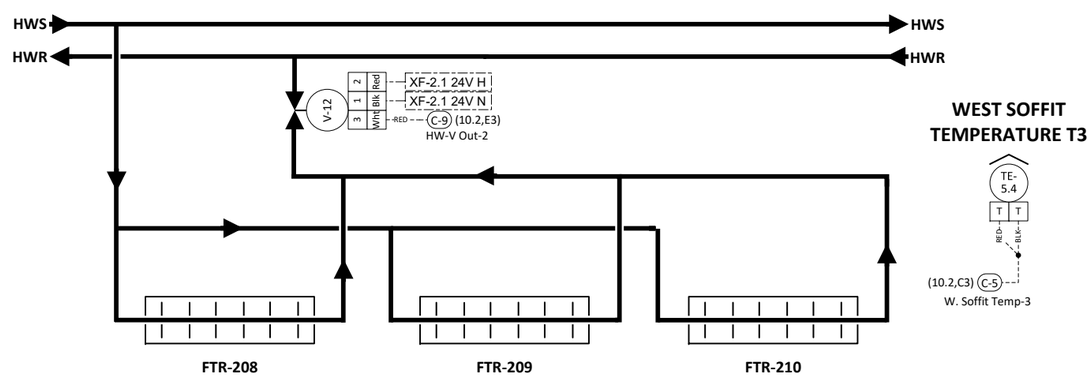
NORTH SOFFIT FINNED TUBE RADIATION CONTROL (FTR-201 AND FTR-202)



SOUTH SOFFIT FINNED TUBE RADIATION CONTROL (FTR-211 THROUGH FTR-214)







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Webster Groves, MO 63119

FILENAME: (10) Soffit FTR

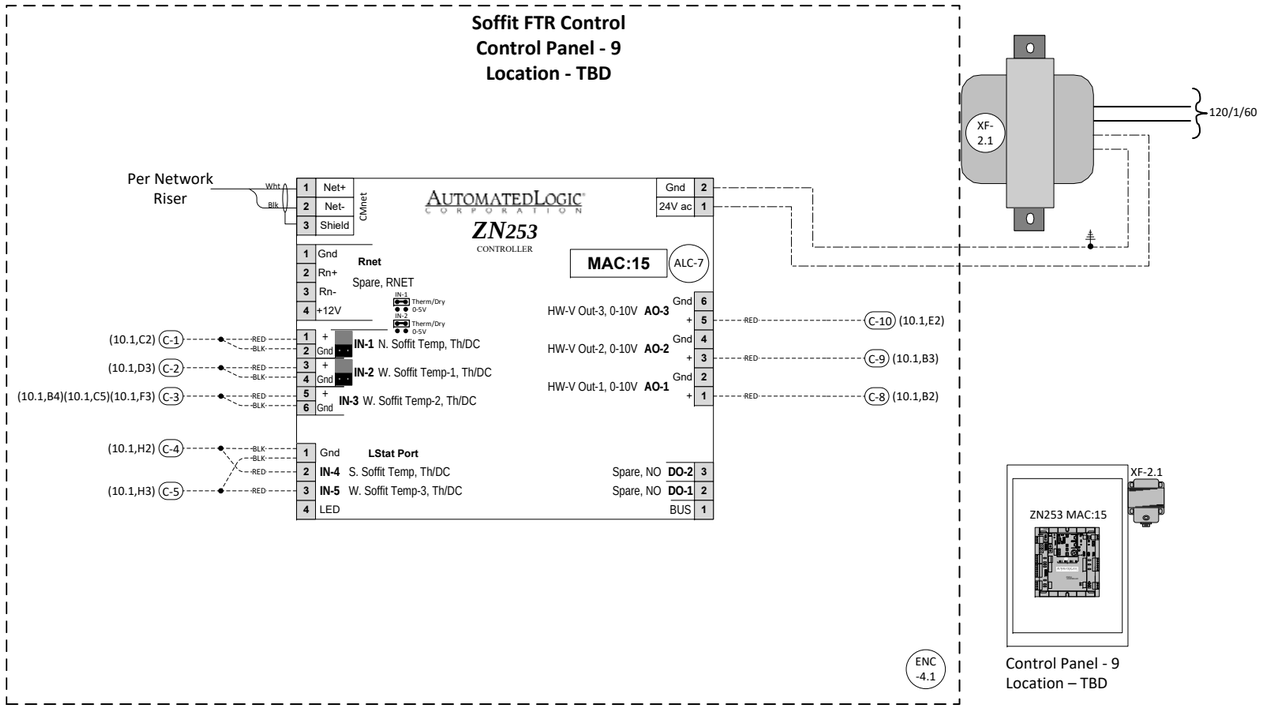
DRAWING NAME: Soffit Finned Tube Radiation

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 10.1

Soffit Finned Tube Radiation Controller Details

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
ENC-4.#	10"x15" (small) Control Panel With Lexan Door	ALPS	YM9050	1
ALC-7	Zone Controller, 2DO, 5UI, 3AO	Automated Logic	ZN253	1
XF-2.#	24V Transformer, 96VA	Core Lectro	LE12100	1



Control Panel - 9
Location – TBD

Automatic Controls equipment systems, inc.	Webster University ISB - HVAC Controls 470 E. Lockwood Ave. Webster Groves, MO 63119	DRAWING NAME: Soffit Finned Tube Radiation Controller Details	
		CONTRACT NO: WU-01-16 | SE:JV | DE: PL | PR: RV	
	FILENAME: (10) Soffit FTR	DRAWING NO.: 10.2	

Soffit Finned Tube Radiation Sequence of Operations

Soffit Finned Tube Radiation Units

General Overview:
The finned tube radiation heating system that serves the soffit areas of the building includes the following components:

- Finned tube radiation units.
- Space temperature sensors.
- Electronically actuated control valves.

The complete operation of the finned tube radiation units is managed by the building automation system.

Run Conditions:
The finned tube radiation units will be placed into operation when the outside air temperature falls below 45°F (adjustable). When placed into operation each controller will maintain the temperature of the soffit area at a 65°F (adjustable) heating setpoint.

Alarms will be provided as follows:

- Low Soffit Temperature: If the temperature in the soffit is less than the heating setpoint by an Operator definable temperature difference (adjustable).

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FILENAME: (10) Soffit FTR

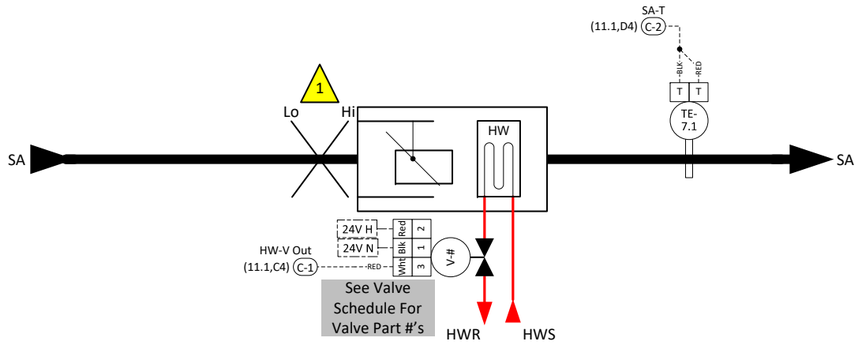
DRAWING NAME:
Soffit Finned Tube Radiation Sequence of Operations

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 10.3

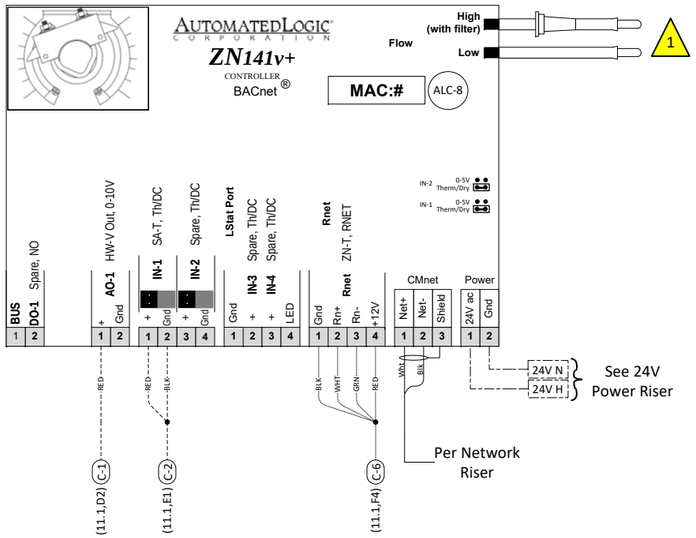
Variable Air Volume Units W/ Hot Water Reheat (Typ. of 65)

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
TE-6.#	ZS Plus Space Temp Sensor, Rnet, SP Adj, Ovrd	Automated Logic	ZSPL-ALC	65
ALC-8	Zone Controller for VAV w/ Actuator, 1DO, 4UI, 1AO	Automated Logic	ZN141V+	65
TE-7.#	Duct, 4" Insertion, w/ 10' Leads, No J-Box	BAPI	ALC/10K-2-D-4"-NB-10'	65
V-14	CCV,0.5",2 Way,1.2 Cv,w/ Non-Spring,24V,Modulating	Belimo	B210B+NO+TR24-SR-T	11
V-16	CCV,0.5",2 Way,0.8 Cv,w/ Non-Spring,24V,Modulating	Belimo	B209B+NO+TR24-SR-T	52
V-17	CCV,0.5",2 Way,3 Cv,w/ Non-Spring,24V,Modulating	Belimo	B212B+NO+TR24-SR-T	2



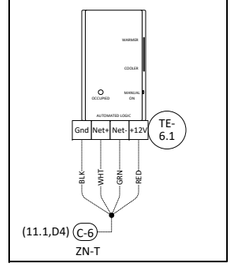
Actuator Note:
Prior to linking Damper, depress clutch release button and rotate actuator collar fully clockwise. Link Damper open. Motor turns counter clockwise to close.

Mounted on VAV



Space Temp Sensor

Location: As shown on plans



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FILENAME: (11) VAVs

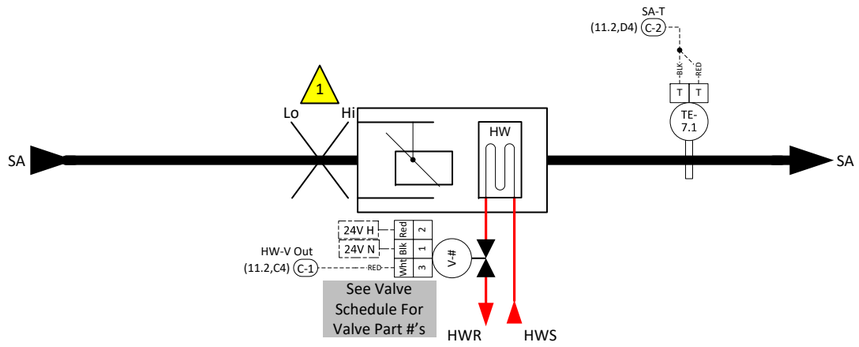
DRAWING NAME:
Variable Air Volume Units W/ Hot Water Reheat (Typ. of 65)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 11.1

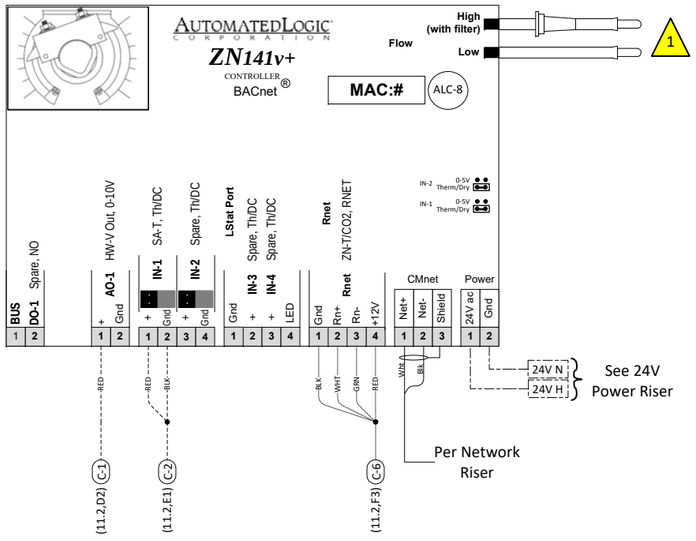
Variable Air Volume Units W/ CO2 (Typ. of 7)

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
ALC-8	Zone Controller for VAV w/ Actuator, 1DO, 4UI, 1AO	Automated Logic	ZN141V+	7
TE-8.#	ZS Plus Space Temp Sensor w/CO2, Rnet, SP Adj, Ovrd	Automated Logic	ZSPL-C-ALC	7
TE-7.#	Duct, 4" Insertion, w/ 10' Leads, No J-Box	BAPI	ALC/10K-2-D-4"-NB-10'	7
V-14	CCV,0.5",2 Way,1.2 Cv,w/ Non-Spring,24V,Modulating	Belimo	B210B+NO+TR24-SR-T	2
V-15	CCV,0.5",2 Way,1.9 Cv,w/ Non-Spring,24V,Modulating	Belimo	B211B+NO+TR24-SR-T	1
V-16	CCV,0.5",2 Way,0.8 Cv,w/ Non-Spring,24V,Modulating	Belimo	B209B+NO+TR24-SR-T	4



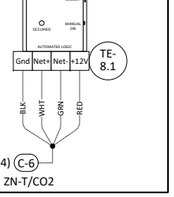
Actuator Note:
Prior to linking Damper, depress clutch release button and rotate actuator collar fully clockwise. Link Damper open. Motor turns counter clockwise to close.

Mounted on VAV



Space Temp Sensor

Location: As shown on plans



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Webster University ISB - HVAC Controls
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Webster Groves, MO 63119

FILENAME: (11) VAVs

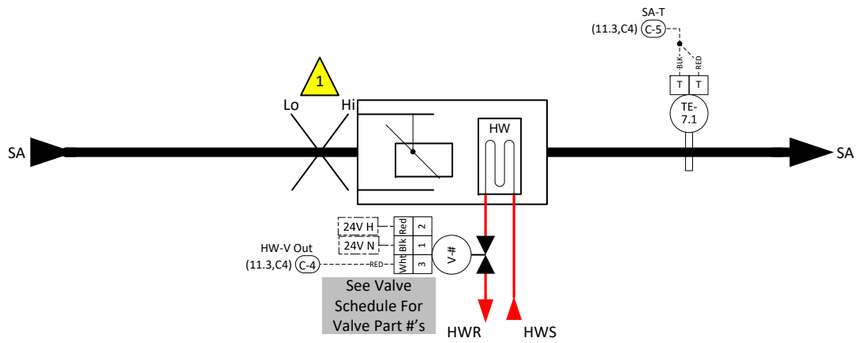
DRAWING NAME: Variable Air Volume Units W/ CO2 (Typ. of 7)

CONTRACT NO: WU-01-16 | SE:JV | DE: PL | PR: RV

DRAWING NO.: 11.2

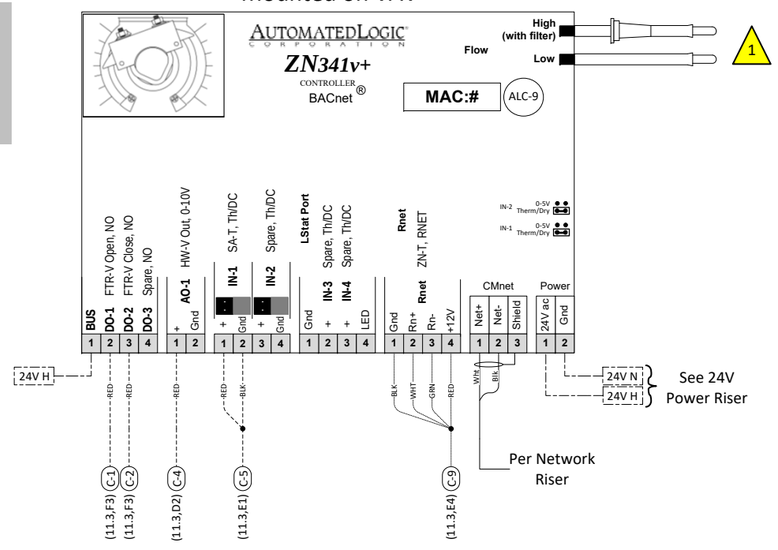
Variable Air Volume Units w/ Fin Tube (Typ. of 7)

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
ALC-9	Zone Controller for VAV w/ Actuator, 3DO, 4UI, 1AO	Automated Logic	ZN341V+	7
TE-6.#	ZS Plus Space Temp Sensor, Rnet, SP Adj, Ovrd	Automated Logic	ZSPL-ALC	7
TE-7.#	Duct, 4" Insertion, w/ 10' Leads, No J-Box	BAPI	ALC/10K-2-D-4"-NB-10'	7
V-7	CCV,0.5",2 Way,0.8 Cv,w/ Non-Spring,24V,Floating	Belimo	B209B+NO+TR24-3-T US	1
V-8	CCV,0.5",2 Way,1.2 Cv,w/ Non-Spring,24V,Floating	Belimo	B210B+NO+TR24-3-T US	3
V-9	CCV,0.5",2 Way,1.9 Cv,w/ Non-Spring,24V,Floating	Belimo	B211B+NO+TR24-3-T US	1
V-10	CCV,0.5",2 Way,3 Cv,w/ Non-Spring,24V,Floating	Belimo	B212B+NO+TR24-3-T US	2
V-14	CCV,0.5",2 Way,1.2 Cv,w/ Non-Spring,24V,Modulating	Belimo	B210B+NO+TR24-SR-T	6
V-15	CCV,0.5",2 Way,1.9 Cv,w/ Non-Spring,24V,Modulating	Belimo	B211B+NO+TR24-SR-T	1



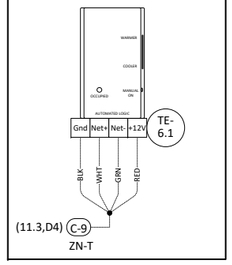
Actuator Note:
Prior to linking Damper, depress clutch release button and rotate actuator collar fully clockwise. Link Damper open. Motor turns counter clockwise to close.

Mounted on VAV

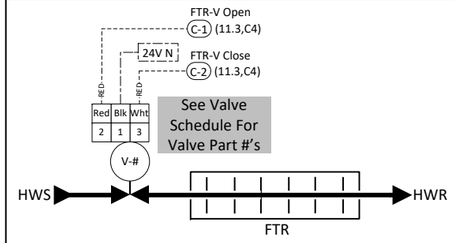


Space Temp Sensor

Location: As shown on plans



FTR Details



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Webster Groves, MO 63119

FILENAME: (11) VAVs

DRAWING NAME: Variable Air Volume Units w/ Fin Tube (Typ. of 7)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 11.3

Variable Air Volume Units Sequence of Operations

Air Terminal Units (VAV)

Run Conditions - Scheduled:
The BAS will include three (3) methods for determining space occupancy:
- Time of Day (TOD) scheduling
- Occupancy (OCC) sensors
- AND Carbon dioxide (CO_2) sensors.

Refer to Division 26 for occupancy sensors. Unit will run according to the occupancy strategy in the following modes:

Occupied Mode: The unit will maintain
- A 74 deg. F. (adj.) cooling set point
- A 70 deg. F. (adj.) heating set point.

Unoccupied Mode (night setback): The unit will maintain
- A 85 deg. F. (adj.) cooling set point.
- A 55 deg. F. (adj.) heating set point.

Alarms will be provided as follows:
- High Zone Temp: If the zone temperature is greater than the cooling set point by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating set point by a user definable amount (adj.).

Zone Setpoint Adjust:
The occupant will be able to adjust the zone temperature heating and cooling set points at the zone sensor.

Zone Unoccupied Override:
A timed local override control will allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit will automatically return to the schedule.

Reversing Variable Volume Terminal Unit - Flow Control:
The unit will maintain zone set points by controlling the airflow through one of the following:

Occupied:
When zone temperature is greater than its cooling set point, the zone damper will modulate between the minimum occupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
When the zone temperature is between the cooling set point and the heating set point, the zone damper will maintain the minimum required zone ventilation (adj.).
When zone temperature is less than its heating set point, the controller will enable heating to maintain the zone temperature at its heating set point. Additionally, if warm air is available from the AHU, the zone damper will modulate between the minimum occupied airflow (adj.) and the maximum heating airflow (adj.) until the zone is satisfied.

Unoccupied:
When the zone is unoccupied the zone damper will control to its minimum unoccupied airflow (adj.).
When the zone temperature is greater than its cooling set point, the zone damper will modulate between the minimum unoccupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
When zone temperature is less than its unoccupied heating set point, the controller will enable heating to maintain the zone temperature at the set point. Additionally, if warm air is available from the AHU, the zone damper will modulate between the minimum unoccupied airflow (adj.) and the auxiliary heating airflow (adj.) until the zone is satisfied.

Reheating Coil Valve:
The controller will measure the zone temperature and modulate the reheating coil valve open on dropping temperature to maintain its heating setpoint.

Reheating - High Discharge Air Temperature Limit:
The controller will measure the discharge air temperature and limit reheating if the discharge air temperature is more than 95°F (adj.).

Discharge Air Temperature:
The controller will monitor the discharge air temperature.

Alarms will be provided as follows:
- High Discharge Air Temp: If the discharge air temperature is greater than 120 deg. F. (adj.).
- Low Discharge Air Temp: If the discharge air temperature is less than 40 deg. F. (adj.).

Perimeter Heating - Fin Tube Radiation (FTR)

Run Conditions:
The perimeter FTR will operate when outside air temperatures are below 50 deg. F (adj.) with an outside air OA reset function.

Perimeter FTR Draft Barrier Heating:
The Space/Zone VAV units will control to space set point as described in “Air Terminal Units (VAV)” sequence. When the outside air temperatures are below 50 deg. F (adj.) the perimeter heating FTR valve will modulate open on an OA reset from 0 to 100 percent (adj.) based on OA temperatures between 50 to 10 deg. F (adj.). The perimeter FTR heating valve will fully close once space temperature rises to within 2 deg F (adj.) of any associated VAV unit cooling set point in order to avoid simultaneous heating and cooling.

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
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Webster Groves, MO 63119

FILENAME: (11) VAVs

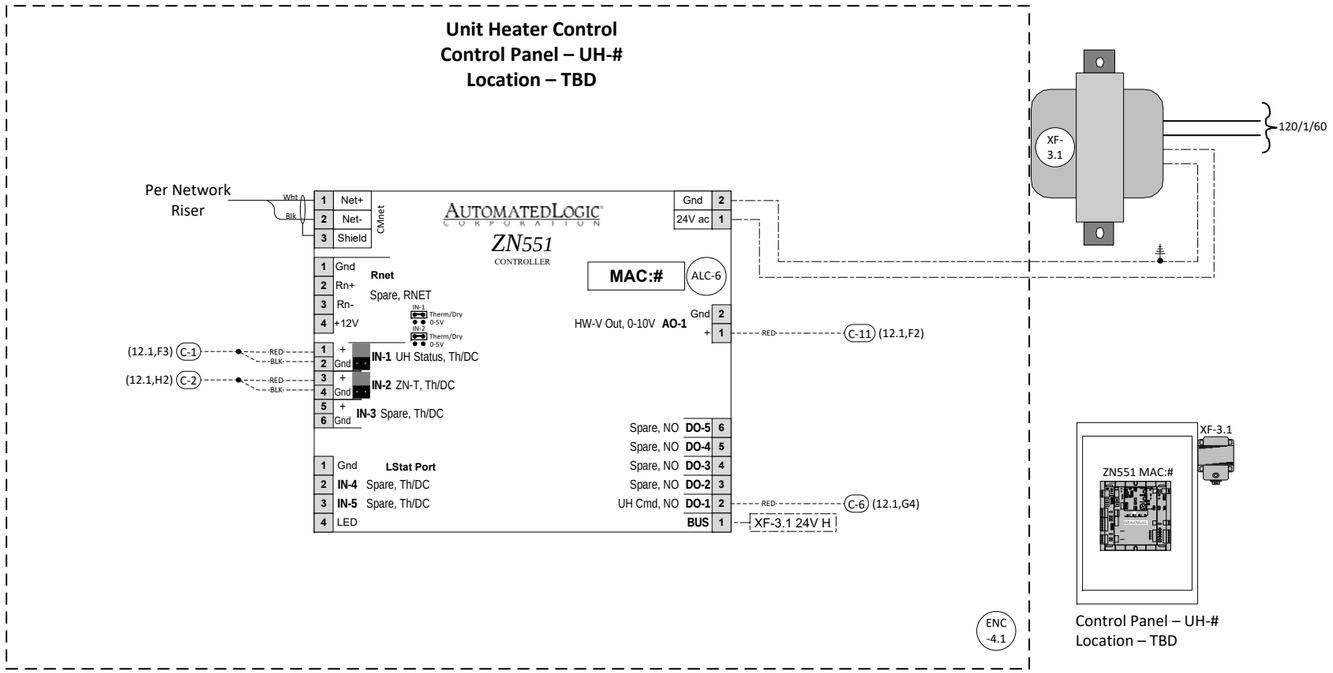
DRAWING NAME:
Variable Air Volume Units Sequence of Operations

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 11.4

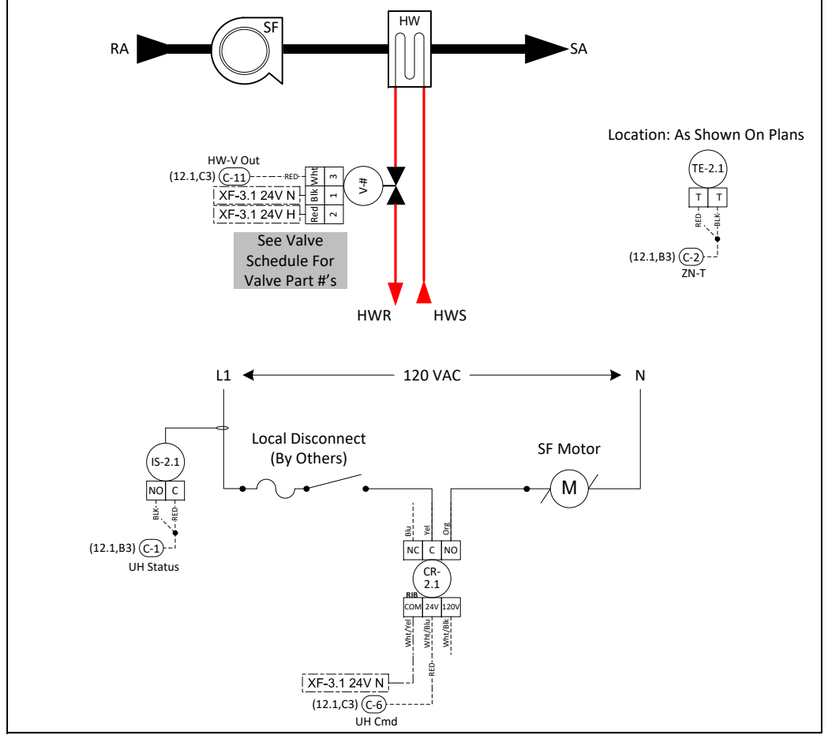
Unit Heaters (Typ. of 3)

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
ENC-4.#	10"x15" (small) Control Panel With Lexan Door	ALPS	YM9050	3
ALC-6	Zone Controller, 5DO, 5UI, 1AO	Automated Logic	ZN551	3
TE-2.#	Room Temp Delta Style	BAPI	ALC/10K-2-R-Z-CG	3
V-15	CCV,0.5",2 Way,1.9 Cv,w/ Non-Spring,24V,Modulating	Belimo	B211B+NO+TR24-SR-T	2
V-17	CCV,0.5",2 Way,3 Cv,w/ Non-Spring,24V,Modulating	Belimo	B212B+NO+TR24-SR-T	1
XF-3.#	24V Transformer, 40VA	Core Lectro	LE11300	3
CR-2.#	Enclosed Relay 20 Amp SPDT with 24 Vac/DC/208-277 Vac Coil	Functional Devices	RIB2401B	3
IS-2.#	Current Switch, Split Core, Fixed Setpoint 0.15A, Micro	Veris	H300	3



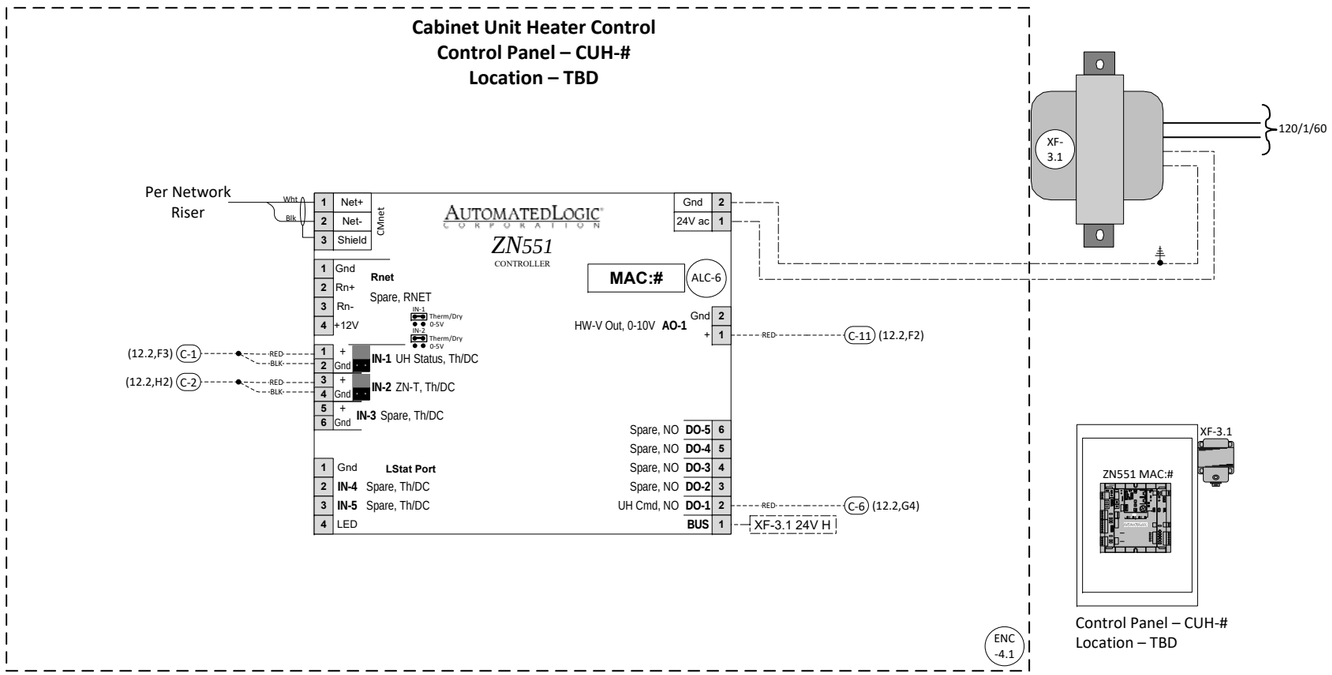
Control Panel – UH-#
Location – TBD

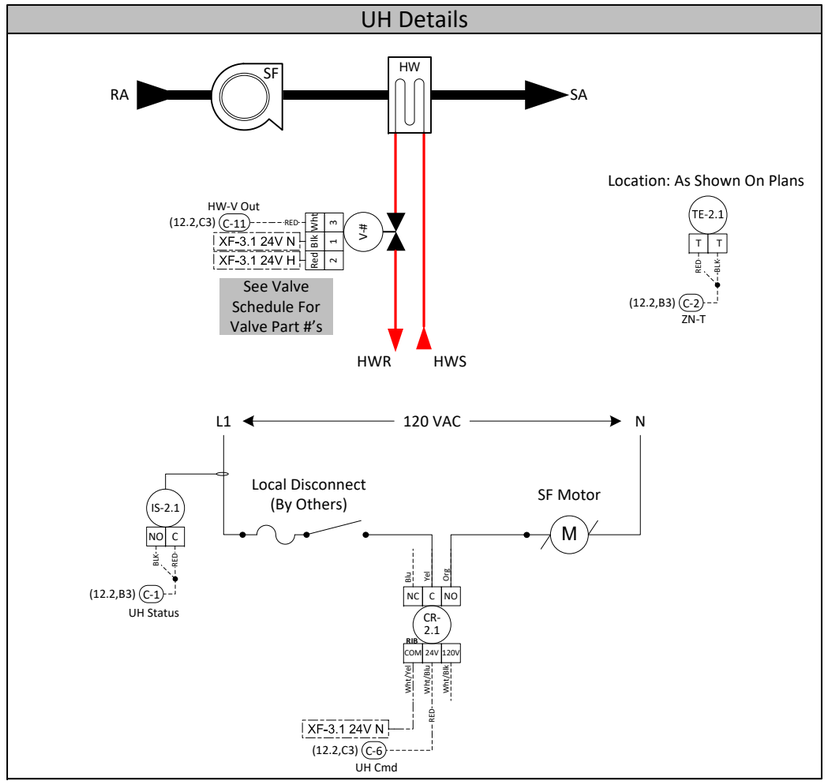
UH Details



Cabinet Unit Heaters (Typ. of 6)

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
ENC-4.#	10"x15" (small) Control Panel With Lexan Door	ALPS	YM9050	6
ALC-6	Zone Controller, 5DO, 5UI, 1AO	Automated Logic	ZN551	6
TE-2.#	Room Temp Delta Style	BAPI	ALC/10K-2-R-Z-CG	6
V-14	CCV,0.5",2 Way,1.2 Cv,w/ Non-Spring,24V,Modulating	Belimo	B210B+NO+TR24-SR-T	3
V-15	CCV,0.5",2 Way,1.9 Cv,w/ Non-Spring,24V,Modulating	Belimo	B211B+NO+TR24-SR-T	2
V-17	CCV,0.5",2 Way,3 Cv,w/ Non-Spring,24V,Modulating	Belimo	B212B+NO+TR24-SR-T	1
XF-3.#	24V Transformer, 40VA	Core Lectro	LE11300	6
CR-2.#	Enclosed Relay 20 Amp SPDT with 24 Vac/DC/208-277 Vac Coil	Functional Devices	RIB2401B	6
IS-2.#	Current Switch, Split Core, Fixed Setpoint 0.15A, Micro	Veris	H300	6





Automatic Controls equipment systems, inc.	Webster University ISB - HVAC Controls 470 E. Lockwood Ave. Webster Groves, MO 63119	DRAWING NAME: Cabinet Unit Heaters (Typ. of 6)		
	FILENAME: (12) Unit Heaters	CONTRACT NO: WU-01-16	SE:JV	DE: PL / PR: RV
		DRAWING NO.: 12.2		

Unit Heaters/Cabinet Unit Heaters Sequence of Operations

Space Heating Units - Unit Heaters (UH) and Cabinet Unit Heater (CUH)

Run Conditions:
The unit will run to maintain a heating set point of 65 deg. F. (adj.).
Low Zone Temp Alarm: If the zone temperature is less than the heating set point by a user definable amount (adj.).

Fan (where applicable):
The fan will run anytime the zone temperature drops below heating set point, unless shutdown on safeties.

Heating Coil Valve:
The controller will measure the zone temperature and open the heating coil valve to maintain its heating set point. The heating will be enabled whenever outside air temperature is less than 65 deg. F. (adj.).

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FILENAME: (12) Unit Heaters

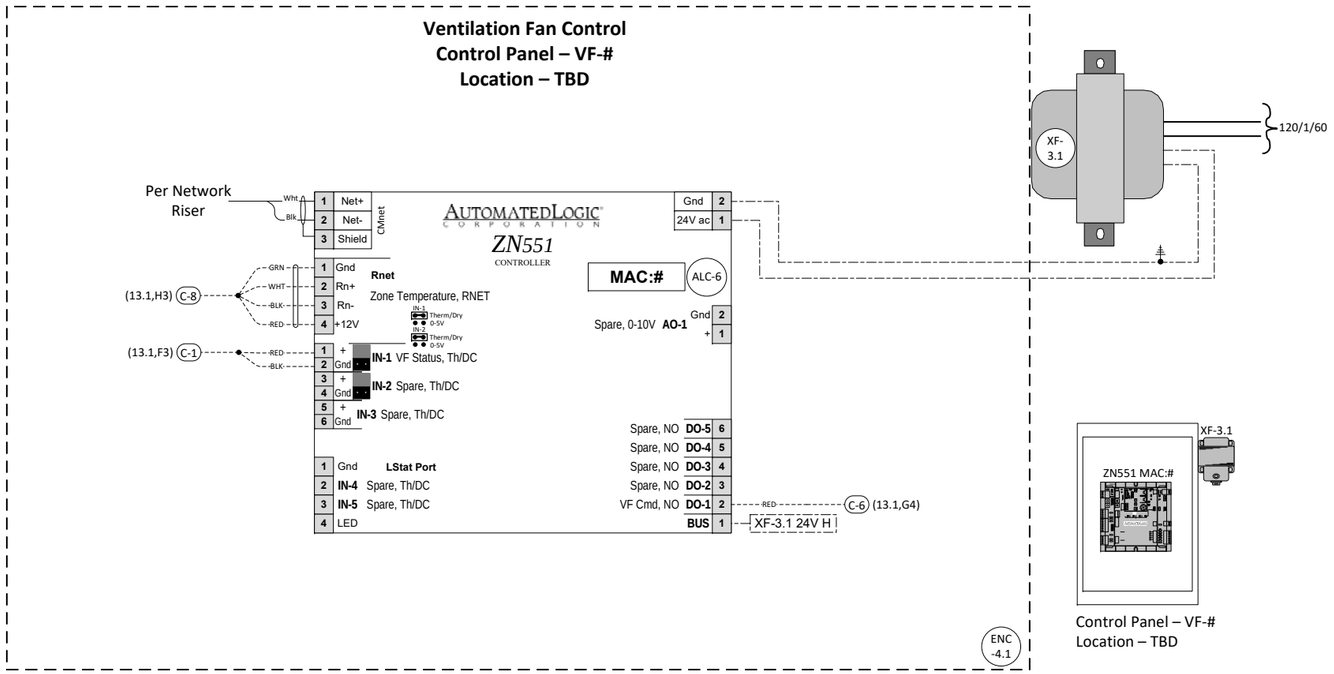
DRAWING NAME:
Unit Heaters/Cabinet Unit Heaters Sequence of Operations

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 12.3

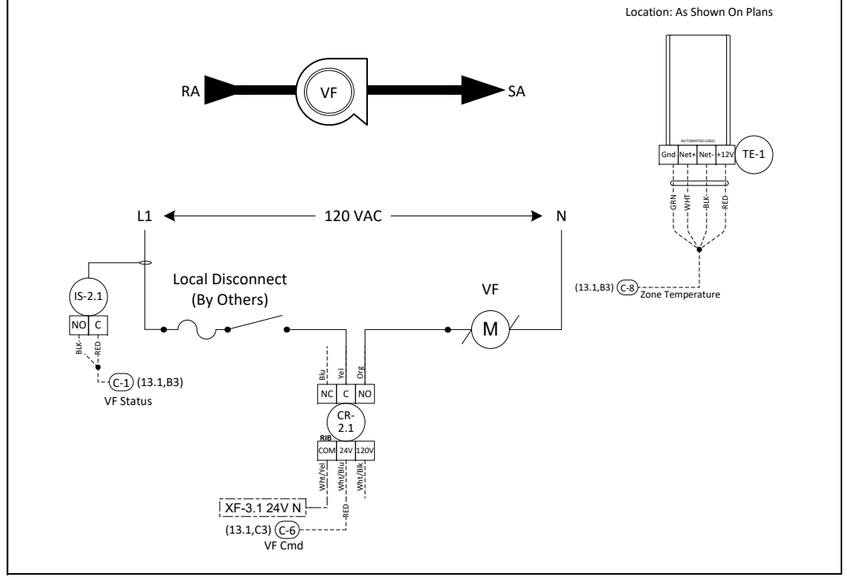
Ventilation Fans (Typ. of 2: VF-2 & VF-3)

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
ENC-4.1	10"x15" (small) Control Panel With Lexan Door	ALPS	YM9050	2
TE-1	ZS Std Space Temp Sensor, Rnet	Automated Logic	ZS-ALC	2
ALC-6	Zone Controller, 5DO, 5UI, 1AO	Automated Logic	ZN551	2
XF-3.1	24V Transformer, 40VA	Core Lectro	LE11300	2
CR-2.1	Enclosed Relay 20 Amp SPDT with 24 Vac/DC/208-277 Vac Coil	Functional Devices	RIB2401B	2
IS-2.1	Current Switch, Split Core, Fixed Setpoint 0.15A, Micro	Veris	H300	2



Control Panel – VF-#
Location – TBD

VF Details



Automatic Controls equipment systems, inc.	Webster University ISB - HVAC Controls 470 E. Lockwood Ave. Webster Groves, MO 63119	DRAWING NAME: Ventilation Fans (Typ. of 2: VF-2 & VF-3)	
	FILENAME: (13) Ventilation Fans	CONTRACT NO: WU-01-16 / SE:JV / DE: PL / PR: RV	DRAWING NO.: 13.1

Ventilation Fans Sequence of Operations (Typ. of 2: VF-2 & VF-3)

Ventilation Fans - VF-2 (L1 Elev. Control Rm) and VF-3 (L1 AV Control Rm)

Run Conditions - Scheduled:
The fan will run according to a user definable schedule.

Fan:
The fan will have a user definable (adj.) minimum runtime.

Zone Temp:
If the zone temperature is above set point 80 deg. F (adj.) by a user definable amount (adj.) the fan will start.

Alarms will be provided as follows:

- Fan Status: The controller will monitor the fan status. Alarms will be provided as follows:
- Fan Failure: Commanded on, but the status is off.
- Fan in Hand: Commanded off, but the status is on.

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Webster University ISB - HVAC Controls
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Webster Groves, MO 63119

FILENAME: (13) Ventilation Fans

DRAWING NAME: Ventilation Fans Sequence of Operations (Typ. of 2: VF-2 & VF-3)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

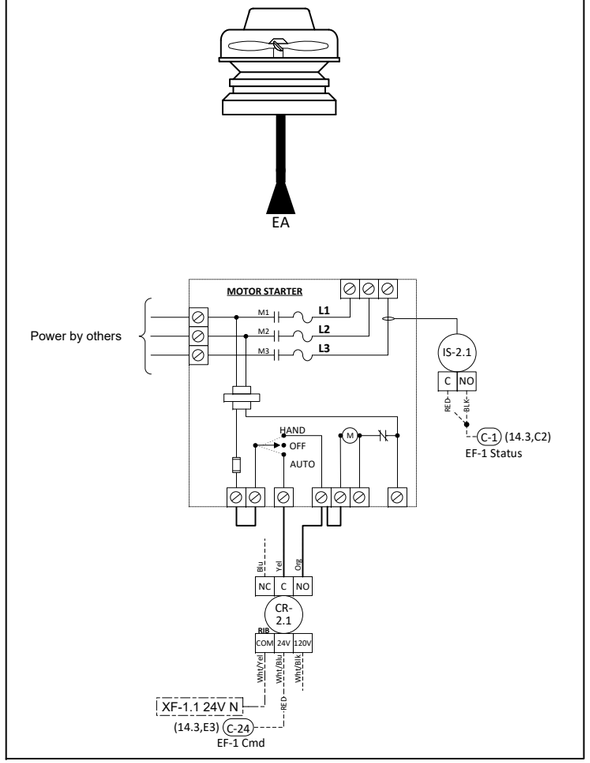
DRAWING NO.: 13.2

Exhaust Fans (Typ. of 3: KEF-1, EF-1 & EF-4)

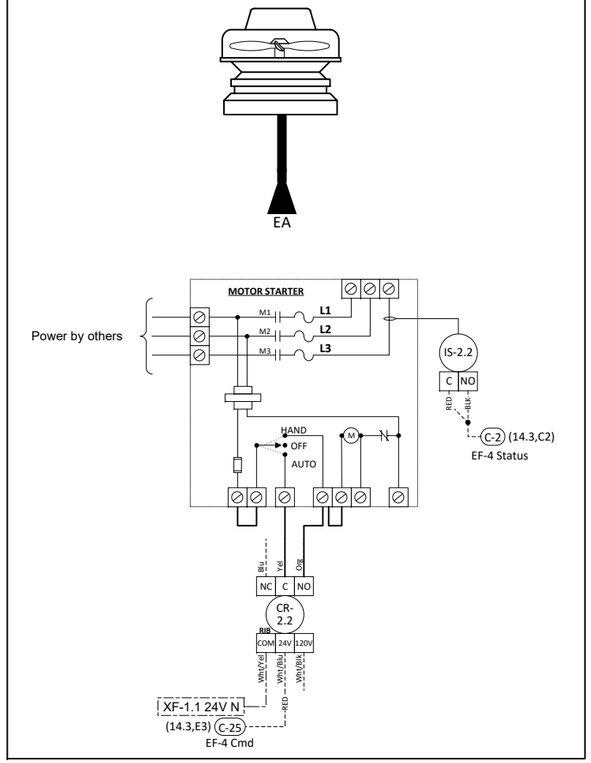
Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
CR-2.#	Enclosed Relay 20 Amp SPDT with 24 Vac/DC/208-277 Vac Coil	Functional Devices	RIB2401B	2
IS-2.#	Current Switch, Split Core, Fixed Setpoint 0.15A, Micro	Veris	H300	3

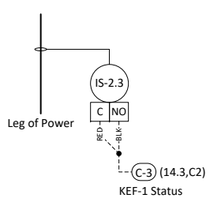
EF-1 Details



EF-4 Details



KEF-1 Details



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Webster University ISB - HVAC Controls
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Webster Groves, MO 63119

FILENAME: (14) Exhaust Fans

DRAWING NAME:
Exhaust Fans (Typ. of 3: KEF-1, EF-1 & EF-4)

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

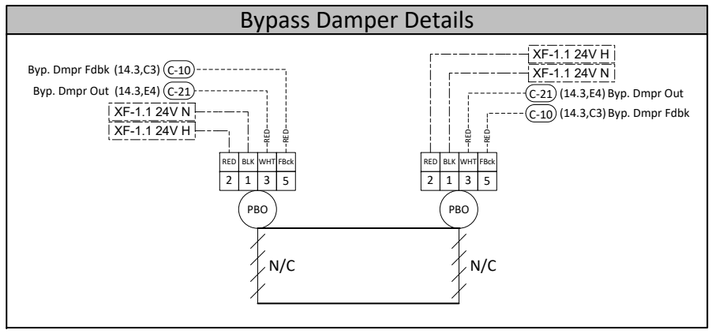
DRAWING NO.: 14.1

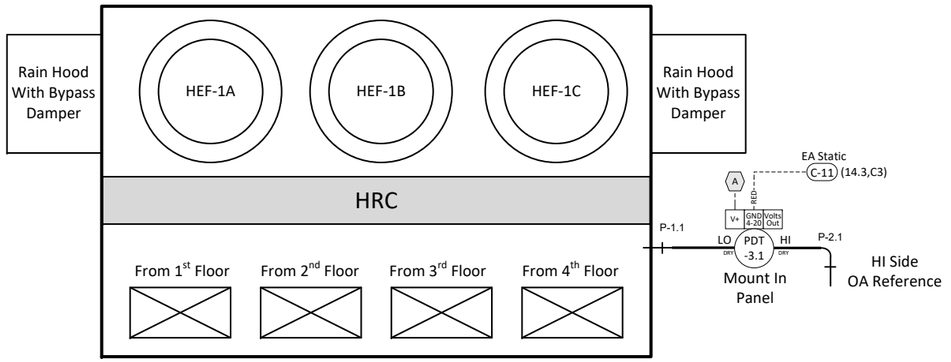
Lab Exhaust Fan (HEF-1)

Instrument List

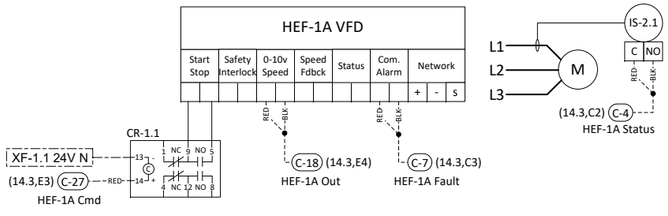
Tag	Product Description	Manufacturer	Part Number	Quantity
P-1.#	Zone Pressure Pickup Port, 6" Static Pressure Probe Assembly	BAPI	ALC/ZPS-ACC07	1
P-2.#	Low Profile Pressure Pickup Point	BAPI	ALC/ZPS-ACC20	1
PDT-3.#	Standard Range Pressure Sensor, 0-5"w.c., Bapi Box, w/ Display	BAPI	ZPT-20-SR75-BB-NT-D	1
CR-1.#	Control Relay,DPDT,24VAC,LED,w/ Socket	Idec	RH2B-ULAC24V+SH2B-05	3
IS-2.#	Current Switch, Split Core, Fixed Setpoint 0.15A, Micro	Veris	H300	3

Bypass Damper Details

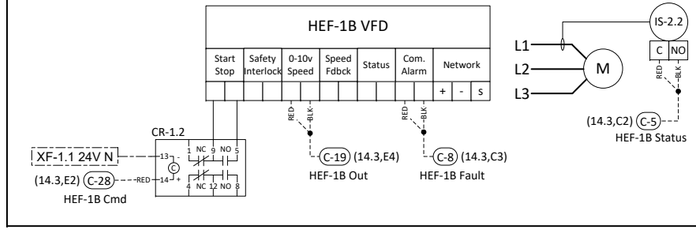




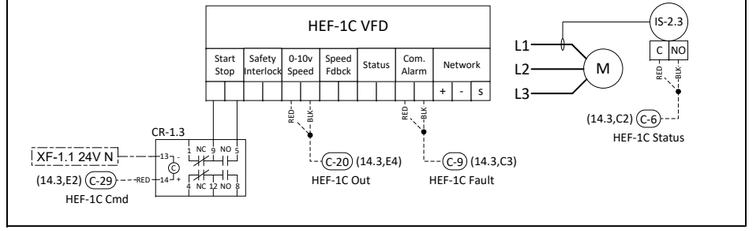
HEF-1A Wiring Details



HEF-1B Wiring Details



HEF-1C Wiring Details



Legend	
PBO	Provided By Others

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (14) Exhaust Fans

DRAWING NAME: Lab Exhaust Fan (HEF-1)

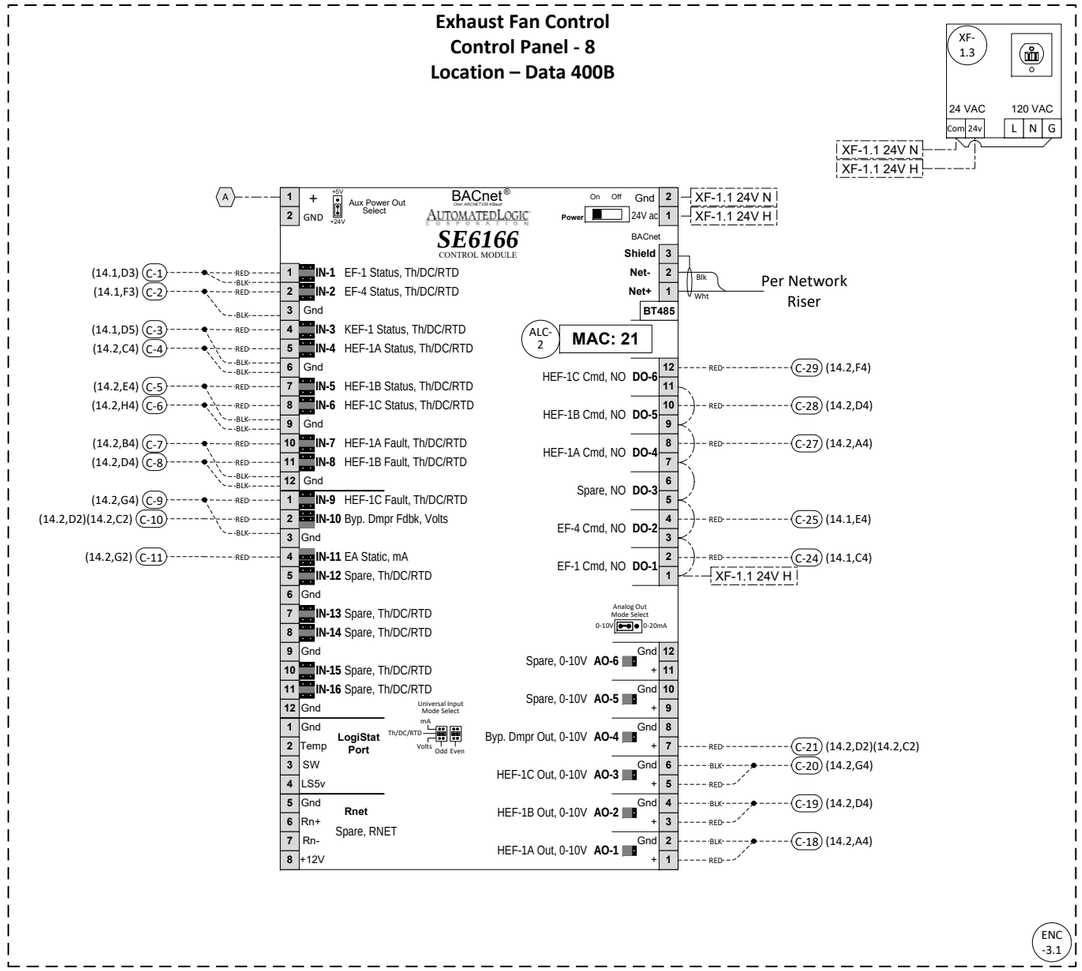
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

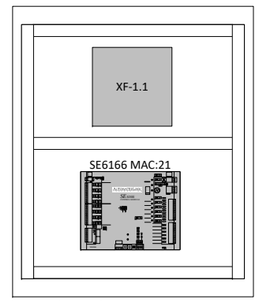
DRAWING NO.: 14.2

Exhaust Fans Controller

Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-2	Control Module, 6DO, 16UI, 6AO	Automated Logic	SE6166	1
XF-1.#	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	Functional Devices	PSB100AB10	1
ENC-3.#	20" x 24" (Medium) Control Panel	Saginaw	SCE-24N2006NKT	1





Control Panel - 8
Location – Data 400B

Automatic Controls equipment systems, inc.	Webster University ISB - HVAC Controls 470 E. Lockwood Ave. Webster Groves, MO 63119	DRAWING NAME: Exhaust Fans Controller	
	FILENAME: (14) Exhaust Fans	CONTRACT NO: WU-01-16 / SE:JV / DE: PL / PR: RV	DRAWING NO.: 14.3

Exhaust Fans Sequence of Operations

Central Toilet Exhaust - EF-1

Run Conditions - Scheduled:
The fan will run according to a user definable schedule.

Fan:
The fan will have a user definable (adj.) minimum runtime.

Exhaust Air Damper (where applicable):
The exhaust air damper will open anytime the fan runs and will close anytime the fan stops. The exhaust air damper will close 30 sec (adj.) after the fan stops.

Alarms will be provided as follows:
- Damper Failure: Commanded open, but the status is closed.
- Damper in Hand: Commanded closed, but the status is open.
- Damper Status: The fan will be enabled after the damper status has proven. Alarms will be provided as follows:
- Damper Failure: Commanded open, but the status is closed.
- Damper in Hand: Commanded closed, but the status is open.
- Fan Status: The controller will monitor the fan status. Alarms will be provided as follows:
- Fan Failure: Commanded on, but the status is off.
- Fan in Hand: Commanded off, but the status is on.

Exhaust Fan - EF-4

Run Conditions - Continuous:
The fan will run continuously.

Fan Status:
The controller will monitor the fan status.

Alarms will be provided as follows:
- Failure: Commanded on, but the status is off.

Kitchen Hood Exhaust - KEF-1

Run Conditions - Local Switch:
The fan will run by a local switch.

Fan Status:
The controller will monitor the fan status.

Hood Exhaust Fan System (HEF-1)
Consists of three high plume exhaust fans (A, B, & C) mounted on a heat recovery plenum with coil. Hoods on each floor are connected together and each individual floor duct riser is connected to the common exhaust plenum on the roof. The plenum includes bypass control dampers to maintain plume height and inlet plenum static pressure. Provide damper actuators, duct static pressure sensor, and interface with Variable Frequency Drives (VFD) to control fume hood exhaust airflow as described below. Lead-Lag fan designation will rotate on a periodic basis as scheduled by operations staff.

Run Conditions:
The hood exhaust system will run continuously unless shutdown on safeties.

Staging ON Fans: During occupied periods the Lead fan “A” will start and ramp up to minimum speed setting (66% of full speed (adj.)) and as required to maintain static pressure set point of negative 2.0-inches (adj.) at the inlet plenum. This setting will be determined during air balancing and will be at the lowest practice negative static pressure.

Once the fan speed reaches 75% (adj.) of full flow or above for 10-minutes (adj.), the Lag fan “B” will start and ramp up to minimum speed setting (66% of full speed (adj.)). Both fans will modulate to maintain negative static pressure set point (adj.). Then start the third fan “C” in the same manner.

The bypass dampers will modulate to maintain inlet plenum negative static pressure setting (adj.) anytime the fans are operating at minimum speed and the inlet negative static pressure is 0.5-inches (adj.) above set point.

Stage fans OFF when all fans are operating at minimum speed and the bypass damper is open 50% or greater (adj.) (as determined during air balancing) for more than 10-minutes (adj.).

Reset minimum fan speed setting based on wind speed as follows:
- Minimum fan speed = 66% at wind speeds between 0 and 20 mph (adj.)
- Minimum fan speed = 75% at wind speeds between 20 and 40 mph (adj.)
- Minimum fan speed = 100% at wind speeds above 40 mph (adj.).

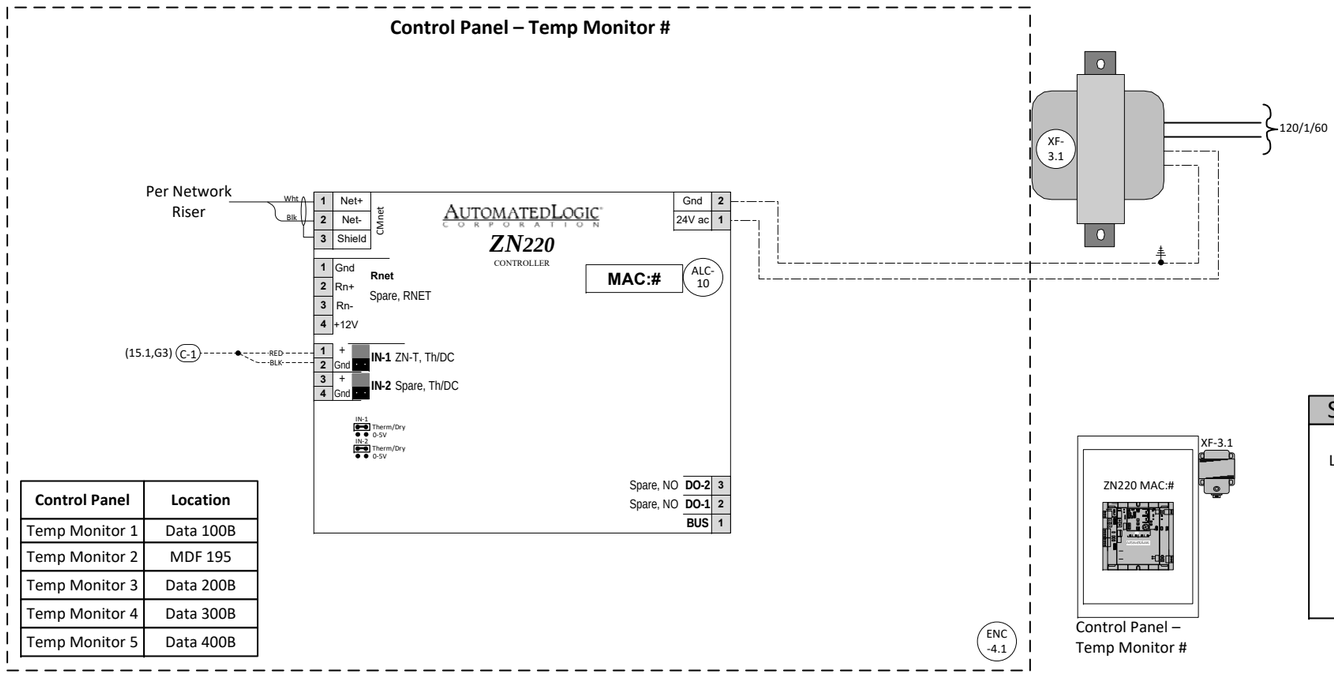
Wind speed to be determined from the weather application. If the network is down, the default value will be maximum speed.

If any fan stops for any reason or fails to start when called to run by the automation system, the next available fan will start.

Safeties:
Provide high negative static pressure alarm
Provide fan and drive fault alarms

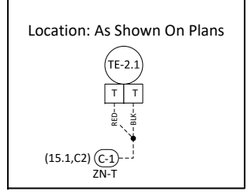
IT/MDF Room Temperature Monitoring (Typ. of 5)

Instrument List				
Tag	**Product Description**	**Manufacturer**	**Part Number**	**Quantity**
ENC-4.#	10" x 15" (small) Control Panel With Lexan Door	ALPS	YM9050	5
ALC-10	Zone Controller, 2DO, 2UI	Automated Logic	ZN220	5
TE-2.#	Room Temp Delta Style	BAPI	ALC/10K-2-R-Z-CG	5
XF-3.#	24V Transformer, 40VA	Core Lectro	LE11300	5



Control Panel	Location
Temp Monitor 1	Data 100B
Temp Monitor 2	MDF 195
Temp Monitor 3	Data 200B
Temp Monitor 4	Data 300B
Temp Monitor 5	Data 400B

Control Panel – Temp Monitor #



Data Closet Cooling Systems - FCU-1/ACCU-2 , FCU-2/ACCU-2, FCU-3/ACCU-3, FCU- 4/ACCU-4, and FCU-5(A/B/C)/ACCU-5

Run Conditions:
The systems will operate using factory furnished controls to maintain set point of 80 deg. F. (adj.).

The BAS will monitor space temperature and alarm if our of range.

Alarms will be provided as follows:

- High Zone Temp Alarm: If the zone temperature is above set point by a user definable amount (adj.).

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FILENAME: (15) IT MDF Rm Temp Monitoring

DRAWING NAME: IT/MDF Room Temperature Monitoring (Typ. of 5)

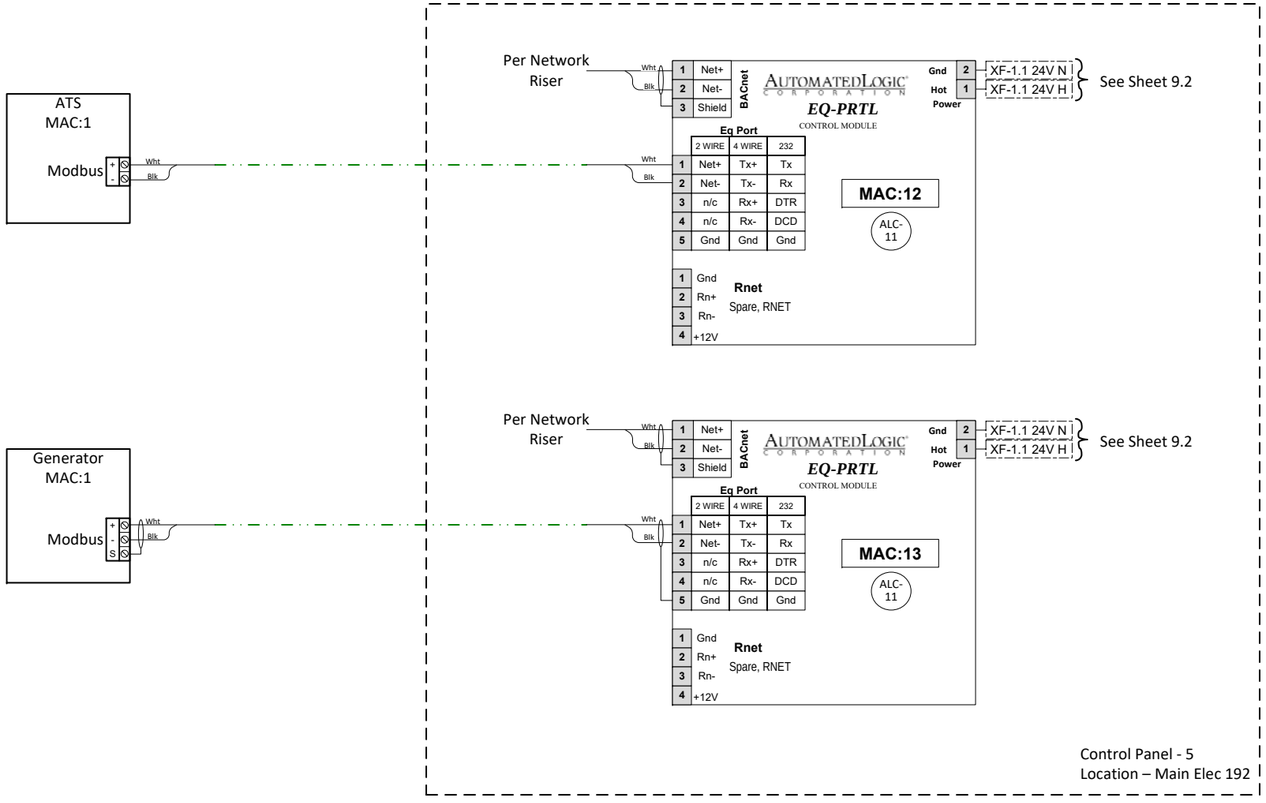
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

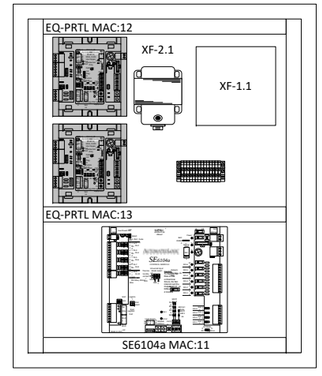
DRAWING NO.: 15.1

Building Power Meter & Generator Monitoring

Instrument List

Tag	Product Description	Manufacturer	Part Number	Quantity
ALC-11	Single Equipment Gateway, 100 3rd Party Points	Automated Logic	EQ-PRTL	2





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FILENAME: (16) Power Monitoring

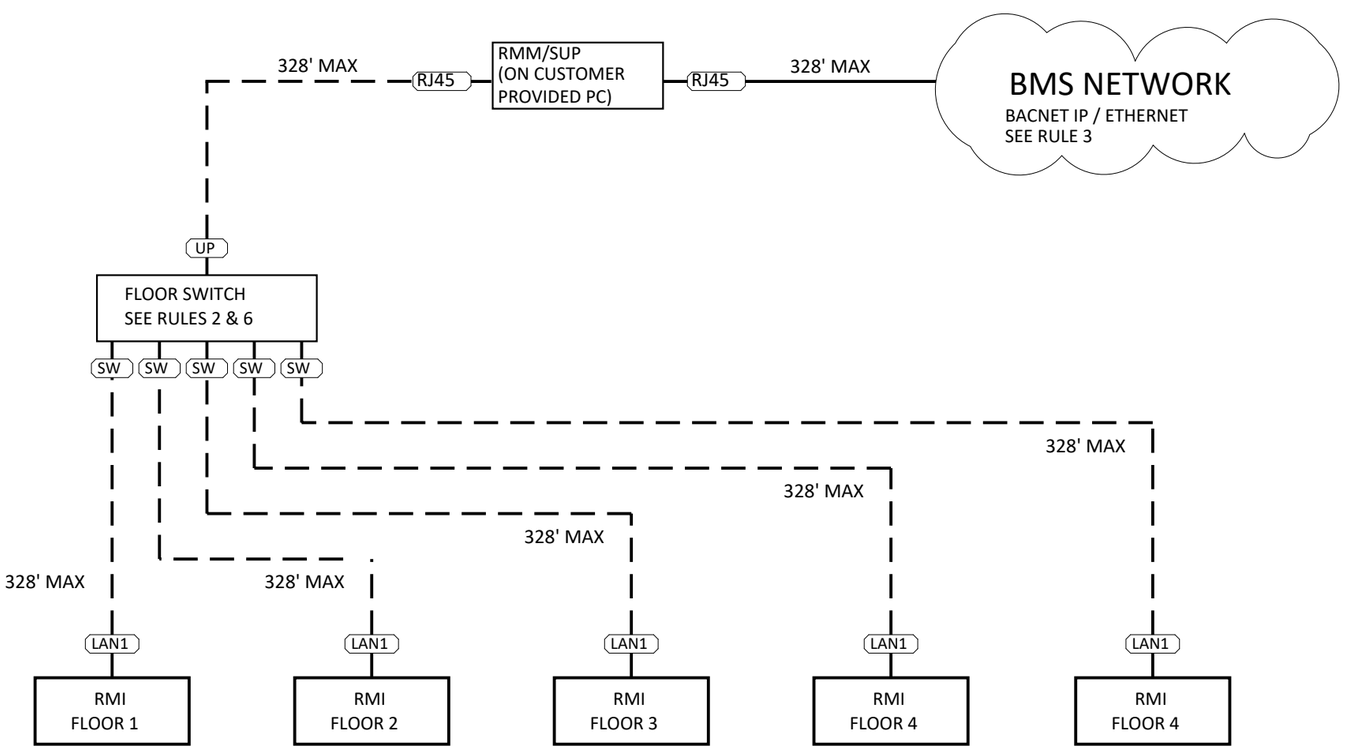
DRAWING NAME: Building Power Meter & Generator Monitoring

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 16.1

Phoenix Controls: BACnet IP Wiring

Note:
- Low Voltage Wiring Provided By ACES
- Devices Provided BY Phoenix Controls
- See Valve Schedule For Supply Air Valve Information



UPPER LEVEL NETWORK RULES

1) PRIVATE, SINGLE IP, BACNET ETHERNET NETWORK UNDER VANTAGE ROOM MANAGER (RMM) OR SUPERVISOR (SUP)
   - RMM OR SUP REQUIRED WHEN MORE THAN ONE RMI/RMC IS USED.
2) CONNECTON TO PRIVATE BACNET ETHERNET VIA SWITCHES.
   - NON-PHOENIX PRODUCT, TYPICALLY PROVIDED BY PHOENIX REP
   - SELECTION MUST BE APPROVED BY LOCAL IT DEPARTMENT.
3) CONNECTION TO BMS NETWORK VIA STANDARD NETWORK INTERFACES (SWITCHES, HUBS, ROUTERS)
   -
4) DEVICE LIMITS:
   - UP TO 100 TOTAL ROOM INTERGRATOR (RMI) / ROOM CONTROLLER (RMC)
5) CABLING:
   - CAT 5/5E/6/6A CABLE
   - LIMITED TO 328 FT (100 M) PER SEGMENT
6) TOPOLOGY:
   - HOME RUNS REQUIRED FROM:
     - EACH RMI/RMC TO THE SWITCH.
     - THE SWITCH TO THE RMM/SUP
     - THE RMM/SUP TO BMS INTERFACE.
   - MAXIMUM OF TWO SWITCHES ALLOWED BETWEEN EACH RMI/RMC AND THE RMM/SUP.
   - MAXIMUM DISTANCE FROM RMM/SUP TO FARTHEST RMI/RMC IS 984 FT (300 M)

RMI / RMC RULES

7) UPPER LEVEL CHANNEL: BACNET ETHERNET ONLY
8) LOWER LEVEL CHANNEL LIMITS:
   - PER RMI: TWO LON AND ONE BACNET MS/TP
   - PER RMC: UP TO TWO LON OR FIVE BACNET MSTP
9) (P2) POWER: DEDICATED UL LISTED 24 VAC CLASS 2 TRANSFORMER PER RMI/RMC TO REDUCE NOISE.

LOWER LEVEL "ROOM" NETWORK RULES

10) LON NODE LIMITS:
    - 20 NODES PER CHANNEL MAXIMUM (RMI/RMC DOES NOT COUNT).
11) LON CABLING:
    - FTT-10 CABLE (22 AWG) LIMITED TO 4,500 FT (1,370 M) WITH NO REPEATERS IN BUS TOPOLOGY.
    - REFER TO VANTAGE SPECS: TABLE 1
12) BACNET MS/TP LIMITS:
    - SMALLER OF 32 UNIT LOADS OR 50 DEVICES PER NETWORK SEGMENT.
    - REFER TO VANTAGE SPECS: TABLE 2
13) BACNET MS/TP CABLING:
    - 3-CONDUCTOR, SHIELDED 22 AWG CABLE LIMITED TO 4,000 FT (1,219 M) WITHOUT REPEATERS IN BUS TOPOLOGY.
    - REFER TO VANTAGE SPECS: TABLE 1 AND BACNET MS/TP WIRING.

CABLE LEGEND

- BMS BACNET IP/ETHERNET NETWORK: CAT 5/5E/6/6A
- PRIVATE BACNET ETHERNET NETWORK: CAT 5/5E/6/6A
- VAC — POWER (2 CONDUCTOR)
- ROOM LEVEL - LON: TP (FTTP-10)
- ROOM LEVEL - BACNET MS/TP: MS/TP (3 CONDUCTOR)

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Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME: Phoenix Controls: BACnet IP Wiring

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

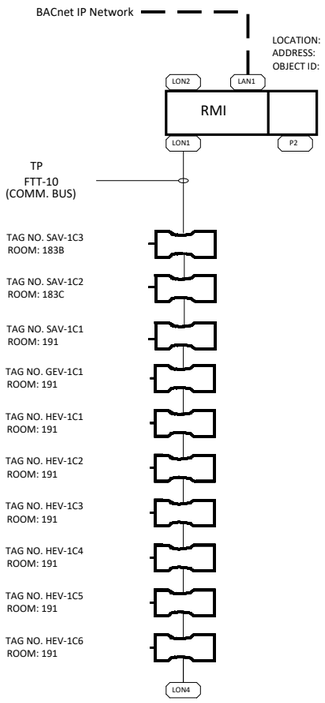
DRAWING NO.: 17.1

Phoenix Controls: LON Network

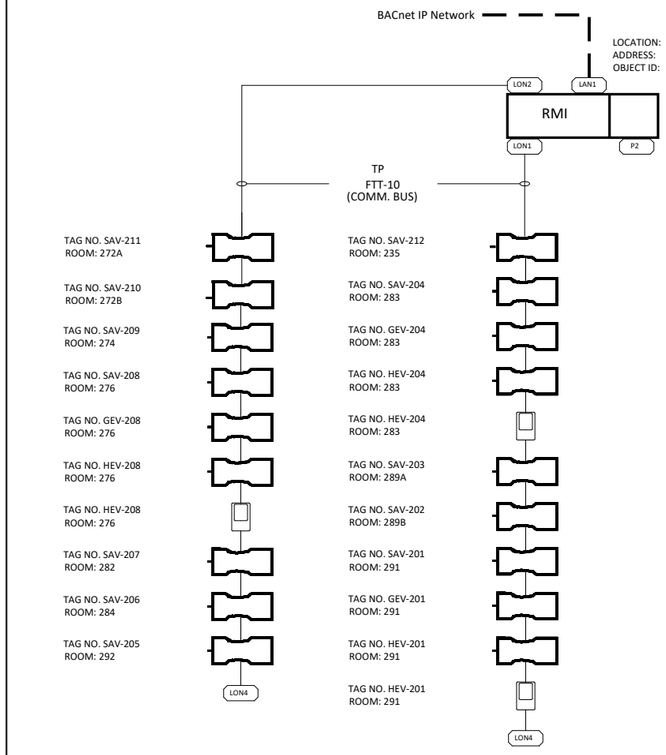
Level 01 – Level 02 – Level 03

Note:
- Low Voltage Wiring Provided By ACES
- Devices Provided BY Phoenix Controls
- See Valve Schedule For Supply Air Valve Information

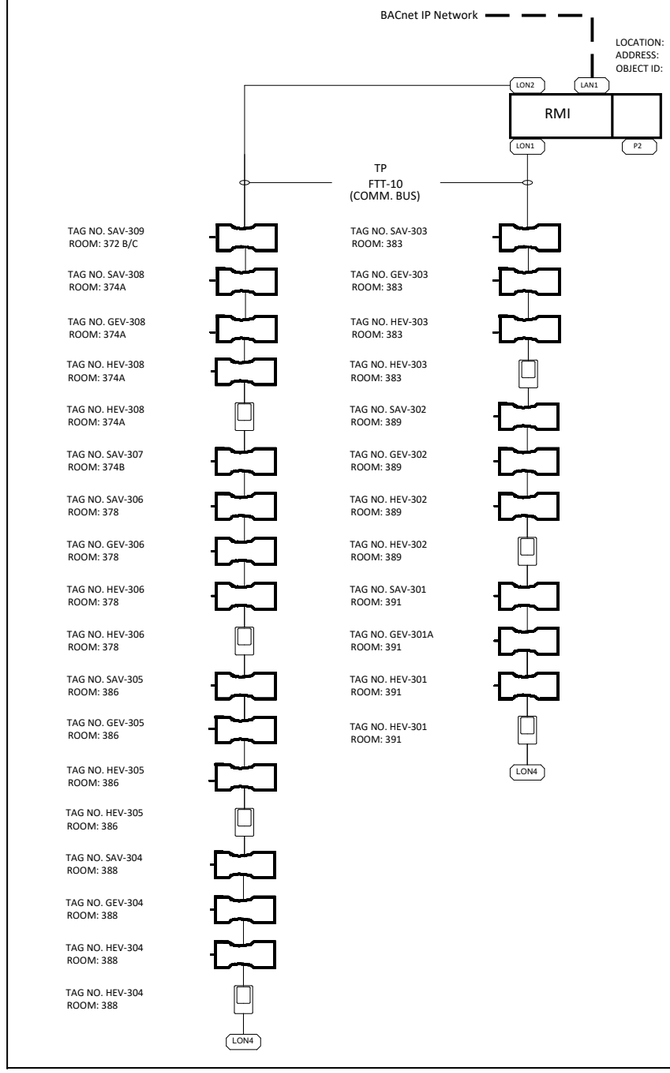
Level 01



Level 02



Level 03



LON NETWORK WIRING RULES

1. THE FTT10 TERMINATION SEQUENCE SHOWN FOR DIAGRAMMATICAL PURPOSES ONLY,
2. THIS NETWORK TOPOLOGY DRAWING ONLY REFERENCES DIGITAL PRODUCTS. FOR ADDITIONALWIRING SPECIFICS REFER TO INDIVIDUAL ROOM DRAWINGS.
3. REFERENCE "VANTAGE SPECS" FOR APPROVED MANUFACTURERS AND CABLE SPECIFICATIONS
4. REFERENCE "LON WIRE DETAILS" SHEET FOR CABLE TERMINATIONS REPRESENTED BY THE SYMBOL: (XX)
5. SEE SPECIFIC ROOM DRAWINGS FOR NETWORK VALVE TERMINATIONS.

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470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME: Phoenix Controls: LON Network

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

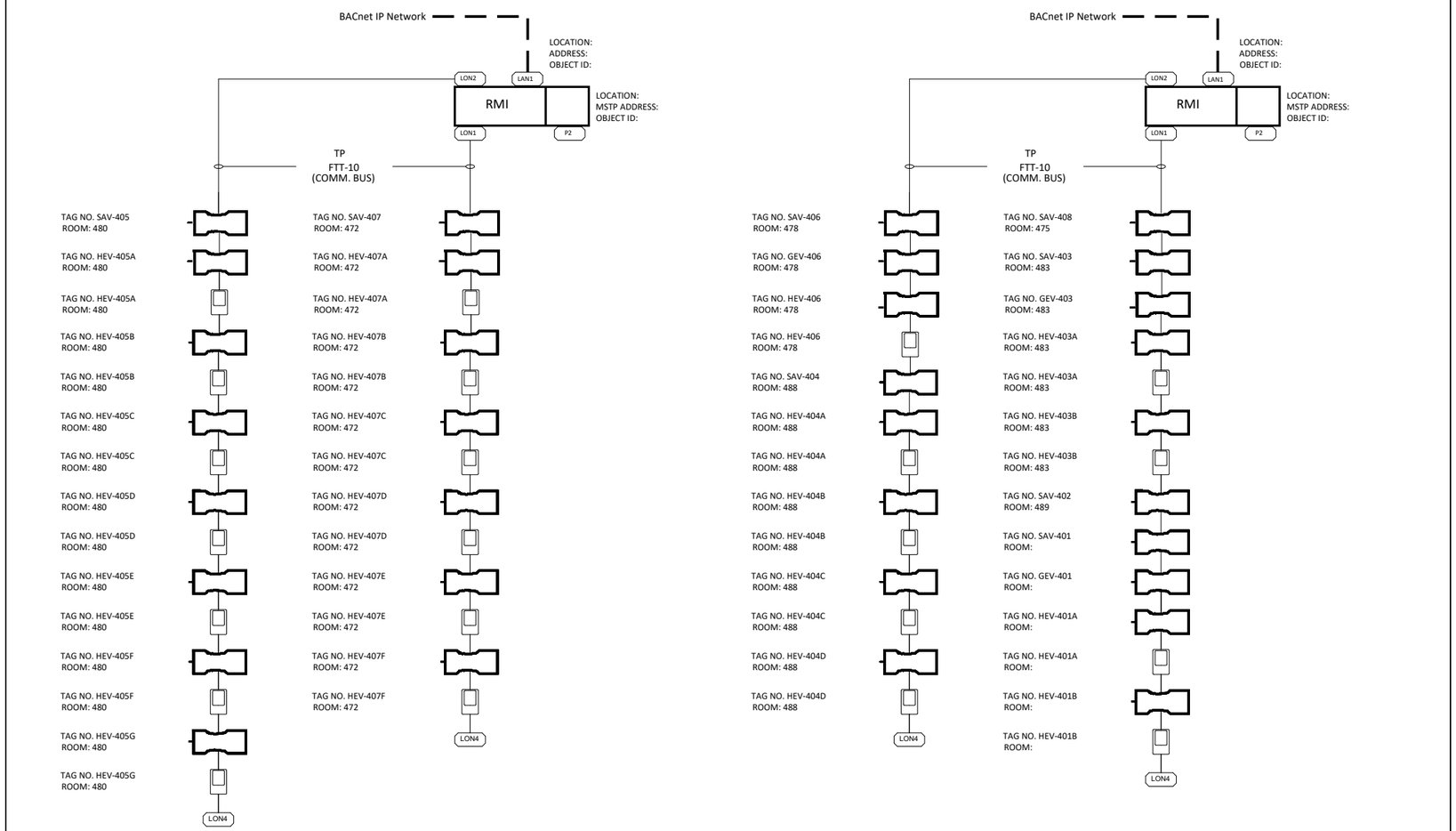
DRAWING NO.: 17.2

Phoenix Controls: LON Network Continued

Level 04

Note:
- Low Voltage Wiring Provided By ACES
- Devices Provided BY Phoenix Controls
- See Valve Schedule For Supply Air Valve Information

Level 04



LON NETWORK WIRING RULES

1. THE FTT10 TERMINATION SEQUENCE SHOWN FOR DIAGRAMMATICAL PURPOSES ONLY,
2. THIS NETWORK TOPOLOGY DRAWING ONLY REFERENCES DIGITAL PRODUCTS. FOR ADDITIONALWIRING SPECIFICS REFER TO INDIVIDUAL ROOM DRAWINGS.
3. REFERENCE "VANTAGE SPECS" FOR APPROVED MANUFACTURERS AND CABLE SPECIFICATIONS
4. REFERENCE "LON WIRE DETAILS" SHEET FOR CABLE TERMINATIONS REPRESENTED BY THE SYMBOL: XX
5. SEE SPECIFIC ROOM DRAWINGS FOR NETWORK VALVE TERMINATIONS.

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME: Phoenix Controls: LON Network Continued

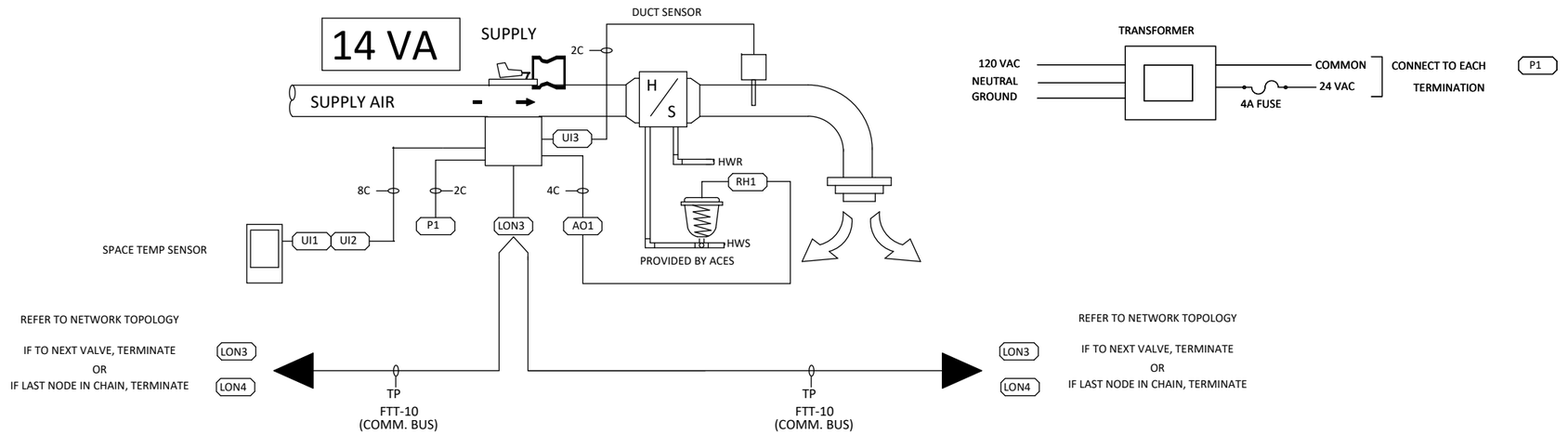
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 17.3

Phoenix Controls: Celers 2 Lab Detail 1

INCLUDES: LOW SPEED SUPPLY VALVE

Note:
- Low Voltage Wiring Provided By ACES
- Devices Provided BY Phoenix Controls
- See Valve Schedule For Supply Air Valve Information



ROOM LEVEL NOTES:

1. REFER TO ROOM SCHEDULE SHEET (RSS).
2. VALVES ARE SHOWN HORIZONTALLY FOR DIAGRAMMATICAL PURPOSES ONLY, ACTUAL VALVE ORIENTATIONIS SPECIFIED ON THE ROOM SCHEDULE SHEET.
3. REFER TO CABLE/PNEUMATICS/AC POWER SHEET FOR SPECIFICATIONS AND ALTERNATES(INCLUDING ALTERNATE WIRE COLOR CODES).
4. REFERENCE WIRING DETAILS AND FUME HOOD DETAIL SHEETS FOR CABLE TERMINATIONS REPRESENTED BY THE FOLLOWING SYMBOL: XX

SYMBOL KEY

= CABLE PROVIDED BY FACTORY

= CABLE PROVIDED BY ACES
x = # OF CONDUCTORS

(P) VALVE MOUNTED PRESSURE SWITCH

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME: Phoenix Controls: Celers 2 Lab Detail 1

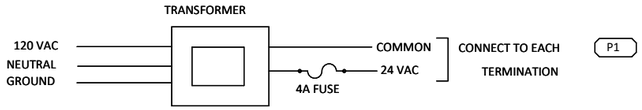
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

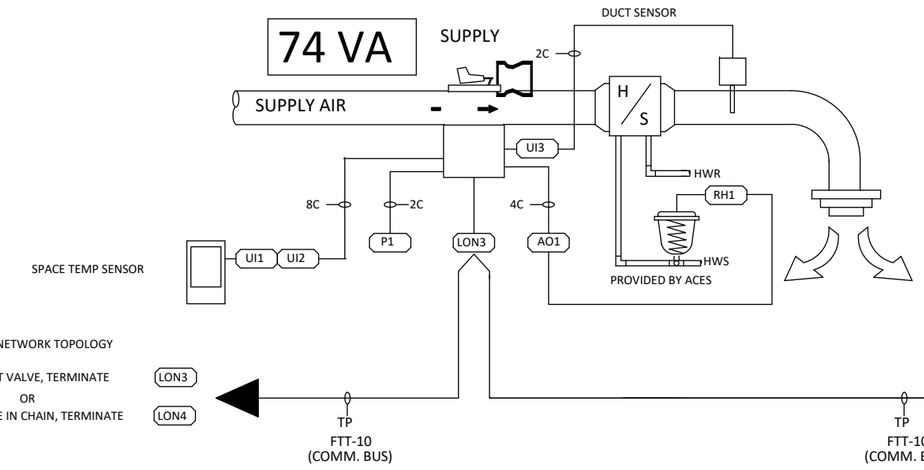
DRAWING NO.: 17.4

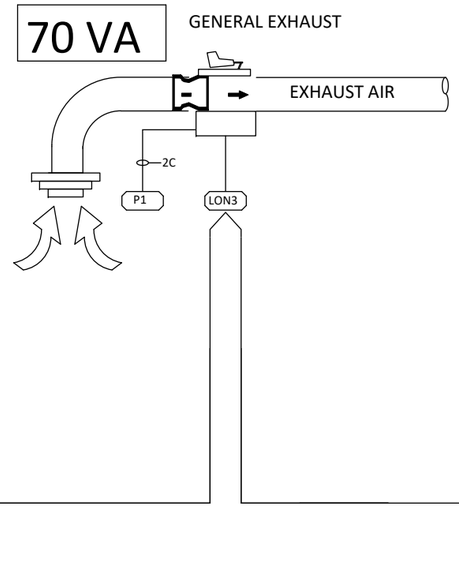
Phoenix Controls: Celers 2 Lab Detail 3

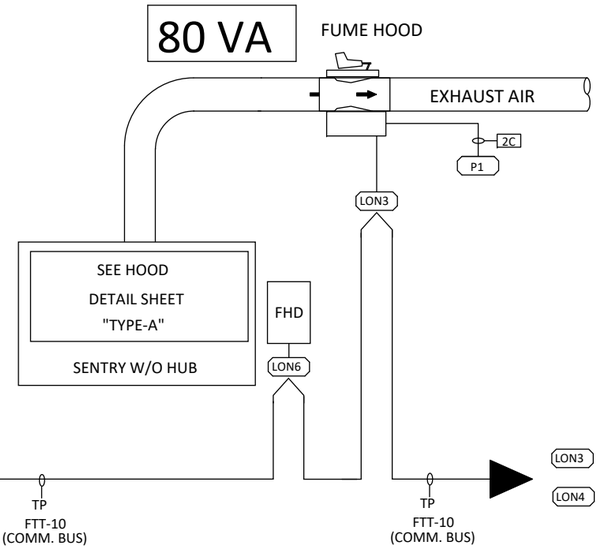
INCLUDES: HIGH SPEED SUPPLY, GENERAL EXHAUST, AND FUME HOOD

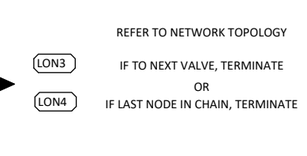
Note:
- Low Voltage Wiring Provided By ACES
- Devices Provided BY Phoenix Controls
- See Valve Schedule For Supply Air Valve Information











ROOM LEVEL NOTES:

1. REFER TO ROOM SCHEDULE SHEET (RSS).
2. VALVES ARE SHOWN HORIZONTALLY FOR DIAGRAMMATICAL PURPOSES ONLY, ACTUAL VALVE ORIENTATIONIS SPECIFIED ON THE ROOM SCHEDULE SHEET.
3. REFER TO CABLE/PNEUMATICS/AC POWER SHEET FOR SPECIFICATIONS AND ALTERNATES(INCLUDING ALTERNATE WIRE COLOR CODES).
4. REFERENCE WIRING DETAILS AND FUME HOOD DETAIL SHEETS FOR CABLE TERMINATIONS REPRESENTED BY THE FOLLOWING SYMBOL: XX

SYMBOL KEY

xC = CABLE PROVIDED BY FACTORY

xC = CABLE PROVIDED BY ACES
x = # OF CONDUCTORS

(P) VALVE MOUNTED PRESSURE SWITCH

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME: Phoenix Controls: Celers 2 Lab Detail 3

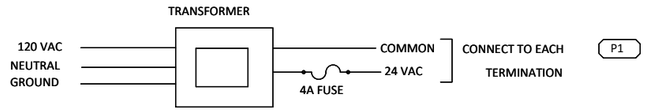
CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

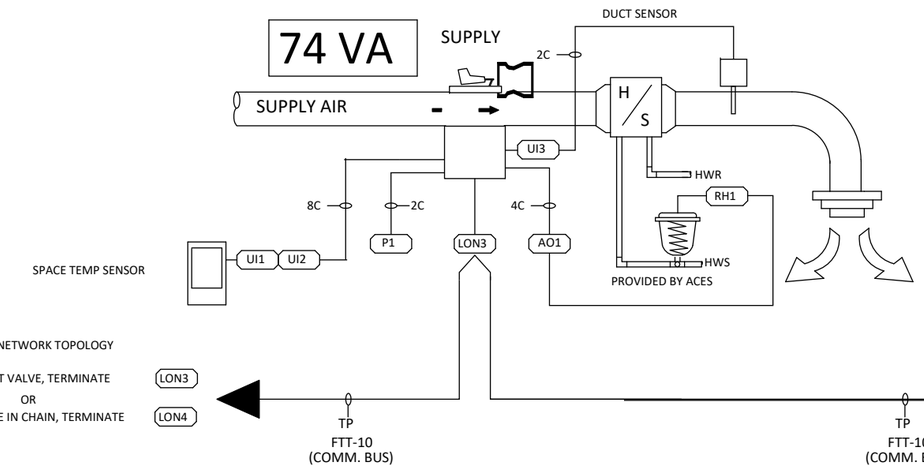
DRAWING NO.: 17.5

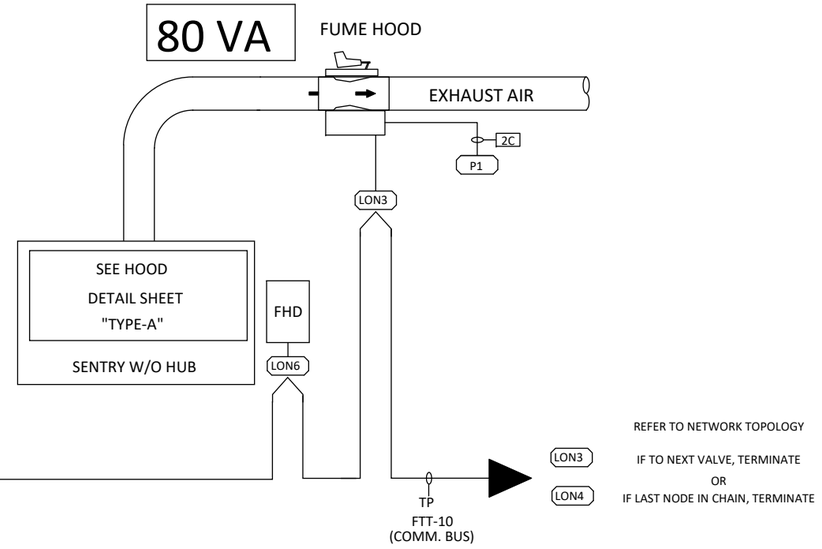
Phoenix Controls: Celers 2 Lab Detail 5

INCLUDES: HIGH SPEED SUPPLY AND FUME HOOD

Note:
- Low Voltage Wiring Provided By ACES
- Devices Provided BY Phoenix Controls
- See Valve Schedule For Supply Air Valve Information







ROOM LEVEL NOTES:

1. REFER TO ROOM SCHEDULE SHEET (RSS).
2. VALVES ARE SHOWN HORIZONTALLY FOR DIAGRAMMATICAL PURPOSES ONLY, ACTUAL VALVE ORIENTATIONIS SPECIFIED ON THE ROOM SCHEDULE SHEET.
3. REFER TO CABLE/PNEUMATICS/AC POWER SHEET FOR SPECIFICATIONS AND ALTERNATES(INCLUDING ALTERNATE WIRE COLOR CODES).
4. REFERENCE WIRING DETAILS AND FUME HOOD DETAIL SHEETS FOR CABLE TERMINATIONS REPRESENTED BY THE FOLLOWING SYMBOL: XX

SYMBOL KEY

xC = CABLE PROVIDED BY FACTORY

xC = CABLE PROVIDED BY ACES
x = # OF CONDUCTORS

(P) VALVE MOUNTED PRESSURE SWITCH

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

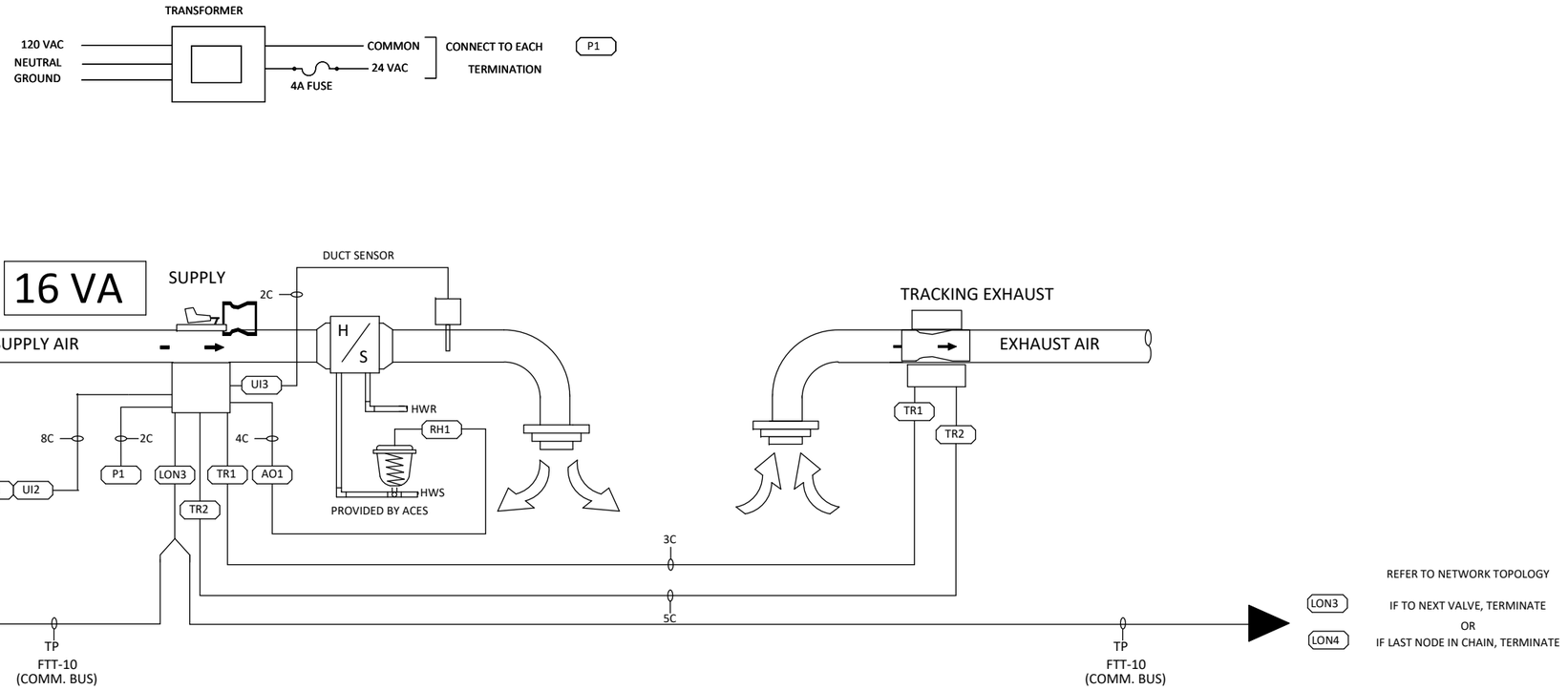
DRAWING NAME: Phoenix Controls: Celers 2 Lab Detail 5

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 17.6

Phoenix Controls: Traccel Tracking Pair Detail 6

Note:
- Low Voltage Wiring Provided By ACES
- Devices Provided BY Phoenix Controls
- See Valve Schedule For Supply Air Valve Information



ROOM LEVEL NOTES:

1. REFER TO ROOM SCHEDULE SHEET (RSS).
2. VALVES ARE SHOWN HORIZONTALLY FOR DIAGRAMMATICAL PURPOSES ONLY, ACTUAL VALVE ORIENTATIONIS SPECIFIED ON THE ROOM SCHEDULE SHEET.
3. REFER TO CABLE/PNEUMATICS/AC POWER SHEET FOR SPECIFICATIONS AND ALTERNATES(INCLUDING ALTERNATE WIRE COLOR CODES).
4. REFERENCE WIRING DETAILS AND FUME HOOD DETAIL SHEETS FOR CABLE TERMINATIONS REPRESENTED BY THE FOLLOWING SYMBOL: XX

SYMBOL KEY

= CABLE PROVIDED BY FACTORY (xC)

= CABLE PROVIDED BY ACES (xC) x = # OF CONDUCTORS

(P) VALVE MOUNTED PRESSURE SWITCH

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

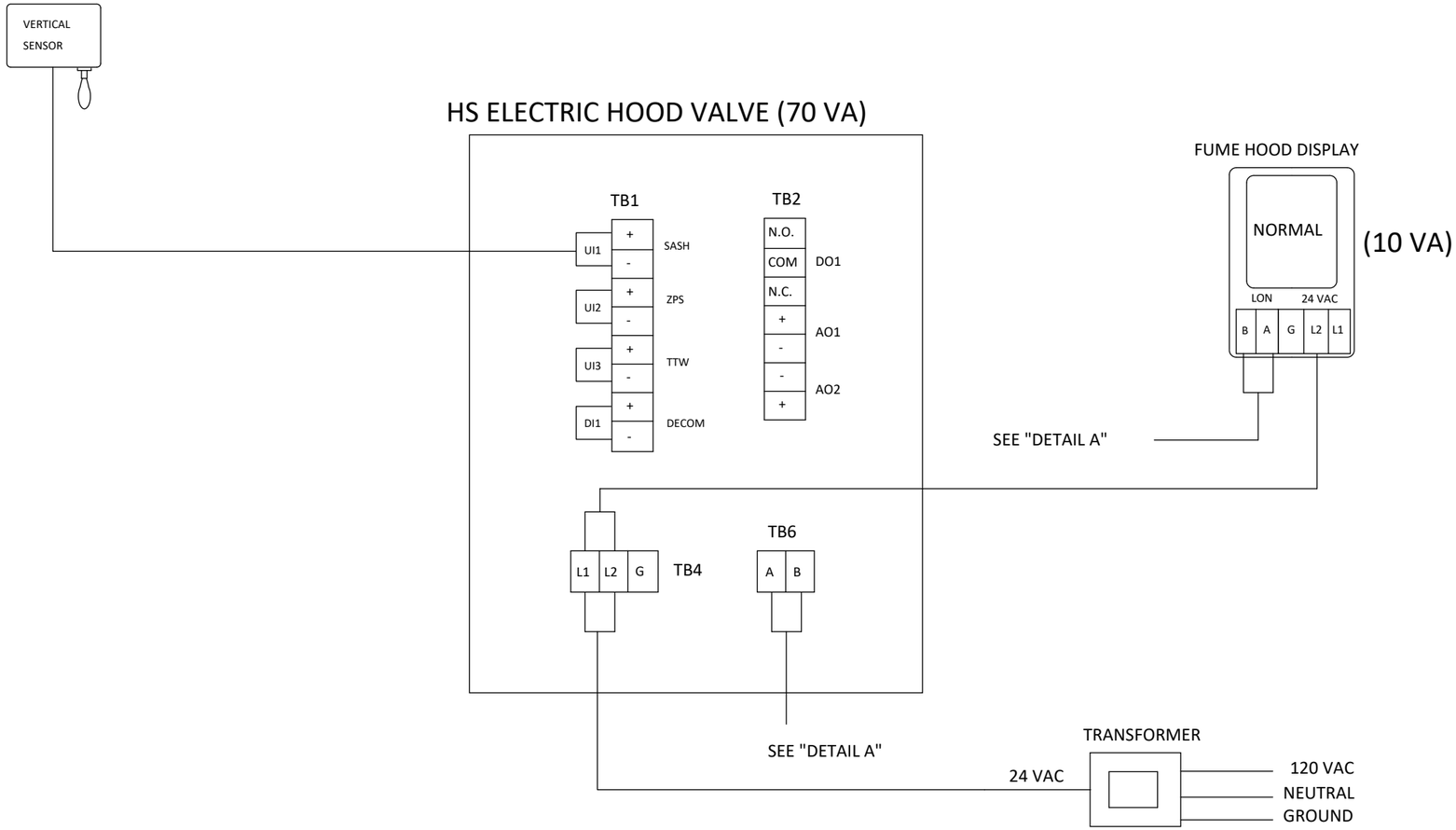
DRAWING NAME: Phoenix Controls: Traccel Tracking Pair Detail 6

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

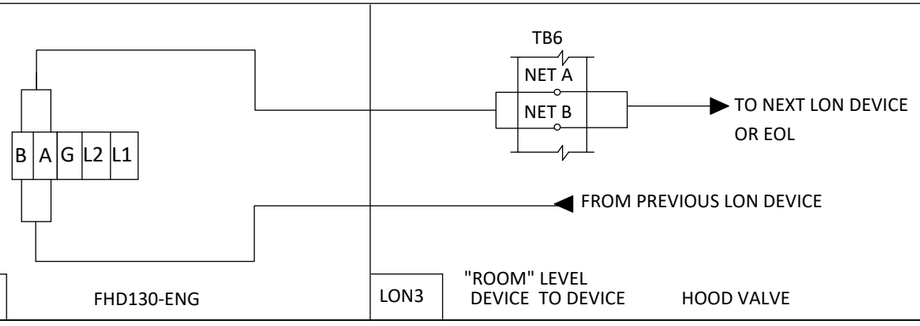
DRAWING NO.: 17.7

Phoenix Controls: Hood Valve with Fume Hood Display Wiring

Note:
- Low Voltage Wiring Provided By ACES
- Devices Provided BY Phoenix Controls
- See Valve Schedule For Supply Air Valve Information



LON FTT10 COMMUNICATION DETAIL "A"



LON6	FHD130-ENG	LON3	"ROOM" LEVEL DEVICE TO DEVICE	HOOD VALVE

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

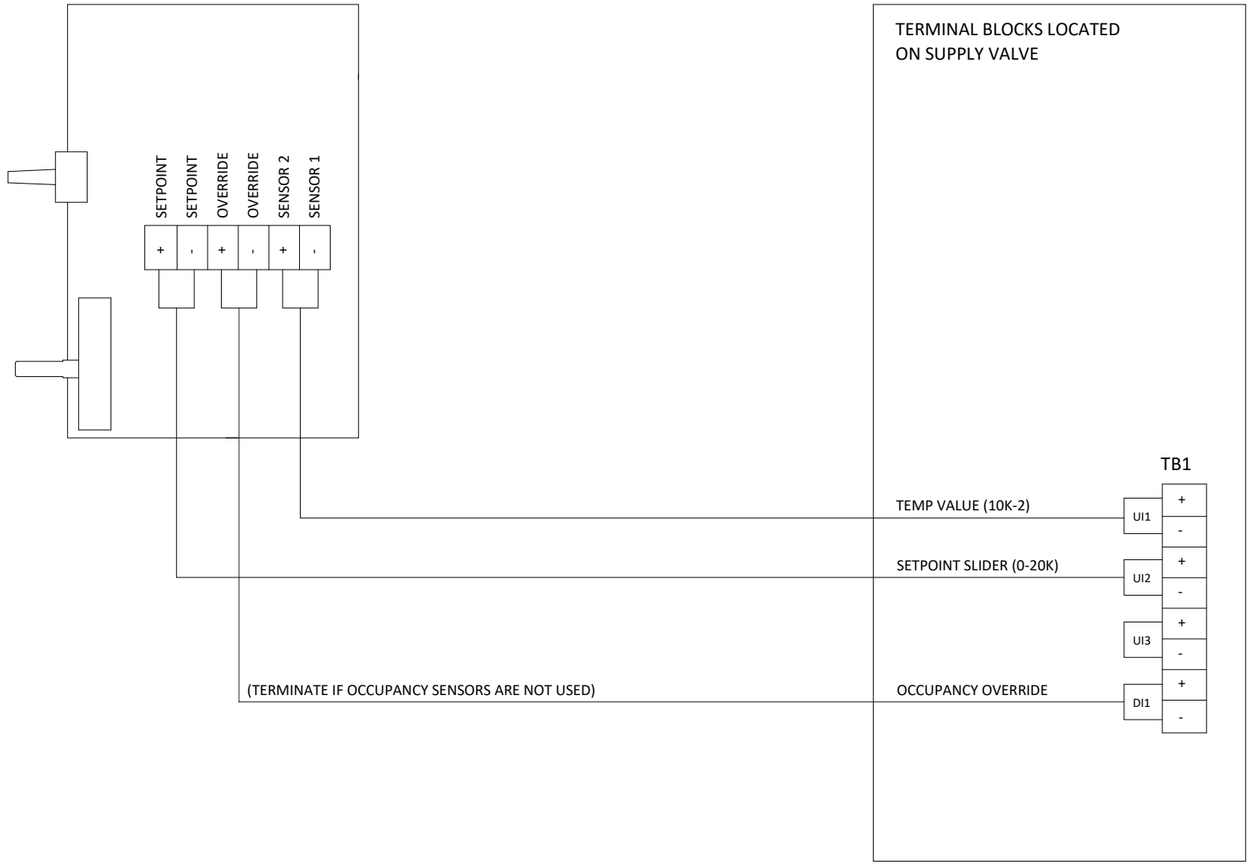
DRAWING NAME:
Phoenix Controls: Hood Valve with Fume Hood Display Wiring

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 17.8

Phoenix Controls: Space Temperature Sensor

Note:
- Low Voltage Wiring Provided By ACES
- Devices Provided BY Phoenix Controls
- See Valve Schedule For Supply Air Valve Information



NOTES:

1. PHOENIX CONTROLS DOES NOT RECOMMEND WIRING THE SENSOR WITH POWER APPLIED AS ACCIDENTAL ARCING MAY DAMAGE THE PRODUCT AND WILL VOID THE WARRANTY.

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME:
Phoenix Controls: Space Temperature Sensor

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

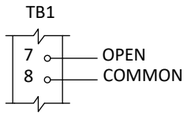
DRAWING NO.: 17.9

Phoenix Controls: Wiring

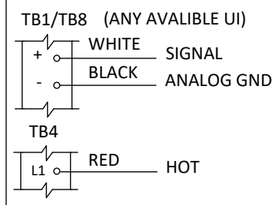
LON VALVE

INPUTS

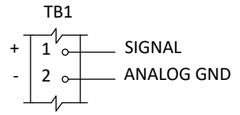
DI1 — OCCUPANCY CONTACT INPUT (TYPICAL)



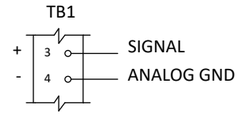
FSR — FAN STATIC RESET



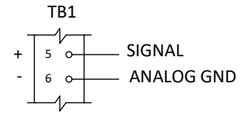
UI1 — TEMP OR HUMIDITY SENSOR (TYPICAL): SEE NOTE 1



UI2 — TEMP SET POINT OR DUCT TEMP (TYPICAL)

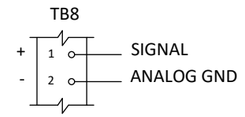


UI3 — DISCHARGE TEMP SENSOR (TYPICAL)



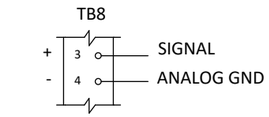
HxV/TxV: TX VERSIONS ONLY

UI4 — AVAILABLE (TYPICAL)



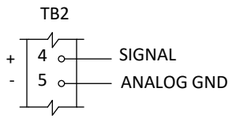
HxV/TxV: TX VERSIONS ONLY

UI5 — AVAILABLE (TYPICAL)



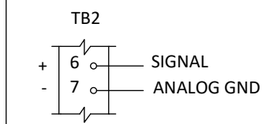
OUTPUTS

AO1 — REHEAT VALVE (TYPICAL)

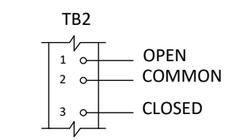


AO2 — FEEDBACK TO BMS

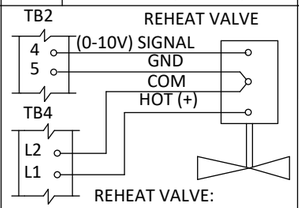
NON NETWORKED VALVE



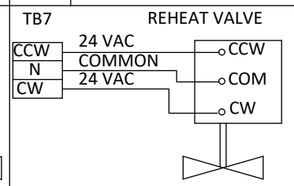
DO1 — AUX HEAT/COOL CONTACT (TYPICAL)



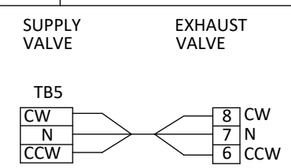
RH1 — REHEAT VALVE: PROPORTIONAL CONTROL



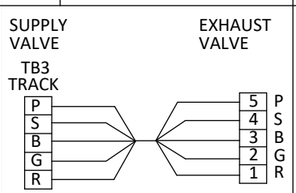
RH2 — REHEAT VALVE: FLOATING POINT CONTROL



TR1



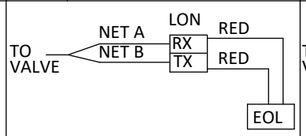
TR2



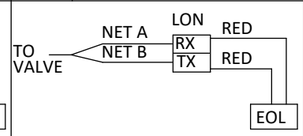
NETWORK

LAN1 — PTL/RMI/RMC: IP OR ETHERNET

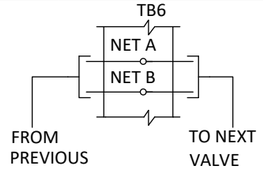
LON1 — RMI/RMC: FIRST FTT-10 CHANNEL (SAME SIDE AS LAN)



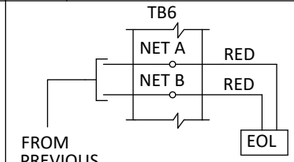
LON2 — RMI/RMC: SECOND FTT-10 CHANNEL (OPPOSITE SIDE OF LAN)



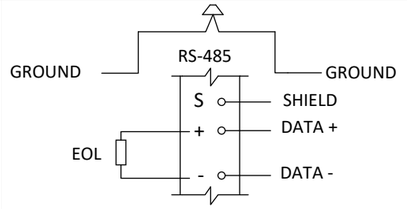
LON3 — "ROOM" LEVEL DEVICE TO DEVICE



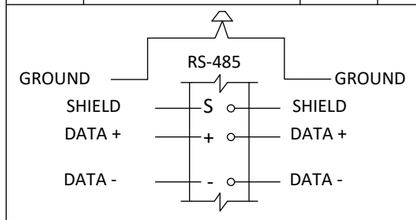
LON4 — END OF LINE "ROOM" LEVEL DEVICE



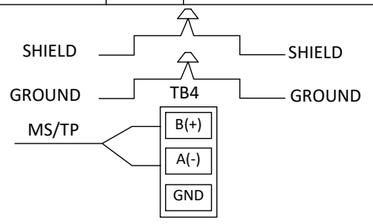
MSTP1 — PTL/RMI/RMC: ON BOARD ISOLATED SEE NOTES 2 & 3



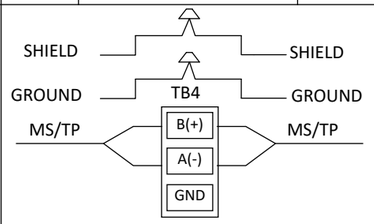
MSTP6 — PTL/RMI/RMC: ON BOARD ISOLATED SEE NOTE 2



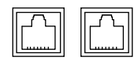
MSTP11 — TDU: NON ISOLATED SEE NOTES 2 & 4



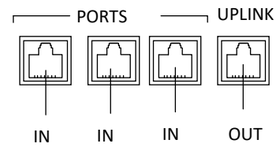
MSTP12 — TDU: NON ISOLATED SEE NOTES 2 & 4



RJ45 — RMM/SUP: IP OR ETHERNET

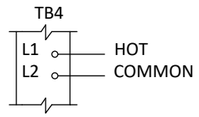


SW = IN / UP = OUT — SWITCH

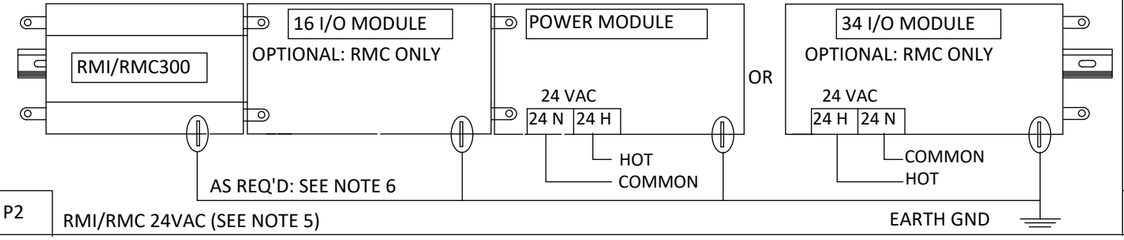


POWER (REFER TO VANTAGE SPECS)

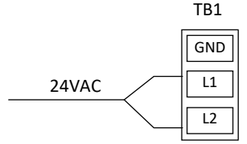
P1 — VALVE 24 VAC



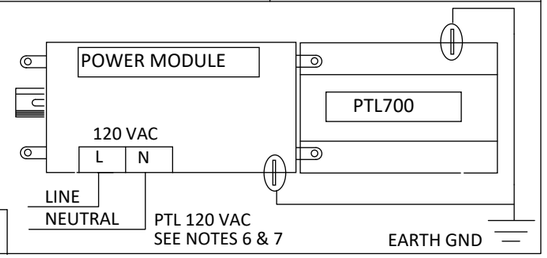
P2 — RMI/RMC 24VAC (SEE NOTE 5)



P3 — VIEW TDU 24 VAC



P4 — PTL 120 VAC SEE NOTES 6 & 7



NOTES:

1. HUMIDITY CONTROL ONLY AVAILABLE WITH CELERIS MODEL CODES MT, ZV, & BT AND THERIS/TRACCEL TX, TX-EXH, & TX-RTN PRODUCT MODELS.
2. SEE DRAWING "BACNET MS/TP WIRING" FOR BUS CONNECTIONS AND RULES.
3. TERMINATING RESISTOR THAT MATCHES CABLE IMPEDANCE IS REQUIRED (NON-PHOENIX PRODUCT, PROVIDED BY OTHERS).
4. WHEN TDU IS FIRST OR LAST DEVICE INSTALL JUMPER J2 (INTERNAL TERMINATING RESISTOR).
5. DEDICATED 24 VAC TRANSFORMER (UNGROUNDED SECONDARY) REQUIRED.
6. CONNECT SUPPLIED GROUNDING WIRES FROM SPADE LUGS ON ALL MODULES TO EARTHGROUND; KEEP WIRE AS SHORT AS POSSIBLE.
7. MAKE ALL 120 VAC CONNECTIONS IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

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FILENAME: (17) Labratory Controls

DRAWING NAME: Phoenix Controls: Wiring

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 17.10

Phoenix Controls: Vantage Specifications

TABLE 1: CABLE SPECIFICATIONS & ALTERNATES

CABLE TYPE	PLENUM RATED	FUNCTION	WIRE GAUGE (AWG)	VENDOR & PART NUMBER		COLOR CODE (n = CONDUCTOR / PAIR #)	NOTES
				PRIMARY	ALTERNATE		
2C ROUND (NON-SHIELDED)	NO	24 VAC POWER (110 FT MAX)	14 [A]	BELDEN 9411		1: RED 2: BLACK	MUST BE STRANDED
			18 [B]	BELDEN 9409			
2C ROUND (NON-SHIELDED)	YES	24 VAC POWER (110 FT MAX)	14 [A]	WINDY CITY NP007960		1: RED 2: BLACK	MUST BE STRANDED
			18 [B]	BELDEN 82740	WINDY CITY NP002360		
3C ROUND (NON-SHIELDED)	NO	CONTROL	22	BELDEN 8443		1: RED 3: GREEN 2: BLACK	MUST BE STRANDED
3C ROUND (NON-SHIELDED)	YES	CONTROL	22	BELDEN 88444	WINDY CITY 004380	1: RED 3: GREEN 2: BLACK	MUST BE STRANDED
4C ROUND (NON-SHIELDED)	NO	CONTROL	22	BELDEN 8444	MANHATTAN MI3304	1: WHITE 3: BLACK 2: GREEN 4: RED	MUST BE STRANDED
5C ROUND (NON-SHIELDED)	NO	CONTROL	22	BELDEN 8445	MANHATTAN MI3305	1: WHITE 4: RED 2: BROWN 5: GREEN 3: BLACK	MUST BE STRANDED
8C ROUND (NON-SHIELDED)	NO	CONTROL	22	BELDEN 9421	MANHATTAN MI3308	1: WHITE 5: GREEN 2: ORANGE 6: YELLOW 3: BLACK 7: BLUE 4: RED 8: BROWN	NO SUBSTITUTES
8C ROUND (NON-SHIELDED)	YES	CONTROL	22	COMTRAN 4956		1: WHITE 5: GREEN 2: ORANGE 6: YELLOW 3: BLACK 7: BLUE 4: RED 8: BROWN	NO SUBSTITUTES
CAT 5/5E/6/6A (8C IP NON-SHIELDED, TYPICAL, OR SHIELDED)	YES/NO	BACNET IP / ETHERNET (328 FT MAX)	23 [C]	SEE CAT 5, 5E, 6 OR 6A CABLE REQUIREMENTS (ANSI/TIA-586-C)		PAIR 1: GREEN WHITE/GREEN PAIR 2: ORANGE WHITE/ORANGE PAIR 3: BLUE WHITE/BLUE PAIR 4: BROWN WHITE/BROWN	THE USE OF NON-PLENUM RATED CABLE MAY REQUIRE CONDUIT. CONSULT LOCAL CODES.
MS/TP (3C SHIELDED)	NO	BACNET MS/TP COMMUNICATION (4,000 FT MAX)	22 [D]	BELDEN 3106A (120 ohm)	SEE FOOTNOTE D	1. WHITE W/ORANGE STRIPE 2. ORANGE W/WHITE STRIPE 3. BLUE W/WHITE STRIPE	SHIELDED W/DRAIN
MS/TP (3C SHIELDED)	YES	BACNET MS/TP COMMUNICATION (4,000 FT MAX)	22 [D]	CONNECT AIR W223C-2060YPC	SEE FOOTNOTE D	1. BLACK 2. WHITE 3. RED	FOIL SHIELD WITH DRAIN
TP (NON-SHIELDED)	NO	FTT-10 (4,500 FT MAX)	22	WINDY CITY 107500 SMARTWIRE.COM		1: WHITE W/BLUE STRIPE 2: BLUE W/WHITE STRIPE	FOR ALTERNATES SEE: www.echelon.com
		FTT-10 (8,800 FT MAX)	16	WINDY CITY 109600 SMARTWIRE.COM			
TP (NON-SHIELDED)	YES	FTT-10 (4,500 FT MAX)	22	WINDY CITY 105500-S= SPOOL OR B=BOX	CONNECT AIR W221P-2001B	1: WHITE W/BLUE STRIPE 2: BLUE W/WHITE STRIPE	
		FTT-10 (8,800 FT MAX)	16	WINDY CITY 109500 SMARTWIRE.COM			

[A] HIGH-SPEED ELECTRIC VALVE POWER:
(1) MUST BE WIRED IN A HOME-RUN CONFIGURATION.
(2) FOR LOADS UP TO 96 VA USE A DEDICATED 14 AWG CABLE WITH A MAXIMUM LENGTH OF 110 FT (33m) BETWEEN THE TRANSFORMER AND THE VALVE.
(3) NO OTHER VALVES CAN BE DAISY-CHAINED FROM THIS POWER; BUS CONFIGURATIONS ARE NOT ALLOWED BETWEEN HIGH-SPEED VALVES.

[B] LOW-SPEED ELECTRIC & PNEUMATIC VALVE POWER AND ALL OTHER PHOENIX CONTROLS 24 VAC DEVICE POWER:
(1) CAN BE WIRED IN A BUS CONFIGURATION, EXCEPT FOR DEVICES THAT REQUIRE A DEDICATED TRANSFORMER (SEE TABLE 2).
(2) FOR LOADS UP TO 96 VA USE 18 AWG CABLE WITH A MAXIMUM LENGTH OF 110 FT (33m) BETWEEN THE TRANSFORMER AND THE LAST DAISY-CHAINED DEVICE.

[C] CAT 5/5E/6:
(1) CABLES CAN BE ORDERED BY SPECIFIC LENGTH COMPLETE WITH THE RJ45 CONNECTOR ALREADY INSTALLED
(2) CABLES CAN ALSO BE PURCHASED ON A ROLL; FIELD INSTALLATION OF THE RJ45 CONNECTOR IS THEN REQUIRED.

[D] MS/TP BACnet CABLE SPECIFICATIONS FOR ALTERNATE SOLUTIONS
(1) AN MS/TP EIA-485 NETWORK SHALL USE SHIELDED, 3 CONDUCTOR CABLE WITH CHARACTERISTIC IMPEDENCE BETWEEN 100 AND 130 OHMS.
(2) DISTRIBUTED CAPACITANCE BETWEEN CONDUCTORS SHALL BE LESS THAN 100pF PER METER (30pF PER FOOT).
(3) DISTRIBUTED CAPACITANCE BETWEEN CONDUCTORS AND SHIELD SHALL BE LESS THAN 200pF PER METER (60pF PER FOOT).
(4) FOIL OR BRAIDED SHIELDS ARE ACCEPTABLE. THE MAXIMUM RECOMMENDED LENGTH OF AN MS/TP SEGMENT IS 4000 FT (1200 M) WITH AWG 18 CABLE.
(5) THE USE OF GREATER DISTANCES AND/OR DIFFERENT WIRE GAUGES SHALL COMPLY WITH THE ELECTRICAL SPECIFICATIONS OF EIA-485 MS/TP CABLE REQUIREMENTS.

24VAC POWER RULES:

1) SIZE THE TRANSFORMER FOR THE NUMBER AND TYPE OF EQUIPMENT IT WILL SERVE BASED ON VA RATINGS IN TABLE 2.
2) PRIMARY POWER WIRING TO BE PERFORMED BY LOCAL ELECTRICIAN AND MEET LOCAL ELECTRICAL CODES.
3) DEDICATED PRIMARY CIRCUIT OR SECONDARY CIRCUIT DISCONNECT REQUIRED FOR:
   * EACH HIGH-SPEED (ELECTRIC/PNEUMATIC) PRESSURIZATION ZONE
   * MULTIPLE LOW-SPEED (ELECTRIC) PRESSURIZATION ZONES
4) SECONDARY POWER SHALL BE INTERNALLY THERMAL PROTECTED OR EXTERNALLY FUSED WITH A 4A SLOW BLOW FUSE IN ACCORDANCE WITH NEC CLASS 2 POWER REQUIREMENTS (SEE FIGURES 1 & 2).
5) GROUNDING:
   * SEE "TRANSFORMER SECONDARY" COLUMN IN TABLE 2
   * FOR BACNET VALVES AND PCM5XX: EARTH GROUND SECONDARY OF TRANSFORMER (SEE FIGURE 1)
   * FOR ALL OTHER PHOENIX DEVICES: DO NOT EARTH GROUND SECONDARY OF TRANSFORMER (SEE FIGURE 2)
6) MAXIMUM CABLE LENGTH FOR 96 VA LOAD = 110 FT (33M):
   * HIGH-SPEED VALVES: USE 14 AWG CABLE
   * PNEUMATIC AND LOW-SPEED ELECTRIC VALVES: USE 18 AWG CABLE MINIMUM
   * ALL OTHER PHOENIX CONTROLS DEVICES: USE 18 AWG CABLE MINIMUM
7) IF POWERING OTHER DEVICES OFF SAME TRANSFORMER SERVING THE VALVE CONTROLLER, POLARITY MUST BE OBSERVED.
8) ADDITIONAL REQUIREMENTS FOR PHOENIX PRODUCTS THAT REQUIRE DEDICATED TRANSFORMERS:
   * SEE "DEDICATED TRANSFORMER" COLUMN IN TABLE 2
9) ADDITIONAL BACNET MS/TP REQUIREMENTS:
   * FULL WAVE DEVICES CANNOT BE MIXED ON SAME TRANSFORMER AS THE HALF WAVE BACNET VALVE CONTROLLERS (BVC)
   * SEE TABLE 2 ON VANTAGE SPECS SHEET 2 OF 2 FOR A LIST OF HALF WAVE (HW) AND FULL WAVE (FW) DEVICES.

96 VA MAX PER XFMR

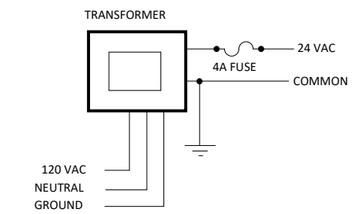

FIGURE 1: BACNET VALVES AND PCM5XX

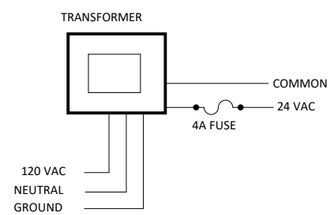

FIGURE 2: ALL OTHER PHOENIX DEVICES

FOLLOW GOOD WIRING PRACTICES:

10) DO NOT RUN SIGNAL OR COMMUNICATIONS CABLE IN THE SAME CONDUIT OR WIREWAY AS POWER CABLES.
11) IF SIGNAL CABLES MUST CROSS POWER CABLES, IT IS BEST TO DO SO AT A 90 DEGREE ANGLE.

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DRAWING NO.: 17.11

Laboratory Controls Sequence of Operations

Laboratory Airflow Control System (LACS) - HEF-1 and associated Hood Exhaust Valves, Supply Air Valves, General Exhaust Air Valve, and Laboratory Space Controls:

Performance/Design Criteria:
Each laboratory will have a dedicated LACS.

The LACS will employ individual average face velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood's exhaust airflow to maintain a constant face velocity over a minimum range of 20 percent to 100 percent of sash travel. The corresponding minimum hood exhaust flow turndown ratio will be 5 to 1.

The hood exhaust airflow control device will respond to the fume hood sash opening by achieving 90 percent of its commanded value within one second of the sash reaching 90 percent of its final position (with no more than 5 percent overshoot/undershoot) of required airflow. Rate of sash movement will be from one to one and one-half feet per second.

The hood exhaust airflow control device will be switched automatically between in-use and standby levels based on the operator's presence immediately in front of the hood. A presence and motion sensor will activate the switching. The airflow control device will achieve the required in-use commanded value in less than one second from the moment of detection with no more than a 5 percent overshoot or undershoot.

The LACS will maintain specific airflow (±5 percent of signal within one second of a change in duct static pressure) regardless of the magnitude of the pressure change, airflow change or quantity of airflow control devices on the manifold (within 0.6 inch to 3.0 inch w.c.).

The LACS will use volumetric offset control to maintain room pressurization. The system will maintain proper room pressurization polarity (negative or positive) regardless of any change in room/system conditions, such as the raising and lowering of any or all fume hood sashes or rapid changes in duct static pressure. Systems using differential pressure measurement or velocity measurement to control room pressurization are unacceptable.

The LACS will maintain specific airflow (±5 percent of signal) with a minimum turndown as specified in subparagraph 2. "LACS Operation Sequences" below, to ensure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.

Airflow Control Sound Specification:
The LACS manufacturer will provide comprehensive sound power level data for each size airflow control device. All data will be obtained from testing in accordance with ASHRAE/ANSI Standard 130, Methods of Testing Air Terminal Units.

All proposed airflow control devices will include discharge, exhaust and radiated sound power level performance.

If the airflow control device cannot meet the sound power levels required to achieve the sound criteria appropriate for the space, as determined by the engineer, a properly sized sound attenuator must be used. All sound attenuators must be of a pack less design (constructed of at least 18 gauge 316L stainless steel when used with fume hood exhaust) with a maximum pressure drop at the device's maximum rated flow rate not to exceed 0.20 inches of water.

LACS Operation Sequences:
The airflow control devices will utilize peer-to-peer, distributed control architecture to perform room-level control functions. Master-slave control schemes will not be acceptable. Control functions will include, at a minimum, volumetric offset pressurization, temperature, humidity control, as well as respond to occupancy and emergency control commands.

Volumetric Offset Pressurization Control:
The laboratory control system will control supply and auxiliary exhaust airflow devices in order to maintain a volumetric offset (either positive or negative). Offset will be maintained regardless of any change in flow or static pressure. This offset will be field adjustable and represents the volume of air, which will enter (or exit) the room from the corridor or adjacent spaces.

The pressurization control algorithm will sum the flow values of all supply and exhaust airflow devices and command appropriate controlled devices to new set points to maintain the desired offset. The offset will be adjustable.

The pressurization control algorithm will consider both networked devices, as well as:

- Up to three non-networked devices providing a linear analog flow signal.
- Any number of constant volume devices where the total of supply devices and the total of exhaust devices may be factored into the pressurization control algorithm.

Volumetric offset will be the only acceptable means of controlling room pressurization. Systems that rely on differential pressure as a means of control will provide documentation to demonstrate that space pressurization can be maintained if fume hood sashes are changed at the same time a door to the space is opened.

The volumetric offset control algorithm will support the ability to regulate the distribution of total supply flow across multiple supply airflow control devices in order to optimize air distribution in the space.

Temperature Control

Standard Primary Temperature Control:
The laboratory control system will regulate the space temperature through a combination of volumetric thermal override and control of reheat coils and/or auxiliary temperature control devices. The laboratory control system will support up to four separate temperature zones for each pressurization zone. Each zone will have provisions for monitoring up to five temperature inputs and calculating a straight-line average to be used for control purposes. Separate cooling and heating set points will be writeable from the BAS, with the option of a local offset adjustment.

Temperature control will be implemented through the use of independent primary cooling and heating control functions, as well as an auxiliary temperature control function, which may be used for either supplemental cooling or heating. Cooling will be provided as a function of thermal override of conditioned air with both supply and exhaust airflow devices responding simultaneously so as to maintain the desired offset. Heating will be provided through modulating control of a properly sized reheat coil.

Auxiliary Temperature Control:
The auxiliary temperature control function will offer the option of either heating or cooling mode and to operate as either a standalone temperature control loop, or staged to supplement the corresponding primary temperature control loop.

Occupancy Control:
The laboratory control system will have the ability to change the minimum ventilation and/or temperature control set points, based on the occupied state, in order to reduce energy consumption when the space is not occupied. The occupancy state may be set by either the BAS as a s c h e d u l e d event or through the use of a local occupancy sensor or switch. The laboratory control system will support a local occupancy override button that allows a user to override the occupancy mode and set the space to occupied for a predetermined interval. The override interval will be configurable from one to 1440 minutes. The local occupancy sensor/switch or bypass button will be given priority over a BAS command.

Laboratory Controls Sequence of Operations

Emergency Mode Control:
The laboratory control system will provide a means of overriding temperature and pressurization control in response to a command indicating an emergency condition exists, and airflow control devices are to be driven to a specific flow set point. The system will support up to four emergency control modes. The emergency control modes may be initiated either by a local contact input or BAS command. Valve level emergency modes can be individually programmed on each valve as one of four emergency control modes. Zone level emergency modes will drive supply and exhaust valves to maintain or ignore zone offset (excludes control of hood valves).

Once an emergency mode is invoked, pressurization and temperature control are overridden for the period that the mode is active. Emergency modes will have a priority scheme allowing a more critical mode to override a previously set condition.

Local Alarm Control:
The laboratory control system will provide the means of summing selective alarm activity at the room-level network and generating a local alarm signal. The local alarm signal may be directed to any available output, as well as to the BAS. The alarm mask may be configured differently for each room- level system.

Fume Hood Control:
Airflow devices intended to control the face velocity of a fume hood will have the ability to interface directly with the fume hood monitoring device.

The airflow control device will:

- Accept command inputs to regulate the flow accordingly and make this command value available to the BAS.
- Accept a sash position signal and make this value available to the BAS.
- Accept a Usage Based Control signal to indicate user presence and make this signal available to the BAS.
- Provide a flow feedback signal to the fume hood monitor, which may be used for calculating face velocity or to confirm the airflow device has achieved the proper flow rate and make this value available to the BAS.
- Provide alarm signals to the fume hood monitor in the event the airflow device is unable to achieve the proper flow rate, there is a loss of static pressure indicating improper fan operation, or there is a loss of power to the airflow control device, in order to provide a local alarm indication.
- The fume hood airflow control device will respond to changes in sash position and user presence within one second, in order to provide a constant 100-feet-per-minute face velocity when the fume hood is in use.

The laboratory control system will be segregated into subnets to isolate network communications to ensure room-level control functions and BAS communications are carried out reliably. Each laboratory space or pressurization zone will be its own subnet. Commercially available routers will be used to provide this isolation.

The LACS will support at least 20 networked devices in each pressurized zone.

All points will be available through the interface to the BAS for trending, archiving, graphics, alarm notification and status reports. LACS performance (speed, stability and accuracy) will be unaffected by the quantity of points being monitored, processed or controlled.

Refer to the BAS specification for the required input/output summary for the necessary points to be monitored and/or controlled.

Interface to Building Management Systems:
The LACS network will have the capability of digitally interfacing with the BAS. The required software interface drivers will be developed and housed in a dedicated interface device furnished by the LACS supplier.

LACS critical environment integration will support distributed network architecture from room level BACnet MS/TP segment or LON FTT-10 bus to a dedicated BACnet MS/TP segment, building BACnet/Ethernet, or BACnet/IP building backbone using single or multiple IP addresses. Backbone communication protocol must be field selectable/upgradable.

Communication between devices in a room or zone will operate independent of building level communications maintaining integrity of the airflow. LACS Building level communication, or loss of, will not disrupt the communication between devices in a room or zone.

LACS critical environment integration will provide an easy means to access room level device health status at a room-by-room or building wide level via web page. The system health pages will provide information to assist in diagnostics for:

- Online/Offline status for the room level integration appliance.
- Runtime information such as heap memory usage and CPU usage.
- Communication channel online/offline and configuration data.
- Device level online/offline information.
- Device level alarm information.
- Device level Configuration errors.

LACS critical environment integration will provide an easy means to access a Test and Balance function tool at a room-by-room or building wide level via web page. Test and balance functions should include:

- Setting the devices in the room to various conditions in order to read airflow.
- Manually override the outputs for testing purposes.
- Adjust airflow to meet field acceptance tests.
- Output a report for airflow performance test.

LACS critical environment integration must be able to support SQL database for long term data storage.

LACS critical environment integration will provide optional software to manage local backup and restore, entire site device management, building wide test and balance functions, building wide diagnostic tools, and building wide configuration tools. Software will be field upgradable to support graphical dashboard displays.

Integration Points List

TYPICAL POINTS AVAILABLE FOR INTEGRATION

Recommended for Integration	Point Name	Description	Data Type	Writable?
Alarm Points (available on any node)				
	COM_FAILURE	LVC Neuron chip has lost communications	Binary	Read only
	SENSOR_FAILURE	LVC has detected a sensor failure on an input	Binary	Read only
*	JAM_ALARM	The valve is unable to reach the commanded set point	Binary	Read only
*	FLOW_ALARM	The pressure switch detected low static pressure	Binary	Read only
	UI_1_ALARM	UI 1 is configured as an alarm input	Binary	Read only
	UI_2_ALARM	UI 2 is configured as an alarm input	Binary	Read only
	UI_3_ALARM	UI 3 is configured as an alarm input	Binary	Read only
	DI_1_ALARM	DI 1 is configured as an alarm input	Binary	Read only
Flow Points (available on any node)				
*	EFF_VLV_CMD	Effective valve flow command	Analog	Read only
*	EFF_VLV_FLOW_FDBK	Effective flow feedback from valve	Analog	Read only
Points Associated with a Hood Valve				
*	BROKEN_SASH_CABLE	Alarm indicating sash sensor cable is broken	Binary	Read only
*	HOOD_OVERRIDE	Alarm indicating emergency override function on the fume hood monitor is active	Binary	Read only
*	SASH_HEIGHT_ALARM	Alarm indicating sash input signal exceeds maximum sash height set point	Binary	Read only
	AUXILIARY_AIR_SETPT	Tracking supply valve (MAV) flow set point	Analog	Read/write
	INVERSE_GEX_SETPT	Tracking inverse general exhaust valve (GEX) set point	Analog	Read/write
*	FACE_VELOCITY	Calculated face velocity	Analog	Read only
*	SASH_OPEN_PERCENT	Calculated Sash Opening (0-100%)	Analog	Read only
	SASH_SWITCH_STATE	Sash switch status (hood open or closed)	Binary	Read only
*	USER_STATUS_STATE	Fume hood normal or standby (setback) mode	Binary	Read only
Points Associated with Occupancy Control				
*	OCCUPANCY_CMD	Commanded occupancy state (occupied/unoccupied/standby)	Multi-state	Read/write
	BYPASS_TIME_REMAIN	Time remaining for occupancy override mode (bypass)	Analog	Read only
*	EFF_OCC_MODE	Present occupancy state (occupied/unoccupied/standby/bypass)	Multi-state	Read only
Points Associated with Emergency Mode Control				
	EMER_MODE_1	Alarm indicating emergency mode 1 is available	Binary	Read only
	EMER_MODE_2	Alarm indicating emergency mode 2 is available	Binary	Read only
	EMER_MODE_3	Alarm indicating emergency mode 3 is available	Binary	Read only
	EMER_MODE_4	Alarm indicating emergency mode 4 is available	Binary	Read only
*	EFF_EMER_MODE	Present emergency mode state (none, 1, 2, 3 or 4 active)	Multi-state	Read only
*	EMER_MODE_CMD	Commanded emergency mode state (1, 2, 3 or 4)	Multi-state	Read/write
Points Associated with Humidity Control				
*	EFF_HUMIDITY_SETPT	Effective humidity set point	Analog	Read only
	HUMIDITY_DEMAND	Relative humidity command	Analog	Read only
	HUMIDITY_SETPT	Humidity control set point	Analog	Read/write
*	SPACE_HUMIDITY	Relative humidity present value	Analog	Read only
Points Associated with Temperature Control				
*	OCC_COOL_SETPT	Cooling set point in the occupied mode	Analog	Read/write
*	OCC_HEAT_SETPT	Heating set point in the occupied mode	Analog	Read/write
*	UNOCC_COOL_SETPT	Cooling set point in the unoccupied mode	Analog	Read/write
*	UNOCC_HEAT_SETPT	Heating set point in the unoccupied mode	Analog	Read/write
	STNDBY_COOL_SETPT	Cooling set point in the standby mode	Analog	Read/write

TYPICAL POINTS AVAILABLE FOR INTEGRATION CONTINUED

Recommended for Integration	Point Name	Description	Data Type	Writable?
Points Associated with Temperature Control Continued				
	STNDBY_HEAT_SETPT	Heating set point in the standby mode	Analog	Read/write
*	EFF_TEMP_SETPT	Average of the cooling and heating set points	Analog	Read only
*	OCC_TEMP_SETPT	Occupied temperature set point	Analog	Read/write
	OCC_TOFFSET_SETPT	Occupied temperature set point offset for cooling and heating	Analog	Read/write
*	AVG_SPACE_TEMP	Average of temperature sensor inputs used for control	Analog	Read only
*	OFFSET_LVR_ENABLE	Enables or disables temperature offset lever	Binary	Read/write
	OFFSET_LVR_PERCENT_OF_RANGE	Scaling value (0 to 100%) of the configured offset lever set point range	Analog	Read/write
	AUX_TEMP_SETPT	Auxiliary temperature control set point	Analog	Read/write
	EFF_AUX_TEMP_SETPT	Effective auxiliary temperature control set point	Analog	Read only
	AUX_TEMP_CMD_STATE	Auxiliary temperature control demand output (on/off)	Analog	Read only
	AUX_TEMP_CMD_VALUE	Auxiliary temperature control demand output (0 to 100%)	Analog	Read only
	COOLING_DEMAND	Cooling demand output (-100% = cooling)	Analog	Read only
	HEATING_DEMAND	Heating demand output (+100% = heating)	Analog	Read only
	DUCT_TEMP	Present value of duct sensor (not used for control)	Analog	Read only
	DSCHRG_AIR_TEMP	Present value of discharge air temperature sensor	Analog	Read only
	DSCHRG_TEMP_SETPT	Discharge air temperature set point for thermal anticipatory control	Analog	Read only
	HEAT_DELIVERED	Present value of thermal energy (BTU) delivered to the space	Analog	Read only
*	TEMP_CTRL_MODE	Reports current temperature control state	Multi-state	Read only
	HVAC_MODE_OVERRIDE	Allows BMS to override temperature control to one of eight states	Multi-state	Read/write
Points Associated with Zone Balance				
	DIVERSITY_ALARM	Total exhaust has exceeded diversity alarm threshold	Binary	Read only
	OFFSET_SETPT	Zone offset set point	Analog	Read/write
*	OFFSET	Calculated zone offset	Analog	Read only
	OCC_MIN_SETPT	Occupied minimum ventilation flow set point	Analog	Read/write
*	UNOCC_MIN_SETPT	Unoccupied minimum ventilation flow set point	Analog	Read/write
*	TOTAL_ZONE_SUPPLY	Total of all networked and non-networked supply devices	Analog	Read only
*	TOTAL_ZONE_EXHAUST	Total of all network and non-network exhaust devices	Analog	Read only
	TOTAL_CNST_VOL_EXH_FLOW	Entered value of constant volume exhaust devices	Analog	Read only
	TOTAL_CNST_VOL_SUP_FLOW	Entered value of constant volume supply devices	Analog	Read only
	TOTAL_ADD_EXH_FLOW	Total of all hard-wired (non-networked) exhaust devices	Analog	Read only
	TOTAL_ADD_SUP_FLOW	Total of all hard-wired (non-networked) supply devices	Analog	Read only
Points Associated with Pressure Control				
*	SENSOR_FAILURE	Alarm indicating the pressure sensor is functioning or has failed	Binary	Read only
*	ZONE_PRES_ALARM	Alarm indicating over or under pressure alarm condition	Binary	Read only
*	EFF_PRES_SETPT	The set point to which the pressure control system will control	Analog	Read only
*	ZONE_PRES_DIF	Present value of the measured zone differential pressure	Analog	Read only
	ZONE_PRES_ABS	Present value of the measured zone absolute pressure	Analog	Read only
	POC_STATE	Present state of progressive offset control function	Multi-state	Read only
*	PRES_WARN_SETPT	Set point value for the over or loss of pressure warning function	Analog	Read/write
*	PRES_ALRM_SETPT	Set point value for the over pressure alarm function	Analog	Read/write
	FRZ_TIME_SETPT	Set point for duration of freeze mode if door remains open	Analog	Read/write
	FRZ_TIME_REMAIN	Time remaining before freeze mode terminates	Analog	Read only
	FRZ_MODE_OFFSET_SETPT	Set point for an alternate offset when the freeze mode is active	Analog	Read/write

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Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME: Integration Points List

CONTRACT NO: WU-01-16 | SE:JV | DE: PL | PR: RV

DRAWING NO.: 17.14

1st Level Room Schedule Sheet

Catalog Number	Room	Tag	Desc	Func	Min Flow	Max Flow	Model Code	Linked Set	Offset	Unocc Vent	Serial Number	Production Note
MAVA108L-ALEHZ-SFX-PSL	183B	SAV-1C3	VALVE	SUP	115	380	ZV					FEEDS 191
NEUA108	183B	SAV-1C3	NEU	NEUA								
PTS300-P-OS	183B	183B	SENSOR	OTHR								
PTS102-D-04	183B	183B	SENSOR	OTHR								
MAVA112L-ALEHZ-SFX-PSL	183C	SAV-1C2	VALVE	SUP	190	620	ZV					FEEDS 191
NEUA112	183C	SAV-1C2	NEU	NEUA								
PTS300-P-OS	183C	183C	SENSOR	OTHR								
PTS102-D-04	183C	183C	SENSOR	OTHR								
CEVA108M-ACNHZ-SFX-PSL	187	GEV101	VALVE	GEX	360	360						
NEUA108	187	GEV-101	NEU	NEUA								
MAVA212L-ALEHZ-PSL	191	SAV-1C1	VALVE	SUP	540	1800	ZV		-100			
EXVA214M-ALEHZ-PSL	191	GEV-1C1	VALVE	GEX	1200	2700	GM					
EXVA108M-SLEHZ-SFX-PSL	191	HEV-1C1	VALVE	OTHR	35	450	GM					S.O.
EXVA108M-SLEHZ-SFX-PSL	191	HEV-1C2	VALVE	OTHR	35	450	GM					S.O.
EXVA108M-SLEHZ-SFX-PSL	191	HEV-1C3	VALVE	OTHR	35	450	GM					S.O.
EXVA108M-SLEHZ-SFX-PSL	191	HEV-1C4	VALVE	OTHR	35	450	GM					S.O.
EXVA108M-SLEHZ-SFX-PSL	191	HEV-1C5	VALVE	OTHR	35	450	GM					S.O.
EXVA108M-SLEHZ-SFX-PSL	191	HEV-1C6	VALVE	OTHR	35	450	GM					S.O.
WSP100-GRY	191	HEV-1C1	WS	WS							1087	
WSP100-GRY	191	HEV-1C2	WS	WS							1088	
WSP100-GRY	191	HEV-1C3	WS	WS							1089	
WSP100-GRY	191	HEV-1C4	WS	WS							1090	
WSP100-GRY	191	HEV-1C5	WS	WS							1091	
WSP100-GRY	191	HEV-1C6	WS	WS							1092	
NEUA212	191	SAV-1C1	NEU	NEUA								
NEUA214	191	GEV-1C1	NEU	NEUA								
NEUA108	191	HEV-1C1	NEU	NEUA								
NEUA108	191	HEV-1C2	NEU	NEUA								
NEUA108	191	HEV-1C3	NEU	NEUA								
NEUA108	191	HEV-1C4	NEU	NEUA								
NEUA108	191	HEV-1C5	NEU	NEUA								
NEUA108	191	HEV-1C6	NEU	NEUA								
PTS300-P-OS	191	191	SENSOR	OTHR								
PTS102-D-04	191	191	SENSOR	OTHR								

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Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME: 1st Level Room Schedule Sheet

CONTRACT NO: WU-01-16 | SE:JV | DE: PL | PR: RV

DRAWING NO.: 17.15

2nd Level Room Schedule Sheet

Catalog Number	Room	Tag	Desc	Func	Min Flow	Max Flow	Model Code	Linked Set	Offset	Unocc Vent	Serial Number	Production Note
TSVA214L-ALEHZ-PSL	235	SAV-212	VALVE	SUP	660	2200	ZV2	1				
TEVA212M-ALNHZ-PSL	235	GEV-212	VALVE	GEX	730	2270	TV1	1				
NEUA214	235	SAV-212	NEU	NEUA								
NEUA212	235	GEV-212	NEU	NEUA								
PTS300-P-OS	235	235	SENSOR	OTHR								
PTS102-D-04	235	235	SENSOR	OTHR								
TSVA108L-ALEHZ-SFX-PSL	272A	SAV-211	VALVE	SUP	100	300	ZV2	2	-100			
TEVA110M-ALNHZ-SFX-PSL	272A	GEV-211	VALVE	GEX	200	400	TV1	2				
NEUA108	272A	SAV-211	NEU	NEUA								
NEUA110	272A	GEV-211	NEU	NEUA								
PTS300-P-OS	272A	272A	SENSOR	OTHR								
PTS102-D-04	272A	272A	SENSOR	OTHR								
TSVA108L-ALEHZ-SFX-PSL	272B	SAV-210	VALVE	SUP	120	400	ZV2	3	-70			
TEVA110M-ALNHZ-SFX-PSL	272B	GEV-210	VALVE	GEX	190	470	TV1	3				
NEUA108	272B	SAV-210	NEU	NEUA								
NEUA110	272B	GEV-210	NEU	NEUA								
PTS300-P-OS	272B	272B	SENSOR	OTHR								
PTS102-D-04	272B	272B	SENSOR	OTHR								
TSVA108L-ALEHZ-SFX-PSL	274	SAV-209	VALVE	SUP	65	160	ZV2	4	-70			
TEVA108M-ALNHZ-SFX-PSL	274	GEV-209	VALVE	GEX	135	230	TV1	4				
NEUA108	274	SAV-209	NEU	NEUA								
NEUA108	274	EAV-209	NEU	NEUA								
PTS300-P-OS	274	274	SENSOR	OTHR								
PTS102-D-04	274	274	SENSOR	OTHR								
MAVA114L-AMEHZ-SFX-PSL	276	SAV-208	VALVE	SUP	600	1200	ZV		-140			
EXVA114M-AMEHZ-SFX-PSL	276	GEV-208	VALVE	GEX	540	910	GM					
EXVB110M-SMHUO-SFX	276	HEV-208	VALVE	HOOD	200	430	HM					
FHD110-ENG	276	HEV-208	DISP	HOOD							1849	
VSS4-0100-A	276	HEV-208	S.S.	HOOD							47218	
NEUA114	276	SAV-208	NEU	NEUA								
NEUA114	276	GEV-208	NEU	NEUA								
PTS300-P-OS	276	276	SENSOR	OTHR								
PTS102-D-04	276	276	SENSOR	OTHR								
TSVA108L-ALEHZ-SFX-PSL	282	SAV-207	VALVE	SUP	120	300	ZV2	5	-70			
TEVA110M-ALNHZ-SFX-PSL	282	GEV-207	VALVE	GEX	190	370	TV1	5				
NEUA108	282	SAV-207	NEU	NEUA								
NEUA110	282	GEV-207	NEU	NEUA								
PTS300-P-OS	282	282	SENSOR	OTHR								
PTS102-D-04	282	282	SENSOR	OTHR								
MAVA114L-AMEHZ-SFX-PSL	283	SAV-204	VALVE	SUP	420	1400	ZV		-140			
EXVA114M-AMEHZ-SFX-PSL	283	GEV-204	VALVE	GEX	310	840	GM					
EXVB112M-SMHUO-SFX	283	HEV-204	VALVE	HM	250	700	HM					
FHD110-ENG	283	HEV-204	DISP	HOOD							1850	
VSS4-0100-A	283	HEV-204	S.S.	HOOD							47219	
NEUA114	283	SAV-204	NEU	NEUA								
NEUA114	283	GEV-204	NEU	NEUA								
PTS300-P-OS	283	283	SENSOR	OTHR								
PTS102-D-04	283	283	SENSOR	OTHR								
TSVA212L-ALEHZ-PSL	284	SAV-206	VALVE	SUP	605	1500	ZV2	6	-140			
TEVA114M-ALNHZ-SFX-PSL	284	GEV-206	VALVE	GEX	745	1640	TV1	6				
NEUA212	284	SAV-206	NEU	NEUA								
NEUA114	284	GEV-206	NEU	NEUA								
PTS300-P-OS	284	284	SENSOR	OTHR								
PTS102-D-04	284	284	SENSOR	OTHR								
TSVA108L-ALEHZ-SFX-PSL	289A	SAV-203	VALVE	SUP	65	160	ZV2	7	-70			
TEVA108M-ALNHZ-SFX-PSL	289A	GEV-203	VALVE	GEX	135	230	TV1	7				
NEUA108	289A	SAV-203	NEU	NEUA								
NEUA108	289A	GEV-203	NEU	NEUA								
PTS300-P-OS	289A	289A	SENSOR	OTHR								
PTS102-D-04	289A	289A	SENSOR	OTHR								
TSVA108L-ALEHZ-SFX-PSL	289B	SAV-202	VALVE	SUP	240	370	ZV2	8	110			

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME: 2nd Level Room Schedule Sheet

CONTRACT NO: WU-01-16 | SE:JV | DE: PL | PR: RV

DRAWING NO.: 17.16

3rd Level Room Schedule Sheet

Catalog Number	Room	Tag	Desc	Func	Min Flow	Max Flow	Model Code	Linked Set	Offset	Unocc Vent	Serial Number	Production Note
TSVA108L-ALEHZ-SFX-PSL	372 B/C	SAV-309	VALVE	SUP	100	380	ZV2	10	-160			
TEVA110M-ALNHZ-SFX-PSL	372 B/C	GEV-309	VALVE	GEX	260	540	TV1	10				
NEUA108	372 B/C	SAV-309	NEU	NEUA								
NEUA110	372 B/C	GEV-309	NEU	NEUA								
PTS300-P-OS	372 B/C	372 B/C	SENSOR	OTHR								
PTS102-D-04	372 B/C	372 B/C	SENSOR	OTHR								
MAVA108L-AMEHZ-SFX-PSL	374A	SAV-308	VALVE	SUP	270	360	ZV		-70			
EXVA110M-SMEHZ-SFX-PSL	374A	GEV-308	VALVE	GEX	50	140	GM					S.O.
EXVB110M-SMHUO-SFX	374A	HEV-308	VALVE	HOOD	200	430	HM					
FHD110-ENG	374A	HEV-308	DISP	HOOD							1852	
VSS4-0100-A	374A	HEV-308	S.S.	HOOD							47221	
NEUA108	374A	SAV-308	NEU	NEUA								
NEUA110	374A	GEV-308	NEU	NEUA								
PTS300-P-OS	374A	374A	SENSOR	OTHR								
PTS102-D-04	374A	374A	SENSOR	OTHR								
TSVA108L-ALEHZ-SFX-PSL	374B	SAV-307	VALVE	SUP	240	360	ZV2	11	110			
TEVA110M-ALNHZ-SFX-PSL	374B	GEV-307	VALVE	GEX	130	250	TV1	11				
NEUA108	374B	SAV-307	NEU	NEUA								
NEUA110	374B	GEV-307	NEU	NEUA								
PTS300-P-OS	374B	374B	SENSOR	OTHR								
PTS102-D-04	374B	374B	SENSOR	OTHR								
MAVA114L-AMEHZ-SFX-PSL	378	SAV-306	VALVE	SUP	610	1200	ZV		-140			
EXVA114M-AMEHZ-SFX-PSL	378	GEV-306	VALVE	GEX	500	640	GM					
EXVB112M-SMHUO-SFX	378	HEV-306	VALVE	HOOD	250	700	HM					
FHD110-ENG	378	HEV-306	DISP	HOOD							1853	
VSS4-0100-A	378	HEV-306	S.S.	HOOD							47222	
NEUA114	378	SAV-306	NEU	NEUA								
NEUA114	378	GEV-306	NEU	NEUA								
PTS300-P-OS	378	378	SENSOR	OTHR								
PTS102-D-04	378	378	SENSOR	OTHR								
MAVA212L-AMEHZ-PSL	383	SAV-303	VALVE	SUP	495	1650	ZV		-140			
EXVA114M-AMEHZ-SFX-PSL	383	GEV-303	VALVE	GEX	435	1360	GM					
EXVB110M-SMHUO-SFX	383	HEV-303	VALVE	HOOD	200	430	HM					
FHD110-ENG	383	HEV-303	DISP	HOOD							1854	
VSS4-0100-A	383	HEV-303	S.S.	HOOD							47223	
NEUA212	383	SAV-303	NEU	NEUA								
NEUA114	383	GEV-303	NEU	NEUA								
PTS300-P-OS	383	383	SENSOR	OTHR								
PTS102-D-04	383	383	SENSOR	OTHR								
MAVA108L-AMEHZ-SFX-PSL	386	SAV-305	VALVE	SUP	270	360	ZV		-70			
EXVA108M-SLEHZ-SFX-PSL	386	GEV-305	VALVE	GEX	140	140	GM					S.O.
EXVB110M-SMHUO-SFX	386	HEV-305	VALVE	HOOD	200	430	HM					
FHD110-ENG	386	HEV-305	DISP	HOOD							1855	
VSS4-0100-A	386	HEV-305	S.S.	HOOD							47224	
NEUA108	386	SAV-305	NEU	NEUA								
NEUA108	386	GEV-305	NEU	NEUA								
PTS300-P-OS	386	386	SENSOR	OTHR								
PTS102-D-04	386	386	SENSOR	OTHR								
MAVA114L-AMEHZ-SFX-PSL	388	SAV-304	VALVE	SUP	480	1200	ZV		-140			
EXVA114M-AMEHZ-SFX-PSL	388	GEV-304	VALVE	GEX	370	640	GM					
EXVB112M-SMHUO-SFX	388	HEV-304	VALVE	HOOD	250	700	HM					
FHD110-ENG	388	HEV-304	DISP	HOOD							1856	
VSS4-0100-A	388	HEV-304	S.S.	HOOD							47225	
NEUA114	388	SAV-304	NEU	NEUA								
NEUA114	388	GEV-304	NEU	NEUA								
PTS300-P-OS	388	388	SENSOR	OTHR								
PTS102-D-04	388	388	SENSOR	OTHR								
MAVA110L-AMEHZ-SFX-PSL	389	SAV-302	VALVE	SUP	180	520	ZV		-70			
EXVA110M-AMEHZ-SFX-PSL	389	GEV-302	VALVE	GEX	50	160	GM					
EXVB110M-SMHUO-SFX	389	HEV-302	VALVE	HOOD	200	430	HM					
FHD110-ENG	389	HEV-302	DISP	HOOD							1857	

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME: 3rd Level Room Schedule Sheet

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 17.17

4th Level Room Schedule Sheet

Catalog Number	Room	Tag	Desc	Func	Min Flow	Max Flow	Model Code	Linked Set	Offset	Unocc Vent	Serial Number	Production Note
MAVA112L-AMEHZ-SFX-PSL	472	SAV-407	VALVE	SUP	700	1000	ZV		200			
EXVB110M-SMHUO-SFX	472	HEV-407A	VALVE	HOOD	200	430	HM					
FHD110-ENG	472	HEV-407A	DISP	HOOD							1859	
VSS4-0100-A	472	HEV-407A	S.S.	HOOD							47228	
EXVB110M-SMHUO-SFX	472	HEV-407B	VALVE	HOOD	200	430	HM					
FHD110-ENG	472	HEV-407B	DISP	HOOD							1860	
VSS4-0100-A	472	HEV-407B	S.S.	HOOD							47229	
EXVB110M-SMHUO-SFX	472	HEV-407C	VALVE	HOOD	200	430	HM					
FHD110-ENG	472	HEV-407C	DISP	HOOD							1861	
VSS4-0100-A	472	HEV-407C	S.S.	HOOD							47230	
EXVB110M-SMHUO-SFX	472	HEV-407D	VALVE	HOOD	200	430	HM					
FHD110-ENG	472	HEV-407D	DISP	HOOD							1862	
VSS4-0100-A	472	HEV-407D	S.S.	HOOD							47231	
EXVB110M-SMHUO-SFX	472	HEV-407E	VALVE	HOOD	200	430	HM					
FHD110-ENG	472	HEV-407E	DISP	HOOD							1863	
VSS4-0100-A	472	HEV-407E	S.S.	HOOD							47232	
EXVB110M-SMHUO-SFX	472	HEV-407F	VALVE	HOOD	200	430	HM					
FHD110-ENG	472	HEV-407F	DISP	HOOD							1864	
VSS4-0100-A	472	HEV-407F	S.S.	HOOD							47233	
NEUA112	472	SAV-407	NEU	NEUA								
PTS300-P-OS	472	472	SENSOR	OTHR								
PTS102-D-04	472	472	SENSOR	OTHR								
TSVA108L-ALEHZ-SFX-PSL	475	SAV-408	VALVE	SUP	50	50	ZV2	12	-100	50		
TEVA108M-ALNHZ-SFX-PSL	475	GEV-408	VALVE	GEX	150	150	TV1	12				
NEUA108	475	SAV-408	NEU	NEUA								
NEUA108	475	GEV-408	NEU	NEUA								
PTS300-P-OS	475	475	SENSOR	OTHR								
PTS102-D-04	475	475	SENSOR	OTHR								
MAVA108L-AMEHZ-SFX-PSL	478	SAV-406	VALVE	SUP	240	240	ZV		-70	60		
EXVA108M-SLEHZ-SFX-PSL	478	GEV-406	VALVE	GEX	35	110	GM					S.O. Until
EXVB110M-SMHUO-SFX	478	HEV-406	VALVE	HOOD	200	430	HM					Hood Closes
FHD110-ENG	478	HEV-406	DISP	HOOD							1865	
VSS4-0100-A	478	HEV-406	S.S.	HOOD							47234	
NEUA108	478	SAV-406	NEU	NEUA								
NEUA108	478	GEV-406	NEU	NEUA								
PTS300-P-OS	478	478	SENSOR	OTHR								
PTS102-D-04	478	478	SENSOR	OTHR								
MAVA112L-AMEHZ-SFX-PSL	480	SAV-405	VALVE	SUP	600	1000	ZV		-140	200		
EXVB112M-SMHUO-SFX	480	HEV-405A	VALVE	HOOD	250	700	HM					
FHD110-ENG	480	HEV-405A	DISP	HOOD							1866	
VSS4-0100-A	480	HEV-405A	S.S.	HOOD							47235	
EXVB112M-SMHUO-SFX	480	HEV-405B	VALVE	HOOD	250	700	HM					
FHD110-ENG	480	HEV-405B	DISP	HOOD							1867	
VSS4-0100-A	480	HEV-405B	S.S.	HOOD							47236	
EXVB112M-SMHUO-SFX	480	HEV-405C	VALVE	HOOD	250	700	HM					
FHD110-ENG	480	HEV-405C	DISP	HOOD							1868	
VSS4-0100-A	480	HEV-405C	S.S.	HOOD							47237	
EXVB110M-SMHUO-SFX	480	HEV-405D	VALVE	HOOD	200	430	HM					
FHD110-ENG	480	HEV-405D	DISP	HOOD							1869	
VSS4-0100-A	480	HEV-405D	S.S.	HOOD							47238	
EXVB112M-SMHUO-SFX	480	HEV-405E	VALVE	HOOD	250	700	HM					
FHD110-ENG	480	HEV-405E	DISP	HOOD							1870	
VSS4-0100-A	480	HEV-405E	S.S.	HOOD							47239	
EXVB112M-SMHUO-SFX	480	HEV-405F	VALVE	HOOD	250	700	HM					
FHD110-ENG	480	HEV-405F	DISP	HOOD							1871	
VSS4-0100-A	480	HEV-405F	S.S.	HOOD							47240	
EXVB112M-SMHUO-SFX	480	HEV-405G	VALVE	HOOD	250	700	HM					
FHD110-ENG	480	HEV-405G	DISP	HOOD							1872	
VSS4-0100-A	480	HEV-405G	S.S.	HOOD							47241	
NEUA112	480	SAV-405	NEU	NEUA								
PTS300-P-OS	480	480	SENSOR	OTHR								

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (17) Labratory Controls

DRAWING NAME:
4th Level Room Schedule Sheet

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 17.18

Variable Air Volume Unit Schedule

Terminal Unit					Primary Airflow		Heating Airflow	Control Details		
Tag	Air Source	Type	Inlet Size	Location	Max CFM	Min CFM	CFM	Controller	Thermostat	Notes
Level 01										
VAV-101	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 01	300	90	135	ZN141v+	ZSPL-ALC	
VAV-102	AHU 1 & AHU-2	Hot Water Reheat	8"	Level 01	460	230	280	ZN141v+	ZSPL-ALC	
VAV-103	AHU 1 & AHU-2	Hot Water Reheat	9"	Level 01	600	180	280	ZN141v+	ZSPL-ALC	
VAV-104	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 01	210	65	105	ZN141v+	ZSPL-ALC	
VAV-105	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 01	275	70	95	ZN141v+	ZSPL-ALC	
VAV-106	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 01	350	105	350	ZN141v+	ZSPL-ALC	
VAV-107	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 01	200	65	170	ZN141v+	ZSPL-ALC	
VAV-108	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 01	360	110	360	ZN141v+	ZSPL-ALC	
VAV-109	AHU 1 & AHU-2	Hot Water Reheat	8"	Level 01	495	170	490	ZN141v+	ZSPL-ALC	
VAV-110	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 01	800	480	600	ZN141v+	ZSPL-C-ALC	With CO2 Control
VAV-111	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 01	390	120	230	ZN141v+	ZSPL-ALC	
VAV-112	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 01	150	50	75	ZN141v+	ZSPL-ALC	
VAV-113	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 01	800	480	500	ZN141v+	ZSPL-C-ALC	With CO2 Control
VAV-114	AHU 1 & AHU-2	Hot Water Reheat	9"	Level 01	730	190	730	ZN141v+	ZSPL-ALC	
VAV-115	AHU 1 & AHU-2	Hot Water Reheat	14"	Level 01	1820	600	1130	ZN141v+	ZSPL-C-ALC	With CO2 Control
VAV-116	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 01	370	125	280	ZN141v+	ZSPL-ALC	
VAV-117	AHU 1 & AHU-2	Hot Water Reheat	9"	Level 01	685	225	550	ZN141v+	ZSPL-ALC	
VAV-118	AHU 1 & AHU-2	Hot Water Reheat	12"	Level 01	1135	270	1135	ZN141v+	ZSPL-ALC	
VAV-119	AHU 1 & AHU-2	Hot Water Reheat	8"	Level 01	490	175	320	ZN141v+	ZSPL-ALC	
VAV-120	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 01	285	100	225	ZN141v+	ZSPL-ALC	
VAV-121	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 01	215	60	185	ZN141v+	ZSPL-ALC	
VAV-122	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 01	210	60	160	ZN141v+	ZSPL-ALC	
VAV-123	AHU 1 & AHU-2	Hot Water Reheat	14"	Level 01	1955	700	1085	ZN141v+	ZSPL-C-ALC	With CO2 Control
VAV-124	AHU 1 & AHU-2	Hot Water Reheat	14"	Level 01	1955	700	1085	ZN141v+	ZSPL-ALC	
Level 02										
VAV-201	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 02	200	65	200	ZN141v+	ZSPL-ALC	
VAV-202	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 02	920	280	555	ZN141v+	ZSPL-ALC	
VAV-203	AHU 1 & AHU-2	Hot Water Reheat	4"	Level 02	80	45	80	ZN141v+	ZSPL-ALC	
VAV-204	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 02	840	180	505	ZN141v+	ZSPL-ALC	
VAV-205	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 02	310	85	310	ZN141v+	ZSPL-ALC	
VAV-206	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 02	310	85	310	ZN141v+	ZSPL-ALC	
VAV-207	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 02	325	85	325	ZN141v+	ZSPL-ALC	
VAV-208	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 02	195	195	195	ZN141v+	ZSPL-ALC	
VAV-209	AHU 1 & AHU-2	Hot Water Reheat	14"	Level 02	1900	480	990	ZN141v+	ZSPL-C-ALC	With CO2 Control
VAV-210	AHU 1 & AHU-2	Hot Water Reheat	14"	Level 02	1500	420	600	ZN141v+	ZSPL-C-ALC	With CO2 Control
VAV-212	AHU 1 & AHU-2	Hot Water Reheat	12"	Level 02	1500	450	1470	ZN141v+	ZSPL-ALC	
VAV-213	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 02	210	50	140	ZN141v+	ZSPL-ALC	
VAV-214	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 02	305	105	155	ZN141v+	ZSPL-ALC	
VAV-215	AHU 1 & AHU-2	Hot Water Reheat	5"	Level 02	200	65	120	ZN141v+	ZSPL-ALC	
VAV-216	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 02	275	70	95	ZN141v+	ZSPL-ALC	
VAV-217	AHU 1 & AHU-2	Hot Water Reheat	12"	Level 02	1200	360	640	ZN141v+	ZSPL-ALC	

Variable Air Volume Unit Schedule

Terminal Unit					Primary Airflow		Heating Airflow	Control Details		
Tag	Air Source	Type	Inlet Size	Location	Max CFM	Min CFM	CFM	Controller	Thermostat	Notes
Level 03										
VAV-301	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 03	250	65	250	ZN141v+	ZSPL-ALC	
VAV-302	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 03	360	110	270	ZN141v+	ZSPL-ALC	
VAV-303	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 03	200	65	110	ZN141v+	ZSPL-ALC	
VAV-304	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 03	680	260	475	ZN141v+	ZSPL-ALC	
VAV-305	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 03	735	200	80	ZN341v+	ZSPL-ALC	With Fin Tube
VAV-306	AHU 1 & AHU-2	Hot Water Reheat	9"	Level 03	630	165	540	ZN141v+	ZSPL-ALC	
VAV-307	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 03	660	165	330	ZN341v+	ZSPL-ALC	With Fin Tube
VAV-308	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 03	935	240	690	ZN341v+	ZSPL-ALC	With Fin Tube
VAV-309	AHU 1 & AHU-2	Hot Water Reheat	12"	Level 03	1320	360	660	ZN141v+	ZSPL-ALC	
VAV-310	AHU 1 & AHU-2	Hot Water Reheat	14"	Level 03	1920	540	975	ZN341v+	ZSPL-ALC	With Fin Tube
VAV-311	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 03	750	225	600	ZN341v+	ZSPL-ALC	With Fin Tube
VAV-312	AHU 1 & AHU-2	Hot Water Reheat	12"	Level 03	1420	430	810	ZN141v+	ZSPL-ALC	
VAV-313	AHU 1 & AHU-2	Hot Water Reheat	12"	Level 03	1180	300	540	ZN141v+	ZSPL-ALC	
VAV-314	AHU 1 & AHU-2	Hot Water Reheat	14"	Level 03	1600	480	1040	ZN341v+	ZSPL-ALC	With Fin Tube
VAV-315	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 03	935	265	795	ZN341v+	ZSPL-ALC	With Fin Tube
VAV-316	AHU 1 & AHU-2	Hot Water Reheat	12"	Level 03	1040	265	680	ZN141v+	ZSPL-ALC	
VAV-317	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 03	210	65	205	ZN141v+	ZSPL-ALC	
VAV-318	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 03	390	110	295	ZN141v+	ZSPL-ALC	
VAV-319	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 03	320	75	180	ZN141v+	ZSPL-ALC	
VAV-320	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 03	710	120	215	ZN141v+	ZSPL-ALC	
VAV-321	AHU 1 & AHU-2	Hot Water Reheat	9"	Level 03	650	455	455	ZN141v+	ZSPL-C-ALC	With CO2 Control
VAV-322	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 03	275	70	70	ZN141v+	ZSPL-ALC	
VAV-411	AHU 1 & AHU-2	Hot Water Reheat	8"	Level 03	540	165	325	ZN141v+	ZSPL-ALC	
Level 04										
VAV-401	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 04	300	90	240	ZN141v+	ZSPL-ALC	
VAV-402	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 04	440	135	440	ZN141v+	ZSPL-ALC	
VAV-403	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 04	720	215	665	ZN141v+	ZSPL-ALC	
VAV-404	AHU 1 & AHU-2	Hot Water Reheat	9"	Level 04	610	180	545	ZN141v+	ZSPL-ALC	
VAV-405	AHU 1 & AHU-2	Hot Water Reheat	8"	Level 04	420	130	355	ZN141v+	ZSPL-ALC	
VAV-406	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 04	850	255	510	ZN141v+	ZSPL-ALC	
VAV-407	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 04	1000	300	480	ZN141v+	ZSPL-ALC	
VAV-408	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 04	670	200	325	ZN141v+	ZSPL-ALC	
VAV-409	AHU 1 & AHU-2	Hot Water Reheat	8"	Level 04	500	150	385	ZN141v+	ZSPL-ALC	
VAV-410	AHU 1 & AHU-2	Hot Water Reheat	9"	Level 04	550	165	440	ZN141v+	ZSPL-ALC	
VAV-412	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 04	320	100	145	ZN141v+	ZSPL-ALC	
VAV-413	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 04	900	270	565	ZN141v+	ZSPL-ALC	
VAV-414	AHU 1 & AHU-2	Hot Water Reheat	8"	Level 04	425	130	255	ZN141v+	ZSPL-ALC	
VAV-415	AHU 1 & AHU-2	Hot Water Reheat	10"	Level 04	585	175	355	ZN141v+	ZSPL-ALC	
VAV-416	AHU 1 & AHU-2	Hot Water Reheat	7"	Level 04	335	100	170	ZN141v+	ZSPL-ALC	
VAV-417	AHU 1 & AHU-2	Hot Water Reheat	6"	Level 04	295	90	100	ZN141v+	ZSPL-ALC	

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (18) Full Schedules

DRAWING NAME: Variable Air Volume Unit Schedule

CONTRACT NO: WU-01-16 | SE:JV | DE: PL | PR: RV

DRAWING NO.: 18.2

Air Handling Unit Valve Schedules

Chilled Water Valves

Item	Coil Tag	Valve Tag	Medium	Qty	Valve Part Number	Valve Type	Trim	Body	Fail Action	Valve Size	Connection	Flow (GPM)	Design Delta P	Valve Delta P	Design Cv	Valve Cv	Valve Closeoff	Actuator	Control Signal
1	AHU-1	V-4	Chilled Water	1	G6100C+NC+EVB24-SR	Globe	Bronze	2-Way	Last Position	4"	Flanged	210.00	3.0 psig	1.5 psig	121.24	170.00	140	EVB24-SR	2 to 10 VDC
2	AHU-2	V-4	Chilled Water	1	G6100C+NC+EVB24-SR	Globe	Bronze	2-Way	Last Position	4"	Flanged	210.00	3.0 psig	1.5 psig	121.24	170.00	140	EVB24-SR	2 to 10 VDC
3	AHU-3	V-5	Chilled Water	1	G232+NC+SVB24-SR	Globe	Bronze	2-Way	Last Position	1 1/4"	NPT Female	30.00	3.0 psig	2.2 psig	17.32	20.00	236	SVB24-SR	2 to 10 VDC
4	AHU-4	V-5	Chilled Water	1	G232+NC+SVB24-SR	Globe	Bronze	2-Way	Last Position	1 1/4"	NPT Female	30.00	3.0 psig	2.2 psig	17.32	20.00	236	SVB24-SR	2 to 10 VDC
5	**AHU-5**	**V-6**	**Chilled Water**	**1**	**G340+NC+SVB24-SR**	**Globe**	**Bronze**	**3-Way**	**Last Position**	**1 1/2"**	**NPT Female**	**37.00**	**3.0 psig**	**1.8 psig**	**21.36**	**28.00**	**159**	**SVB24-SR**	**2 to 10 VDC**

Heat Recovery Valves

Item	Coil Tag	Valve Tag	Qty	Valve Part Number	Valve Type	Trim	Body	Fail Action	Valve Size	Connection	Flow (GPM)	Design Delta P	Valve Delta P	Design Cv	Valve Cv	Valve Closeoff	Actuator	Control Signal
1	AHU-1 HRC	V-2	1	G765+AFX24-MFT-X1 P-10001	Globe	Bronze	3-Way	Fail Safe	2 1/2"	Flanged	110.00	3.0 psig	2.6 psig	63.51	68.00	140	AFX24-MFT-X1	2 to 10 VDC
2	AHU-2 HRC	V-2	1	G765+AFX24-MFT-X1 P-10001	Globe	Bronze	3-Way	Fail Safe	2 1/2"	Flanged	110.00	3.0 psig	2.6 psig	63.51	68.00	140	AFX24-MFT-X1	2 to 10 VDC

Hot Water Valves

Item	Coil Tag	Valve Tag	Medium	Qty	Valve Part Number	Valve Type	Trim	Body	Fail Action	Valve Size	Connection	Flow (GPM)	Design Delta P	Valve Delta P	Design Cv	Valve Cv	Valve Closeoff	Actuator	Control Signal
1	AHU-1 HWC	V-1	Hot Water	1	G250+NO/FO+AFB24-SR-X1	Globe	Bronze	2-Way	Open	2"	NPT Female	68.00	3.0 psig	2.9 psig	39.26	46.00	120	AFB24-SR	2 to 10 VDC
2	AHU-2 HWC	V-1	Hot Water	1	G250+NO/FO+AFB24-SR-X1	Globe	Bronze	2-Way	Open	2"	NPT Female	68.00	3.0 psig	2.9 psig	39.26	46.00	120	AFB24-SR	2 to 10 VDC
3	AHU-3	V-3	Hot Water	1	G220+NO/FO+LF24-SR US	Globe	Bronze	2-Way	Open	3/4"	NPT Female	12.00	3.0 psig	2.6 psig	6.93	7.50	140	LF24-SR US	2 to 10 VDC
4	AHU-4	V-3	Hot Water	1	G220+NO/FO+LF24-SR US	Globe	Bronze	2-Way	Open	3/4"	NPT Female	12.00	3.0 psig	2.6 psig	6.93	7.50	140	LF24-SR US	2 to 10 VDC

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (18) Full Schedules

DRAWING NAME:
Air Handling Unit Valve Schedules

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 18.3

Unit Heater/Cabinet Unit Heater Valve Schedules

Item	Coil Tag	Valve Tag	Medium	Qty	Valve Part Number	Valve Type	Trim	Body	Fail Action	Line Size	Valve Size	Connection	Flow (GPM)	Design Delta P	Valve Delta P	Design Cv	Valve Cv	Valve Closeoff	Actuator	Control Signal
1	UH-001	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.30	3.0 psig	2.6 psig	0.75	0.80	200 psi	TR24-SR-T	2 to 10 VDC
2	UH-002	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.30	3.0 psig	2.6 psig	0.75	0.80	200 psi	TR24-SR-T	2 to 10 VDC
3	UH-101	V-17	Hot Water	1	B212B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	3.60	3.0 psig	1.4 psig	2.08	3.00	200 psi	TR24-SR-T	2 to 10 VDC
4	UH-102	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	3.10	3.0 psig	2.7 psig	1.79	1.90	200 psi	TR24-SR-T	2 to 10 VDC
5	UH-103	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.10	3.0 psig	1.2 psig	1.21	1.90	200 psi	TR24-SR-T	2 to 10 VDC

Item	Coil Tag	Valve Tag	Medium	Qty	Valve Part Number	Valve Type	Trim	Body	Fail Action	Line Size	Valve Size	Connection	Flow (GPM)	Design Delta P	Valve Delta P	Design Cv	Valve Cv	Valve Closeoff	Actuator	Control Signal
1	CUH-101	V-8	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.40	3.0 psig	1.4 psig	0.81	1.20	200 psi	TR24-SR-T	2 to 10 VDC
2	CUH-102	V-10	Hot Water	1	B212B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	4.10	3.0 psig	1.86 psig	2.36	3.00	200 psi	TR24-SR-T	2 to 10 VDC
3	CUH-201	V-8	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.40	3.0 psig	1.4 psig	0.81	1.20	200 psi	TR24-SR-T	2 to 10 VDC
4	CUH-202	V-8	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.40	3.0 psig	1.4 psig	0.81	1.20	200 psi	TR24-SR-T	2 to 10 VDC
5	CUH-203	V-9	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.10	3.0 psig	1.2 psig	1.21	1.90	200 psi	TR24-SR-T	2 to 10 VDC
6	CUH-204	V-9	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.10	3.0 psig	1.2 psig	1.21	1.90	200 psi	TR24-SR-T	2 to 10 VDC

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (18) Full Schedules

DRAWING NAME:
Unit Heater/Cabinet Unit Heater Valve Schedules

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 18.4

Fin Tube Radiation Valve Schedule

Item	Coil Tag	Valve Tag	Medium	Qty	Valve Part Number	Valve Type	Trim	Body	Fail Action	Line Size	Valve Size	Connection	Flow (GPM)	Design Delta P	Valve Delta P	Design Cv	Valve Cv	Valve Closeoff	Actuator	Control Signal
1	FTR-201 FTR-202	V-11	Hot Water	1	B210B+NO/FO+TFRB24-SR	Characterized Ball	Brass	2-Way	Open	3/4"	1/2"	NPT Female	2.00	3.0	2.8	1.15	1.20	200 psi	TFRB24-SR	2 to 10 VDC
2	FTR-203 FTR-204 FTR-205	V-12	Hot Water	1	B211B+NO/FO+TFRB24-SR	Characterized Ball	Brass	2-Way	Open	3/4"	1/2"	NPT Female	3.00	3.0	2.5	1.73	1.90	200 psi	TFRB24-SR	2 to 10 VDC
3	FTR-206 FTR-207	V-11	Hot Water	1	B210B+NO/FO+TFRB24-SR	Characterized Ball	Brass	2-Way	Open	3/4"	1/2"	NPT Female	2.00	3.0	2.8	1.15	1.20	200 psi	TFRB24-SR	2 to 10 VDC
4	FTR-208 FTR-209 FTR-210	V-12	Hot Water	1	B211B+NO/FO+TFRB24-SR	Characterized Ball	Brass	2-Way	Open	3/4"	1/2"	NPT Female	3.00	3.0	2.5	1.73	1.90	200 psi	TFRB24-SR	2 to 10 VDC
5	FTR-211 FTR-212 FTR-213 FTR-214	V-13	Hot Water	1	B212B+NO/FO+TFRB24-SR	Characterized Ball	Brass	2-Way	Open	3/4"	1/2"	NPT Female	4.00	3.0	1.8	2.31	3.00	200 psi	TFRB24-SR	2 to 10 VDC
6	FTR-301A FTR-301B	V-8	Hot Water	1	B210B+NO+TR24-3-T US	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.40	3.0	1.4	0.81	1.20	200 psi	TR24-3-T US	Floating Point
7	FTR-302A FTR-302B FTR-302C FTR-302D FTR-302E FTR-302F FTR-302G	V-10	Hot Water	1	B212B+NO+TR24-3-T US	Characterized Ball	Brass	2-Way	Last Position	3/4"	3/4"	NPT Female	3.40	3.0	1.3	1.96	3.00	200 psi	TR24-3-T US	Floating Point
8	FTR-303A FTR-303B	V-8	Hot Water	1	B210B+NO+TR24-3-T US	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.50	3.0	1.6	0.87	1.20	200 psi	TR24-3-T US	Floating Point
9	FTR-304A FTR-304B FTR-304C FTR-304D FTR-304E FTR-304F FTR-304G	V-9	Hot Water	1	B211B+NO+TR24-3-T US	Characterized Ball	Brass	2-Way	Last Position	3/4"	3/4"	NPT Female	3.00	3.0	2.5	1.73	1.90	200 psi	TR24-3-T US	Floating Point
10	FTR-305A FTR-305B	V-8	Hot Water	1	B210B+NO+TR24-3-T US	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.50	3.0	1.6	0.87	1.20	200 psi	TR24-3-T US	Floating Point
11	FTR-306A FTR-306B FTR-306C FTR-306D FTR-306E FTR-306F FTR-306G	V-10	Hot Water	1	B212B+NO+TR24-3-T US	Characterized Ball	Brass	2-Way	Last Position	3/4"	3/4"	NPT Female	3.70	3.0	1.5	2.13	3.00	200 psi	TR24-3-T US	Floating Point
12	FTR-307A FTR-307B FTR-307C	V-7	Hot Water	1	B209+B+NO+TR24-3-T US	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.85	3.0	1	0.46	0.80	200 psi	TR24-3-T US	Floating Point

Supply Air Valve Schedule

Item	Coil Tag	Valve Tag	Medium	Qty	Valve Part Number	Valve Type	Trim	Body	Fail Action	Line Size	Valve Size	Connection	Flow (GPM)	Design Delta P	Valve Delta P	Design Cv	Valve Cv	Valve Closeoff	Actuator	Control Signal
1	SAV-1C1	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	3.21	3.0	2.8	1.85	1.90	200	TR24-SR-T	2 to 10 VDC
2	SAV-1C2	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.17	3.0	1.3	1.25	1.90	200	TR24-SR-T	2 to 10 VDC
3	SAV-1C3	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.71	3.0	2.0	0.98	1.20	200	TR24-SR-T	2 to 10 VDC
4	SAV-201	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.53	3.0	1.8	1.46	1.90	200	TR24-SR-T	2 to 10 VDC
5	SAV-202	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.0	0.6	0.35	0.80	200	TR24-SR-T	2 to 10 VDC
6	SAV-203	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.0	0.6	0.35	0.80	200	TR24-SR-T	2 to 10 VDC
7	SAV-204	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.29	3.0	1.5	1.32	1.90	200	TR24-SR-T	2 to 10 VDC
8	SAV-205	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.0	0.6	0.35	0.80	200	TR24-SR-T	2 to 10 VDC
9	SAV-206	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.51	3.0	1.7	1.45	1.90	200	TR24-SR-T	2 to 10 VDC
10	SAV-207	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.49	3.0	0.4	0.28	0.80	200	TR24-SR-T	2 to 10 VDC
11	SAV-208	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.59	3.0	1.8	0.91	1.20	200	TR24-SR-T	2 to 10 VDC
12	SAV-209	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.0	0.6	0.35	0.80	200	TR24-SR-T	2 to 10 VDC
13	SAV-210	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.15	3.0	2.1	0.66	0.80	200	TR24-SR-T	2 to 10 VDC
14	SAV-211	V-14	Hot Water	2	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.82	3.0	1.0	0.46	0.80	200	TR24-SR-T	2 to 10 VDC
15	SAV-212	V-17	Hot Water	1	B212B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	4.16	3.0	1.9	2.40	3.00	200	TR24-SR-T	2 to 10 VDC
16	SAV-301	V-17	Hot Water	1	B212B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	3.71	3.0	1.5	2.14	3.00	200	TR24-SR-T	2 to 10 VDC
17	SAV-302	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.86	3.0	1.2	0.49	0.80	200	TR24-SR-T	2 to 10 VDC
18	SAV-303	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	3.28	3.0	2.9	1.89	1.90	200	TR24-SR-T	2 to 10 VDC
19	SAV-304	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.63	3.0	1.8	0.94	1.20	200	TR24-SR-T	2 to 10 VDC
20	SAV-305	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.42	3.0	0.3	0.24	0.80	200	TR24-SR-T	2 to 10 VDC
21	SAV-306	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.06	3.0	2.9	1.18	1.20	200	TR24-SR-T	2 to 10 VDC
22	SAV-307	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.66	3.0	0.7	0.38	0.80	200	TR24-SR-T	2 to 10 VDC
23	SAV-308	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.69	3.0	0.7	0.39	0.80	200	TR24-SR-T	2 to 10 VDC
24	SAV-309	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.29	3.0	2.6	0.74	0.80	200	TR24-SR-T	2 to 10 VDC
25	SAV-401	V-17	Hot Water	1	B212B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	3.63	3.0	1.5	2.09	3.00	200	TR24-SR-T	2 to 10 VDC
26	SAV-402	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.00	3.0	1.6	0.57	0.80	200	TR24-SR-T	2 to 10 VDC
27	SAV-403	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	3.24	3.0	2.9	1.87	1.90	200	TR24-SR-T	2 to 10 VDC
28	SAV-404	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.59	3.0	1.8	0.91	1.20	200	TR24-SR-T	2 to 10 VDC
29	SAV-405	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.75	3.0	2.1	1.01	1.20	200	TR24-SR-T	2 to 10 VDC
30	SAV-406	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.45	3.0	0.3	0.25	0.80	200	TR24-SR-T	2 to 10 VDC
31	SAV-407	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.09	3.0	3.0	1.20	1.20	200	TR24-SR-T	2 to 10 VDC
32	SAV-408	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.0	0.6	0.35	0.80	200	TR24-SR-T	2 to 10 VDC

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (18) Full Schedules

DRAWING NAME: Supply Air Valve Schedule

CONTRACT NO: WU-01-16 | SE:JV | DE: PL | PR: RV

DRAWING NO.: 18.6

Variable Air Volume Valve Schedule

Item	Coil Tag	Valve Tag	Medium	Qty	Valve Part Number	Valve Type	Trim	Body	Fail Action	Line Size	Valve Size	Connection	New (GPM)	Design Delta P	Valve Delta P	Design Cv	Valve Cv	Valve Closeoff	Actuator	Control Signal
1	VAV-101	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.17	3.00	2.1	0.67	0.80	200 psi	TR24-SR-T	2 to 10 VDC
2	VAV-102	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.67	3.00	0.7	0.38	0.80	200 psi	TR24-SR-T	2 to 10 VDC
3	VAV-103	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.77	3.00	2.1	1.02	1.20	200 psi	TR24-SR-T	2 to 10 VDC
4	VAV-104	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.31	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC
5	VAV-105	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.31	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC
6	VAV-106	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.38	3.00	2.9	0.79	0.80	200 psi	TR24-SR-T	2 to 10 VDC
7	VAV-107	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.00	0.6	0.35	0.80	200 psi	TR24-SR-T	2 to 10 VDC
8	VAV-108	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.92	3.00	2.6	1.10	1.20	200 psi	TR24-SR-T	2 to 10 VDC
9	VAV-109	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.03	3.00	2.8	1.15	1.20	200 psi	TR24-SR-T	2 to 10 VDC
10	VAV-110	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.14	3.00	2.0	0.65	0.80	200 psi	TR24-SR-T	2 to 10 VDC
11	VAV-111	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.00	0.6	0.35	0.80	200 psi	TR24-SR-T	2 to 10 VDC
12	VAV-112	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.30	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC
13	VAV-113	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.19	3.00	2.2	0.69	0.80	200 psi	TR24-SR-T	2 to 10 VDC
14	VAV-114	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.99	3.00	2.8	1.15	1.20	200 psi	TR24-SR-T	2 to 10 VDC
15	VAV-115	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2. 21	3.00	1.4	1.27	1.90	200 psi	TR24-SR-T	2 to 10 VDC
16	VAV-116	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.64	3.00	0.7	0.36	0.80	200 psi	TR24-SR-T	2 to 10 VDC
17	VAV-117	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.35	3.00	2.8	0.77	0.80	200 psi	TR24-SR-T	2 to 10 VDC
18	VAV-118	V-17	Hot Water	1	B212B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	3.31	3.00	1.2	1.91	3.00	200 psi	TR24-SR-T	2 to 10 VDC
19	VAV-119	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.83	3.00	1 .0	0.46	0.80	200 psi	TR24-SR-T	2 to 10 VDC
20	VAV-120	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.00	0.6	0.35	0.80	200 psi	TR24-SR-T	2 to 10 VDC
21	VAV-121	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.00	0.6	0.35	0.80	200 psi	TR24-SR-T	2 to 10 VDC
22	VAV-122	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.00	0.6	0.35	0.80	200 psi	TR24-SR-T	2 to 10 VDC
23	VAV-123	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.07	3.00	2.9	1.18	1.20	200 psi	TR24-SR-T	2 to 10 VDC
24	VAV-124	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.07	3.00	2.9	1.18	1.20	200 psi	TR24-SR-T	2 to 10 VDC
25	VAV-201	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.74	3.00	0.7	0.40	0.80	200 psi	TR24-SR-T	2 to 10 VDC
26	VAV-202	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.18	3.00	2.2	0.68	0.80	200 psi	TR24-SR-T	2 to 10 VDC
27	VAV-203	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.51	3.00	0.4	0.29	0.80	200 psi	TR24-SR-T	2 to 10 VDC
28	VAV-204	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.71	3.00	0.7	0.40	0.80	200 psi	TR24-SR-T	2 to 10 VDC
29	VAV-205	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.14	3.00	2.0	0.65	0.80	200 psi	TR24-SR-T	2 to 10 VDC
30	VAV-206	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.10	3.00	2.0	0.63	0.80	200 psi	TR24-SR-T	2 to 10 VDC
31	VAV-207	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.81	3.00	1 .0	0.44	0.80	200 psi	TR24-SR-T	2 to 10 VDC
32	VAV-208	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.00	0.6	0.35	0.80	200 psi	TR24-SR-T	2 to 10 VDC
33	VAV-209	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.77	3.00	2.2	1.02	1.20	200 psi	TR24-SR-T	2 to 10 VDC
34	VAV-210	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.67	3.00	0.7	0.38	0.80	200 psi	TR24-SR-T	2 to 10 VDC
35	VAV-212	V-17	Hot Water	1	B212B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	3.55	3.00	1.4	2.04	3.00	200 psi	TR24-SR-T	2 to 10 VDC
36	VAV-213	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.30	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC
37	VAV-214	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.30	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC
38	VAV-215	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.30	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC
39	VAV-216	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.31	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC
40	VAV-217	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.22	3.00	2.3	0.70	0.80	200 psi	TR24-SR-T	2 to 10 VDC

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (18) Full Schedules

DRAWING NAME:
Variable Air Volume Valve Schedule

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 18.7

Variable Air Volume Valve Schedule

Item	Coil Tag	Valve Tag	Medium	Qty	Valve Part Number	Valve Type	Trim	Body	Fail Action	Line Size	Valve Size	Connection	New (GPM)	Design Delta P	Valve Delta P	Design Cv	Valve Cv	Valve Closeoff	Actuator	Control Signal
41	VAV-301	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.01	3.00	1.6	0.58	0.80	200 psi	TR24-SR-T	2 to 10 VDC
42	VAV-302	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.60	3.00	0.6	0.35	0.80	200 psi	TR24-SR-T	2 to 10 VDC
43	VAV-303	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.65	3.00	0.7	0.37	0.80	200 psi	TR24-SR-T	2 to 10 VDC
44	VAV-304	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.06	3.00	1.8	0.61	0.80	200 psi	TR24-SR-T	2 to 10 VDC
45	VAV-305	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.93	3.00	2.6	1.11	1.20	200 psi	TR24-SR-T	2 to 10 VDC
46	VAV-306	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.02	3.00	2.8	1.16	1.20	200 psi	TR24-SR-T	2 to 10 VDC
47	VAV-307	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.99	3.00	2.8	1.14	1.20	200 psi	TR24-SR-T	2 to 10 VDC
48	VAV-308	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.48	3.00	1.5	0.85	1.20	200 psi	TR24-SR-T	2 to 10 VDC
49	VAV-309	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.12	3.00	1.9	0.64	0.80	200 psi	TR24-SR-T	2 to 10 VDC
50	VAV-310	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.74	3.00	2.1	1.00	1.20	200 psi	TR24-SR-T	2 to 10 VDC
51	VAV-311	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.66	3.00	1.9	0.95	1.20	200 psi	TR24-SR-T	2 to 10 VDC
52	VAV-312	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.51	3.00	1.6	0.87	1.20	200 psi	TR24-SR-T	2 to 10 VDC
53	VAV-313	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.98	3.00	1.5	0.56	0.80	200 psi	TR24-SR-T	2 to 10 VDC
54	VAV-314	V-15	Hot Water	1	B211B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2. 26	3.00	1.4	1.30	1.90	200 psi	TR24-SR-T	2 to 10 VDC
55	VAV-315	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.06	3.00	2.9	1.18	1.20	200 psi	TR24-SR-T	2 to 10 VDC
56	VAV-316	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.02	3.00	2.8	1.16	1.20	200 psi	TR24-SR-T	2 to 10 VDC
57	VAV-317	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.42	3.00	1.4	0.82	1.20	200 psi	TR24-SR-T	2 to 10 VDC
58	VAV-318	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.65	3.00	0.7	0.37	0.80	200 psi	TR24-SR-T	2 to 10 VDC
59	VAV-319	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.43	3.00	0.3	0.24	0.80	200 psi	TR24-SR-T	2 to 10 VDC
60	VAV-320	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.92	3.00	1.3	0.53	0.80	200 psi	TR24-SR-T	2 to 10 VDC
61	VAV-321	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.04	3.00	1.7	0.60	0.80	200 psi	TR24-SR-T	2 to 10 VDC
62	VAV-322	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.30	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC
63	VAV-411	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.84	3.00	1.1	0.50	0.80	200 psi	TR24-SR-T	2 to 10 VDC
64	VAV-401	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.71	3.00	0.7	0.40	0.80	200 psi	TR24-SR-T	2 to 10 VDC
65	VAV-402	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.95	3.00	2.7	1.14	1.20	200 psi	TR24-SR-T	2 to 10 VDC
66	VAV-403	V-14	Hot Water	1	B210B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	2.06	3.00	2.9	1.18	1.20	200 psi	TR24-SR-T	2 to 10 VDC
67	VAV-404	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.39	3.00	2.9	0.79	0.80	200 psi	TR24-SR-T	2 to 10 VDC
68	VAV-405	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.02	3.00	1.7	0.59	0.80	200 psi	TR24-SR-T	2 to 10 VDC
69	VAV-406	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.91	3.00	1.3	0.52	0.80	200 psi	TR24-SR-T	2 to 10 VDC
70	VAV-407	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.83	3.00	1.1	0.48	0.80	200 psi	TR24-SR-T	2 to 10 VDC
71	VAV-408	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.61	3.00	0.6	0.35	0.80	200 psi	TR24-SR-T	2 to 10 VDC
72	VAV-409	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.17	3.00	2.1	0.67	0.80	200 psi	TR24-SR-T	2 to 10 VDC
73	VAV-410	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.94	3.00	1.4	0.54	0.80	200 psi	TR24-SR-T	2 to 10 VDC
74	VAV-412	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.70	3.00	0.8	0.40	0.80	200 psi	TR24-SR-T	2 to 10 VDC
75	VAV-413	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.05	3.00	1.7	0.60	0.80	200 psi	TR24-SR-T	2 to 10 VDC
76	VAV-414	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.78	3.00	1.0	0.45	0.80	200 psi	TR24-SR-T	2 to 10 VDC
77	VAV-415	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	1.16	3.00	2.1	0.67	0.80	200 psi	TR24-SR-T	2 to 10 VDC
78	VAV-416	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.30	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC
79	VAV-417	V-16	Hot Water	1	B209B+NO+TR24-SR-T	Characterized Ball	Brass	2-Way	Last Position	3/4"	1/2"	NPT Female	0.30	3.00	0.2	0.17	0.80	200 psi	TR24-SR-T	2 to 10 VDC

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (18) Full Schedules

DRAWING NAME: Variable Air Volume Valve Schedule

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

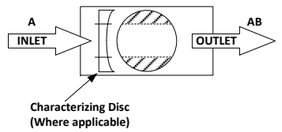
DRAWING NO.: 18.8

Belimo Characterized Control Valve Installation Details

B2 (B) Series Characterized Control Valves

Flow Pattern

Two-way Characterized Control Valves



*Two-way valves should be installed with disc upstream.

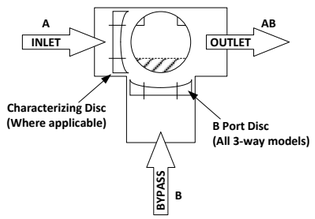
If installed with disc downstream, Cv will be 5% reduced and flow curve will be deeper. If installed "backwards" it is NOT necessary to remove and change. No damage or control problems will occur.

B3 (B) Series Characterized Control Valves

Flow Pattern

Three-way Characterized Control Valves

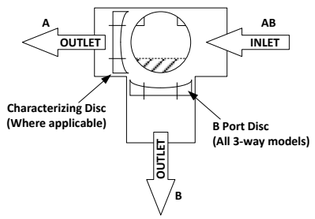
Three-way Mixing



*The A-port must be piped to the coil to maintain proper control.

*The B-port yields 70% of the A-port flow.

Three-way Diverting



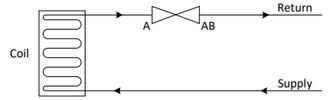
*The B-port should be piped as the bypass port.

B2 (B) Series & B3 (B) Series Characterized Control Valves

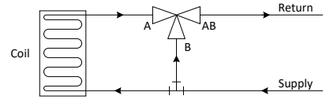
Operation/Installation

Correct Piping: Two-way valves should be installed with disc upstream. If installed with disc downstream, Cv will be 5% reduced and flow curve will be deeper. If installed "backwards" it is NOT necessary to remove and change. No damage or control problems will occur.

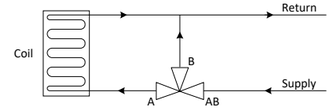
Two-way Valve Piping Diagram
(1 Input, 1 Output)



Three-way Mixing Valve Piping Diagram
(2 Inputs, 1 Output)



Three-way Diverting Valve Piping Diagram
(1 Input, 2 Outputs)



Three-way valves must be piped correctly. They can be mixing or diverting. Mixing is the Preferred piping arrangment.

The A-port must be piped to the coil to maintain proper control. The B-port restricts flow by 30% of A-port value.

The BELIMO Characterized Control Valve is a CONTROL valve, not a manual valve adapted for actuation. The control port is the A-port. It is similar to the globe valve in that the middle port is the B or bypass port. The common port is the AB-port. These diagrams are for typical applications only. Consult engineering specification and drawings for particular circumstances.

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (18) Full Schedules

DRAWING NAME:
Belimo Characterized Control Valve Installation Details

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 18.9

Master Material List

Manufacturer	Part Number	Product Description	Quantity
ALPS	YM9050	10"x15" (small) Control Panel With Lexan Door	20
Automated Logic	AAR	ARCNET to ARCNET Router	4
Automated Logic	BT485	ARCNET156 Terminating and Biasing plug in board	10
Automated Logic	EQ-PRTL	Single Equipment Gateway, 100 3rd Party Points	2
Automated Logic	LGR25	BACnet Router, 25 Point Gateway	1
Automated Logic	ME812U	Control Module, 8UO, 12UI, Supports 5 expanders	1
Automated Logic	MEX48U	Point Expander, 4UO, 8UI	1
Automated Logic	MEX816U	Point Expander, 8UO, 16UI	2
Automated Logic	SE6104a	Control Module, 6DO, 10UI, 4AO	4
Automated Logic	SE6166	Control Module, 6DO, 16UI, 6AO	5
Automated Logic	ZN141V+	Zone Controller for VAV w/ Actuator, 1DO, 4UI, 1AO	72
Automated Logic	ZN220	Zone Controller, 2DO, 2UI	5
Automated Logic	ZN253	Zone Controller, 2DO, 5UI, 3AO	1
Automated Logic	ZN341V+	Zone Controller for VAV w/ Actuator, 3DO, 4UI, 1AO	7
Automated Logic	ZN551	Zone Controller, 5DO, 5UI, 1AO	11
Automated Logic	ZS-ALC	ZS Std Space Temp Sensor, Rnet	3
Automated Logic	ZSPL-ALC	ZS Plus Space Temp Sensor, Rnet, SP Adj, Ovrd	72
Automated Logic	ZSPL-C-ALC	ZS Plus Space Temp Sensor w/CO2, Rnet, SP Adj, Ovrd	7
BAPI	ALC/10K-2-A-24'-BB4	Continuous Averaging, 24' Length, BAPI Box 4 IP44	2
BAPI	ALC/10K-2-D-4"-NB-10'	Duct, 4" Insertion, w/10' Leads, No J-Box	79
BAPI	ALC/10K-2-D-8"-BB4	Duct, 8" Insertion, BAPI Box 4 IP44	7
BAPI	ALC/10K-2-H200-D-BB2	Humidity, Duct, 2% w/Temperature Sensor, BAPI BOX 2 NEMA 4X	1
BAPI	ALC/10K-2-I-4"-BB4 + BA/4" M304	Immersion 4" Insertion, BAPI Box 4 IP44, w/304 Stainless Thermowell	7
BAPI	ALC/10K-2-O-BB2	Outside Air in BAPI BOX 2, 1/2 Size BB NEMA 4X	5
BAPI	ALC/10K-2-R-Z-CG	Room Temp Delta Style	16
BAPI	ALC/ZPS-ACC07	Zone Pressure Pickup Port, 6" Static Pressure Probe Assembly	23
BAPI	ALC/ZPS-ACC20	Low Profile Pressure Pickup Point	1
BAPI	ZPT-20-SR73-BB-ST-D	Standard Range Pressure Sensor, 0-2"w.c., Bapi Box, Remote Static Probe w/ Display	7
BAPI	ZPT-20-SR75-BB-AT-D	Standard Range Pressure Sensor, 0-5"w.c., Bapi Box, Attached Static Probe w/ Display	6
BAPI	ZPT-20-SR75-BB-NT-D	Standard Range Pressure Sensor, 0-5"w.c., Bapi Box, w/ Display	1
Belimo	AFB24-S	Dmpr. Act. 180 in-lbs, Spring Return, On/Off, 24 VAC, 2 Aux Switch	4
Belimo	B209B+NO+TR24-3-T US	CCV,0.5",2 Way,0.8 Cv,w/ Non-Spring,24V,Floating	1
Belimo	B209B+NO+TR24-SR-T	CCV,0.5",2 Way,0.8 Cv,w/ Non-Spring,24V,Modulating	73
Belimo	B210B+NO/FO+TFRB24-SR	CCV,0.5",2 Way,1.2 Cv,w/ Spring Return,24V,Modulating	2
Belimo	B210B+NO+TR24-3-T US	CCV,0.5",2 Way,1.2 Cv,w/ Non-Spring,24V,Floating	3
Belimo	B210B+NO+TR24-SR-T	CCV,0.5",2 Way,1.2 Cv,w/ Non-Spring,24V,Modulating	29
Belimo	B211B+NO/FO+TFRB24-SR	CCV,0.5",2 Way,1.9 Cv,w/ Spring Return,24V,Modulating	2
Belimo	B211B+NO+TR24-3-T US	CCV,0.5",2 Way,1.9 Cv,w/ Non-Spring,24V,Floating	1
Belimo	B211B+NO+TR24-SR-T	CCV,0.5",2 Way,1.9 Cv,w/ Non-Spring,24V,Modulating	13
Belimo	B212B+NO/FO+TFRB24-SR	CCV,0.5",2 Way,3 Cv,w/ Spring Return,24V,Modulating	1
Belimo	B212B+NO+TR24-3-T US	CCV,0.5",2 Way,3 Cv,w/ Non-Spring,24V,Floating	2
Belimo	B212B+NO+TR24-SR-T	CCV,0.5",2 Way,3 Cv,w/ Non-Spring,24V,Modulating	7
Belimo	B238+NC+ARB24-3-S	CCV, 1 1/2", 2 Way, 19 CV, w/ Non-Spring, 24V, ON/OFF	1
Belimo	EFB24-S	Dmpr. Act. 270 in-lbs, Spring Return, On/Off, 24 VAC, 2 Aux Switch	2
Belimo	EFB24-SR	Dmpr. Act. 270 in-lbs, Spring Return, 2-10 V, 24 VAC,	2
Belimo	F6150HD+NO+SY3-120	BFV, 6", 2 Way, CV90=1579 CV60=605, Non-Spring, 120V, ON/OFF	2
Belimo	G220+LF24-SR US	Globe Valve,0.75",2 Way,7.5 Cv,w/ Spring Return,24V,Modulating	2
Belimo	G232+NC+SVB24-SR	Globe Valve,1.25",2 Way,20 Cv,w/ Non-Spring,24V,Modulating	2
Belimo	G250+NO/FO+AFB24-SR-X1	Globe Valve,2",2 Way,40 Cv,w/ Spring Return,24 -240V,Modulating	2
Belimo	G340+NC+SVB24-SR	Globe Valve,1.5",3 Way,28 Cv,w/ Non-Spring,24V,Modulating	1
Belimo	G6100C+NC+EVB24-SR	Globe Valve,4",2 Way,170 Cv,w/ Non-Spring,24V,Modulating	2
Belimo	G765+AFX24-MFT-X1 P-10001	Globe Valve,2.5",3 Way,68 Cv,w/ Spring Return,24V,MFT	2
Belimo	LF24-S US	Dmpr. Act. 35 in-lbs, Spring Return, On/Off, 24 VAC, 1 Aux Switch	2
Belimo	NFB24-S	Dmpr. Act. 90 in-lbs, Spring Return, On/Off, 24 VAC, 2 Aux Switch	2
Belimo	NFB24-SR	Dmpr. Act. 90 in-lbs, Spring Return, 2-10 V, 24 VAC,	4
Belimo	NMB24-3	Dmpr. Act. 90 in-lbs, Non-Spring Return, Floating, 24 VAC,	1
Cleveland	AFS-460-112	Differential Pressure Switch, 0-12 in. WC, SPST, Man. Reset (NC), 1/4" Barbed Fittings	8
Core Lectro	LE11300	24V Transformer, 40VA	19
Core Lectro	LE12100	24V Transformer, 96VA	12
Ebtron	GTC116P+36 x 20-1-2-10	Air Flow Station	1
Ebtron	GTC116P+48 x 20-1-2-10	Air Flow Station	1
Ebtron	GTC116P+56 x 26-1-2-10	Air Flow Station	1
Ebtron	GTC116P+69x60-1-2-15	Air Flow Station	2
Ebtron	GTC116P+70 x 20-1-2-10	Air Flow Station	1
Functional Devices	PSB100AB10	Panel Mount AC Power Supply, 100VA, 120 VAC - 24 VAC @ 10A, 120 VAC Outlet	9
Functional Devices	PSH500A	Enclosed 500VA Pwr Supply, 5x100VA Circuits	4
Functional Devices	RIB2401B	Enclosed Relay 20 Amp SPDT with 24 Vac/DC/208-277 Vac Coil	16
Functional Devices	RIBMNLB-4NO	Relay Logic Board - 4 Alarm Points	2
Functional Devices	RIBMNLB-6NO	Relay Logic Board - 6 Alarm Points	2
Functional Devices	RIBXGTA	Current Switch, Split Core, Adj. Setpoint to 0.5A	22
Idec	RH2B-UAC110-120V+SH2B-05	Power Relay | Compact | Blade | DPDT | 10A | 120 VAC	2
Idec	RH2B-ULAC24V+SH2B-05	Control Relay,DPDT,24VAC,LED,w/ Socket	25
Idec	RH2B-ULDC24V+SH2B-05	Control Relay,DPDT,24VDC,LED,w/ Socket	12
Onicon	F-1210	Insertion Flow Meter, Analog Output	1
Saginaw	SCE-18N1606NKT	16" x 18" (Small) Control Panel	1
Saginaw	SCE-24N2006NKT	20" x 24" (Medium) Control Panel	4
Saginaw	SCE-36N2406NKT	24" x 36" (Large) Control Panel	4
Siemens	134-1511+BA/FPB	Low-Limit Temp Sw,SPDT,Man Rst,35-45F,20' w/ (8) Flexible Probe Brackets	4
Veris	H300	Current Switch, Split Core, Fixed Setpoint 0.15A, Micro	19
Veris	PG07AM	Gauge Press Sensor, 0-100psig, 4-20mA	1
Veris	PW2XX04S	Differential Pressure Sensor (wet), 0-100 PSIG, 0-100 PSID	4

Automatic Controls equipment systems, inc.

Webster University ISB - HVAC Controls
470 E. Lockwood Ave.
Webster Groves, MO 63119

FILENAME: (18) Full Schedules

DRAWING NAME: Master Material List

CONTRACT NO: WU-01-16	SE:JV	DE: PL	PR: RV

DRAWING NO.: 18.10

WM TAO & ASSOCIATES
CONSULTING ENGINEERS

Shop Drawing Submittal Review

Transmitted To: Cannon Design

Date: February 13, 2017

Attention: **stl-cac@cannondesign.com**

Contact Person / WTA Field Inspector: Patrick Garner

Project Name: Webster University-**ISB**

Reviewed by: Mike Nolte

Project No. WT 14127.01

[ ] UPS [ ] Courier [X] **Email**

Copies	No.	Description
1 PDF	239500M03A	(Submittal No.'s:) ~~(R&B CxSRC~~) - Resubmittal
		(Cannon #239500-009) - (Paric #15051-0456) – ~~(WES #607)~~
		➢ **Controls & Instrumentation Product Data REV1**
		(For Record)

*Remarks: Please see PAGE 2 for remarks.

c: **Kelvin Patel**
Kpatel@cannondesign.com

[ ] Furnish as Submitted
[ ] Furnish as Noted
[ ] Rejected
[X] ***Revise & Resubmit**
[ ] Reviewed
See Comments
[ ]

Corrections or comments made on shop drawings during this review do not relieve contractor from compliance with requirements of drawings and specifications. This check is only for review of general conformance with the design concept of project and general compliance with information given in contract documents. Contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

WM TAO & ASSOCIATES
CONSULTING ENGINEERS

Shop Drawing Submittal Review

*Submittal Review Comments

1. This submittal does not reflect the latest drawing revisions. As previously noted: "6. Variable Air Volume Valve Schedules, Drawing No.'s 18.6, 18.7, and 18.8: Tao will issue an ASI/ESI to eliminate the back-pressure valves in the heating water system and change 2-way control valves to 3-way valves at VAV-101, VAV-114, VAV-201, SAV-212, VAV-301, VAV-311, VAV-401, and VAV-409." Submittal is missing information for 3-way control valves. Refer to ESI-017 (ASI-043) for revised control valve information and provide 3-way control valves as indicated.
2. Coordinate control valve selections with final shop drawing selections for Air Terminal Units and Supply Air Valves (SAV) data along with the requirements of the scheduled flows.

14127.01 - 239500 M03A
RESUBMITTAL -
MTN TO REVIEW
01/20/17

WTASHOP - Webster ISB - 23 9500-009

From: STL-CAC <STL-CAC@CANNONDESIGN.COM>
To: 'Patrick Garner' <pgarner@wmtao.com>, "WTASHOP (WTASHOP@wmtao.com)" <WTA...
Date: 1/20/2017 5:02 PM
Subject: Webster ISB - 23 9500-009
Cc: "Patel, Kelvin" <kpatel@CANNONDESIGN.COM>
Attachments: 239500-009 Controls and Instrumentation Product Data FORRECORD.pdf

Attached for review.

Melissa Pirtle

CANNONDESIGN

1100 Clark Ave
St. Louis, Missouri 63102
T 314.425.8797
cannondesign.com

CANNONDESIGN

SUBMITTAL IDENTIFICATION SHEET

To be completed by Contractor/CM

WEBSTER UNIVERSITY ISB
PROJECT NAME

8274 BIG BEND BLVD
ADDRESS

NUMBER

WEBSTER UNIVERSITY
OWNER

CANNON DESIGN
ARCHITECT / ENGINEER

Joe Voypick
SUBMITTED BY

239500-009
CONTRACTOR / CM SUBMITTAL NO.

CANNON DESIGN SUBMITTAL NO.

DRAWING / DETAIL REFERENCE

239500
SPECIFICATION SECTION / PARAGRAPH

icon Mech
MANUFACTURER / SUPPLIER

ITEM / PRODUCT ID

REQUIRED DATE

PRIORITY

◯ CRITICAL

ITEM BEING SUBMITTED (check only one)

- ◯ Shop Drawings
- ◯ Samples (_____ copies)
- ◯ LEED Submittal
- ◯ Certification / Qualifications
- ◯ Record Documents
- ◉ Product Data
- ◯ Coordination Drawing
- ◯ Calculations
- ◯ Schedules
- ◯ O&M Manuals
- ◯ Other _____

ITEM BEING SUBMITTED FOR (check only one)

◉ Action ◯ Information Only ◯ Record

REMARKS OR DEVIATIONS

For Record

CONTRACTOR / CM CERTIFICATION
(SUBMITTALS NOT CERTIFIED WILL BE RETURNED WITHOUT REVIEW)

PARIC

PARIC CORPORATION
SUBMITTAL STAMP

THIS SHOP DRAWING HAS BEEN REVIEWED BY PARIC CORPORATION

Subcontractor remains responsible for dimensions, quantities, coordination with other trades and compliance with contract documents.

By:
Devin D. Gates

Joe Voypick
REVIEWED BY

1/20/17
DATE

To be completed by Reviewer

23 9500-009
CANNON DESIGN SUBMITTAL NUMBER

1/20/17
RECEIVED DATE

- ◯ A. No Exceptions Taken
  No further review of submittal is required.
- ◯ B. Make Corrections Noted
  Incorporate corrections in work; resubmission is not required.
- ◯ C. Revise and Resubmit
  Revise as noted, and resubmit for review.
- ◯ D. Rejected
  Submittal is not in compliance with Contract Documents; provide new submittal.
- ◯ E. For Record / Information Only
  Submittal was reviewed for Record / Information purposes only.
- ◯ F. Not Required for Review
  Submittal is not required by Contract Documents and has not been reviewed.

Review is for conformance with the design concept of this project and for general compliance with contract documents. Contractor is responsible for quantities, dimensions and compliance with contract documents and for information that pertains to fabrication processes, construction techniques and coordination of this work with all trades which will be affected thereby. This review is null and void if submittal deviates from contract documents and does not indicate or note deviations.

A/E COMMENTS ◯ See attached sheet(s) for additional comments

REVIEWED BY

DATE

77 Westport Plaza
Suite 250
St. Louis, MO 63146

TRANSMITTAL

No. 15051-0456

Paric Corporation

PROJECT: 15051-Webster University Interdisciplinary Science Building

DATE: 01/20/2017

TO: Cannon Design
1100 Clark Ave
St Louis MO 63102

Fax;
314-241-2203

RE: Controls and Instrumentation Product Data REV1

ATTN: Kelvin Patel

JOB: 15051

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
☐ Shop Drawings	☐ Approval	☐ Approved as Submitted
☐ Letter	☐ Your Use	☐ Approved as Noted
☐ Prints	☐ As Requested	☐ Returned After Loan
☐ Change Order	☐ Review and Comment	☐ Resubmit
☐ Plans		☐ Submit
☐ Samples	**SENT VIA:**	☐ Returned
☐ Specifications	☐ Attached	☐ Returned for Corrections
☐ Other:	☐ Separate Cover Via:	☐ Due Date:

Item	*Package*	*Code*	*Rev.*	*Copies*	*Date*	*Description*	*Status*
Submittal		239500-009	2		01/20/2017	Controls and Instrumentation Product Data REV1	Submitted

NOTES:

CC:

Signed: _____

Devin Gates

Mechanical

LETTER OF TRANSMITTAL

TO: Paric Corporation
77 West Port Plaza #250
St. Louis, MO 63146

ATTN: Jason Szachnieski, Devin Gates

DATE: 1/13/19
JOB # : 5768
RE: Webster ISB

We are sending you
( ) Attached ( ) Under separate cover
(X) Shop drawings ( ) Prints ( ) Plans ( ) Samples ( ) Specifications
( ) Copy of letter ( ) Change order ( ) Other

COPIES	DATE	NO.	DESCRIPTION
1	1/13/17	239500	Controls and Instrumentation FOR RECORD

These are transmitted as checked below:

( ) For signature ( ) Approved as submitted (X) Resubmit ( ) copies for approval
( ) For your use ( ) Approved as noted ( ) Submit ( ) copies for distribution
( ) As requested ( ) Returned for corrections ( ) Return ( ) corrected prints
( ) For bids due ( ) Prints returned after loan to us
(X) For review and comment ( ) Other

Remarks: FOR RECORD SUBMITTAL with comments attached.

COPY TO: file

SIGNED: Alex Chambers

Webster University ISB
Webster Groves, MO

Submittal #: 235900

Submittal Description: Controls & Instrumentation For Record

Return By:

Please Note: To avoid scheduling delays and equipment release delays, please submit by the "Return By" date.

CHECKED BY:

DESIGNER: ENGINEER:

X	NO EXCEPTION TAKEN		MAKE CORRECTIONS NOTED
	SUBMIT SPECIFIED ITEM		REVISE AND RESUBMIT
	REJECTED		

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Equipment supplier is responsible for: dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and satisfactory performance of his work.

icon Mechanical

Job #:	5768
Date:	1/13/17
By:	ARC

WM TAO & ASSOCIATES
CONSULTING ENGINEERS

Shop Drawing Submittal Review

Transmitted To: Cannon Design

Date: December 15, 2016

Attention: **stl-cac@cannondesign.com**

Contact Person / WTA Field Inspector: Patrick Garner

Project Name: Webster University-**ISB**

Reviewed by: Mark Schaefer

Project No. WT 14127.01 ☐ UPS ☐ Courier ☒ **Email**

Copies	No.	Description
1 PDF	239500M03	(Submittal No.'s) (R&B CxSRC-027)
		(Cannon #239500-009) - (Paric #15051-0316) – ~~(WES #607)~~
		➢ **Controls & Instrumentation Product Data & Drawings (ACES)**

*Remarks: Please see PAGE 2 for remarks.

c: **Kelvin Patel**
Kpatel@cannondesign.com

☐ Furnish as Submitted ☒ ***Furnish as Noted**

☐ Rejected ☐ Revise & Resubmit

☐ Reviewed ☐

Corrections or comments made on shop drawings during this review do not relieve contractor from compliance with requirements of drawings and specifications. This check is only for review of general conformance with the design concept of project and general compliance with information given in contract documents. Contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

WM TAO & ASSOCIATES
CONSULTING ENGINEERS

Shop Drawing Submittal Review

Submittal Review Comments

1. These comments shall supplement the commissioning agent's comments and comments discussed in the Controls Sequence review Meeting notes dated 11/28/2016.
2. AHU-5, Drawing No. 9.3: Freeze pump sequence of operations not required for this unit. No pump exists because this is no outside air to system.
3. Hot Water System: ACES to include isolation control valves at each boiler as shown on piping diagram. Valve shall open when boiler is staged on and close if off.
4. Hot Water System: Change outside air reset temperatures from 140ºF down to 80ºF to 140ºF down to 100ºF (adjustable).
5. Chilled Water System: Move location of main supply and return water sensors to the EAB near the flow meter. Provide calculations for chilled water load based on flow and delta temperature.
6. Variable Air Volume Valve Schedules, Drawing No.'s 18.6, 18.7, and 18.8: Tao will issue an ASI/ESI to eliminate the back-pressure valves in the heating water system and change 2-way control valves to 3-way valves at VAV-101, VAV-114, VAV-201, SAV-212, VAV-301, VAV-311, VAV-401, and VAV-409.

Ross&Baruzzini
6 South Old Orchard I St. Louis, MO 63119
P: 314.918.8383

14127.01 - 239500 M03
MWS TO REVIEW
11/10/16

SUBMITTAL REVIEW COMMENTS

Project:	Webster University – Interdisciplinary Sciences Building
Project No:	1136-16
Date:	12/7/2016
Description:	Temperature Controls and Instrumentation
Spec. Submittal	239500-009
Plan IDs	N/A
Review #:	CxSRC-027
BY:	Kevin McCormick, Ryan Walsh

The submittal has been reviewed for general conformance to the OPR and the construction documents.

Contractor / Design Team / Owner & Operator

1. See attached R&B submittal review comments along with responses from the control sequence review meeting (11/28/2016).
2. Contractor to provide proposed start-up checklists for CxA review. Startup checklists can be OEM forms, templates used by the contractor, or copies of checklists used on other similar projects.

Webster ISB - Temperature controls review comments and responses

Page	Comments	Response - Control Sequence Review Meeting 11/28/2016
General Comments		
1	Fill in the project team member information.	ACES noted this has been complete.
1.1	For the Primary ARCnet network riser how does the network incorporate the phoenix system? Will the Phoenix system be able to be controlled by ACES or are they two separate controls?	ACES noted that Phoenix system has its own server router, ICON supplying everything for Phoenix parts and pieces. ACES will be able to use BACnet to communicate and control points on the Phoenix system.
Chilled Water System		
3.1	Are these alarms not going to be shown on the equipment graphic? Where does it show up?	ACES noted that Visual alarms on graphics will be provided. Same as other campus buildings.
3.1	Chilled water supply and return temperature shown on the diagram but are not included in the sequence of operations. Are these for monitoring purposes only? No alarms?	ACES noted that these are for monitoring purposes only.
3.1	Chilled water flow meter is not referenced in the sequence of operations.	The chilled water flow meter will be used to calculate load. It was agreed by the team that the chilled water sensors shown downstream of CP-1/2 should be moved upsteam of CP-1/2 and piping serving AHU-5.
3.1	Is the AHU-5 chilled water coil included in the "definable number of chilled water coils that need cooling"	ACES noted that the air handler will send a "request" for cooling which will enable the pumps. We discussed using the differential pressure of the loop as reference before starting the pumps, to potentially allow the building to run off EAB loop pressure at low flow rates.
3.3	"AFC Fault" - Is AFC how Webster refers to frequency drives on campus? If not make sure all monitor points, labels and names match to campus standards.	ACES will make sure naming of equipment matches the rest of the campus
3.3	For the chilled water differential pressure, the controls indicate a fixed DP set point for the pumps. R&B recommends using a reset strategy based on demand.	It was agreed by the team to add DP reset, based on polling of valve positions. ACES notes this can be provided at no added cost.
Process Chilled Water Loop		
4.1	Process loop on source side has 2 pumps in series and no isolation valve. When the pumps are off there will still be flow thru the pumps creating a short circuit at no load.	It was agreed by the team that an isolation valve needs to be added to the source side, downstream of the HX. WTA to issue revision.
4.1	Points list doesn't completely match WTA specification, missing points.	ACES to review and correct.
4.1	Make-Up water pressure shown on the process chilled water loop diagram is not referenced in the sequence of operations. Confirm for monitoring purposes only.	ACES to add to points table and clarify intent on sequence.
4.3	Missing chw temperature alarm?	ACES to add high limit alarm, coordinate with Owner/WTA.
4.3	"The process water pumps will be enabled through a user's defined schedule" - Owner to provide what this schedule is. How critical is the equipment that the pumps serve? Are there any backups or provisions if the pumps are to fail or chilled water from the loop is not maintaining the correct temperature.	Per our discussion the process loop will be manual enabled at which time the CP and PCP pumps (4 total) will be enabled. R&B recommends adding a temperature deadband (low/high setpoint) to increase temp control stability and reduce pump start/stop cycles.
Heating Water System		
5.1	How are the boilers staged and controlled? No isolation valves shown on boilers, limiting the ability to run only one boiler.	It was discussed that the boiler manufacturer's controller will coordinate boiler staging. The team agreed isolation valves will be needed at each boiler. ACES to coordinate with ICON on controller requirements. WTA to issue revision.
5.1	The "boiler low water level" is not shown on the boiler wiring diagram as an independent hardware point.	ACES to clarify how this is accomplished.
5.1	The heating water differential pressure reset uses 3 separate sensors. How will the sensors be utilized?	It was agreed that ACES will monitor all 3 differential pressure sensors and use the lowest reading for control. WTA requested that the DP not be reset since the boiler supply temperature already is reset.
5.4	The alarms list does not include high or low heating water loop supply temperature.	R&B recommends adding alarms.
5.4	Provide heating water supply temperature reset based on heating demand from initial setting of 140 deg. F. down to 80 deg. F.- Heating demand from the terminal units or reset based off of outside air temperature? Is 80 too low of a starting minimum?	WTA requested that OA reset be used instead of demand based on 140 LWT at 0 OAT & 90 LWT at 60 OAT.
Heat Recovery System		
6.3	No Comments	
Air Handling Unit (AHU-1 & AHU-2)		
7.2	AHU-1 has two filters shown on the diagram that are not referenced in the sequence of operation. Is the pressure measured across the filter alarmed for changing the filter? Or is there a schedule in place for when to change?	It was discussed that ACES can use both a run time count to change the filter and a DP alarm. Webster standard is runtime. R&B recommended monitoring actual filter pressure since Webster already has a time based filter replacement stategy.
7.8	"Coordinate damper speed with fan starting speed to prevent recirculation if one AHU is already operating" - Does this apply to both supply and return isolation dampers?	We discussed that the dampers will operate in parallel.
7.9	The sequence mentions enabling the heating valve is SAT air temperature drops from 40 deg. F. to 35 deg. F. (adj.). We believe this is a typo.	R&B recommends enabling valve when heating is enabled. ACES to correct.
7.8	How does the operator remove problem VAV zones that may be affecting fan static pressure reset?	ACES noted there is a parameter in the logic that can be removed but its not on the users BMS interface.

Air Handling Unit (AHU-3 & AHU-4)

8.3	Will the static pressure reset control create issued with phoenix valve operation and actuator timing?	WTA requested that the reset scheme be removed for this system, instead control to fixed static pressure.
8.4	The sequence mentions enabling the heating valve is SAT air temperature drops from 40 deg. F. to 35 deg. F. (adj.). We believe this is a typo.	R&B recommends enabling valve when heating is enabled. ACES to correct.
8.3	Filter shown on the diagram that are not referenced in the sequence of operation. Is the pressure measured across the filter alarmed for changing the filter? Or is there a schedule in place for when to change?	It was discussed that ACES can use both a run time count to change the filter and a DP alarm. Webster standard is runtime. R&B recommended monitoring actual filter pressure since Webster already has a time based filter replacement stategy.

Air Handling Unit (AHU-5)

9.1	Pumps are labeled as "freeze pumps", however this is not a freeze pump.	ACES to correct documents. Sequence should also note how the pump is enabled, based on a call for cooling.
9.3	Indicates that the supply fan will run anytime the unit is commanded to run, does not define what commands the unit	Unit was noted operate 24/7/365.

Soffit Finned Tube Radiation

10.3	Sequence for the FTR does not reference that it will fully close when it is within 2F of any associated VAV unit cooling set point in order to avoid simultaneous heating and cooling as indicated in the engineer's VAV sequence	ACES to correct.

Variable Air Volume Units

11.4	The sequence mentions a minimum un-occupied airflow. Where is this airflow setpoint defined?	ACES to coordinate with WTA on vav set-points and make all setpoints availible to Cx Agent in schedule format.
11.4	How long will units run in occupied mode when triggered by the occupancy sensor?	ACES to define delay in sequence.
11.4	Sequence does not mention the use of a limit on the discharge air temperature in order to prevent stratfication of the air while in heating mode.	R&B recommends a high limit of 95 deg if possble. Often this may require a dual max control scheme versus fixed min + reheat valve control. WTA to consider recommendation.

Exhaust Fans

14.4	There is a statement under "Run Conditions" that says fans will be off if un-occupied and chemicals are stored properly.	How is the ACES system doing to provide proper chemical storage? Our concern is this cannot be accomplished which will lead the fan to run 24/7. WTA to review and provide clarification of how this is to be accomplished.
14.4	Is there going to be a sensor that measures the wind speed?	ACES noted they will use a weather application. If internet is down then the system will default to maximum speed setpoint.
14.1	EF-4 is referenced on sheet 14.1 however is not listed in sequence 14.4.	ACES to review and correct.

Phoenix System

17.4	ROOM SCHEDULE SHEET (RSS) is referenced in the ACES drawings but cannot be found in the submittal	ACES to include in updated submittal.
17.14	Sequence mentions that hoods will have a motion sensor for standby levels of the 4 details that include fume hoods only one of them shows an occupancy sensor being tied to the fume hood.	ACES to clarify which fume hoods will have Occ sensors with the WTA and update drawings accordingly.
17.7	Celers 2 Lab Detail 4 includes point exhaust. Could not locate any point exhaust in the design drawings or schedule.	ACES to clarify and update if needed.
-	The design docs suggest that the fume hood valves can go to 0 flow based on the schedule. There is not reference to this in the Phoenix sequence.	WTA to clarify intent of operation.
-	WTA specs provide a list of read/write points that come with phoenix valves. Its not clear from the Phoenix submittal which points and/or alarms will be utilized on the ACES interface.	R&B believes this should be defined in the ACES docs since they will be responsible for integrating the Phoenix system. ACES to coordinate with WTA if needed to resolve this.

14127.01 - 239500 M03
MWS TO REVIEW
11/10/16

WTASHOP - Webster ISB - 23 9500-009

From: STL-CAC <STL-CAC@CANNONDESIGN.COM>
To: 'Patrick Garner' <pgarner@wmtao.com>, "WTASHOP (WTASHOP@wmtao.com)" <WTA...
Date: 11/10/2016 12:12 PM
Subject: Webster ISB - 23 9500-009
Cc: "Patel, Kelvin" <kpatel@CANNONDESIGN.COM>, "Grossman, Lynn" <lgrossman@C...
Attachments: 239500-009 Controls and Instrumentation Product Data.pdf

---

Attached for review.

Melissa Pirtle

CANNONDESIGN

1100 Clark Ave
St. Louis, Missouri 63102
T 314.425.8797
cannondesign.com

CANNONDESIGN

SUBMITTAL IDENTIFICATION SHEET

To be completed by Contractor/CM

WEBSTER UNIVERSITY ISB
PROJECT NAME

8274 BIG BEND BLVD
ADDRESS

NUMBER

WEBSTER UNIVERSITY
OWNER

CANNON DESIGN
ARCHITECT / ENGINEER

Joe Voypick
SUBMITTED BY

239500-009
CONTRACTOR / CM SUBMITTAL NO.

CANNON DESIGN SUBMITTAL NO.

DRAWING / DETAIL REFERENCE

239500
SPECIFICATION SECTION / PARAGRAPH

Icon Mechanical
MANUFACTURER / SUPPLIER

ITEM / PRODUCT ID

REQUIRED DATE

PRIORITY

☐ CRITICAL

ITEM BEING SUBMITTED (check only one)

- ○ Shop Drawings
- ○ Samples (_____ copies)
- ○ LEED Submittal
- ○ Certification / Qualifications
- ○ Record Documents
- ○ Product Data
- ○ Coordination Drawing
- ○ Calculations
- ○ Schedules
- ○ O&M Manuals
- ○ Other _____

ITEM BEING SUBMITTED FOR (check only one)

○ Action ○ Information Only ○ Record

REMARKS OR DEVIATIONS

For Record

CONTRACTOR / CM CERTIFICATION
(SUBMITTALS NOT CERTIFIED WILL BE RETURNED WITHOUT REVIEW)

PARIC

PARIC CORPORATION
SUBMITTAL STAMP

THIS SHOP DRAWING HAS BEEN REVIEWED BY PARIC CORPORATION

Subcontractor remains responsible for dimensions, quantities, coordination with other trades and compliance with contract documents.

By:
Devin D. Gates

Joe Voypick
REVIEWED BY

11/9/16
DATE

To be completed by Reviewer

23 9500-009
CANNON DESIGN SUBMITTAL NUMBER

11/10/16
RECEIVED DATE

- ○ A. No Exceptions Taken
  No further review of submittal is required.
- ○ B. Make Corrections Noted
  Incorporate corrections in work; resubmission is not required.
- ○ C. Revise and Resubmit
  Revise as noted, and resubmit for review.
- ○ D. Rejected
  Submittal is not in compliance with Contract Documents; provide new submittal.
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  Submittal was reviewed for Record / Information purposes only.
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A/E COMMENTS ○ See attached sheet(s) for additional comments

REVIEWED BY

DATE

77 Westport Plaza
Suite 250
St. Louis, MO 63146

TRANSMITTAL

No. 15051-0316

Paric Corporation

PROJECT: 15051-Webster University Interdisciplinary Science Building

DATE: 11/09/2016

TO: Cannon Design
1100 Clark Ave
St Louis MO 63102

RE: Controls and Instrumentation Product Data

ATTN: Kelvin Patel

JOB: 15051

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
☐ Shop Drawings	☑ Approval	☐ Approved as Submitted
☐ Letter	☐ Your Use	☐ Approved as Noted
☐ Prints	☐ As Requested	☐ Returned After Loan
☐ Change Order	☐ Review and Comment	☐ Resubmit
☐ Plans		☐ Submit
☐ Samples	**SENT VIA:**	☐ Returned
☐ Specifications	☐ Attached	☐ Returned for Corrections
☑ Other: Product Data	☐ Separate Cover Via:	☐ Due Date:

Item	*Package*	*Code*	*Rev.*	*Copies*	*Date*	*Description*	*Status*
Submittal		239500-009	1		11/09/2016	Controls and Instrumentation Product Data	Submitted

NOTES:

CC:

Signed: _____

Devin Gates

Mechanical

LETTER OF TRANSMITTAL

TO: Paric Corporation
77 West Port Plaza #250
St. Louis, MO 63146

ATTN: Jason Szachnieski, Devin Gates

DATE: 11/8/16
JOB # : 5768
RE: Webster ISB

We are sending you
( ) Attached ( ) Under separate cover
(X) Shop drawings ( ) Prints ( ) Plans ( ) Samples ( ) Specifications
( ) Copy of letter ( ) Change order ( ) Other

COPIES	DATE	NO.	DESCRIPTION
1	11/8/16	239500	Controls and Instrumentation

These are transmitted as checked below:

( ) For signature ( ) Approved as submitted ( ) Resubmit ( ) copies for approval
( ) For your use ( ) Approved as noted (X) Submit ( ) copies for distribution
( ) As requested ( ) Returned for corrections ( ) Return ( ) corrected prints
( ) For bids due ( ) Prints returned after loan to us
(X) For review and comment ( ) Other

Remarks: Please return by 11/23/16

COPY TO: file

SIGNED: Alex Chambers

Mechanical

Webster University ISB
Webster Groves, MO

Submittal #:	239500
Submittal Description:	Controls and Instrumentation
Return By:	11/23/16

Please Note: To avoid scheduling delays and equipment release delays, please submit by the "Return By" date.

CHECKED BY:

DESIGNER: ENGINEER:

X	NO EXCEPTION TAKEN		MAKE CORRECTIONS NOTED
	SUBMIT SPECIFIED ITEM		REVISE AND RESUBMIT
	REJECTED		

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Equipment supplier is responsible for: dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and satisfactory performance of his work.

Mechanical

Job #:	5768
Date:	11/8/16
By:	ARC

Submittal Review Comments and Responses
Project: Webster University Interdisciplinary Science Building

General Comments

1. Fill in project team member information.

Response: Team information has been added to the project documents.

1.1 For the Primary ARCnet network riser how does the network incorporate the phoenix system? Will the Phoenix system be able to be controlled by ACES or are they two separate controls?

Response: The phoenix system is provided with its own router that will be tied into the existing building automation system via BACnet/IP. This will allow for WebCTRL to view and control the system.

Chilled Water System

3.1 Are these alarms not going to be shown on the equipment graphic? Where does it show up?

Response: The alarms will be shown on the equipment graphics in WebCTRL.

3.1 Chilled water supply and return temperature shown on the diagram but are not included in the sequence of operations. Are these for monitoring purposes only? No alarms?

Response: The supply and return sensors are for monitoring purposes and have been added to the sequence to reflect that.

3.1 Chilled water flow meter is not referenced in the sequence of operations.

Response: Chilled water flow meter will be monitored and will be used to calculate load. It has been added to the sequence to reflect that.

3.1 Is the AHU-5 chilled water coil included in the "definable number of chilled water coils that need cooling"

Response: The air handler will send a request for cooling but we will also look at the differential pressure of the loop before starting the pumps. The EAB pumps should be able to handle low load conditions and we will not have to rely on ISB building pumps. The sequence has been updated to reflect that.

3.2 "AFC Fault" - Is AFC how Webster refers to frequency drives on campus? If not make sure all monitor points, labels and names match to campus standards.

Response: AFC has been updated to VFD to match the current labels on campus.

3.3 For the chilled water differential pressure, the controls indicate a fixed DP set point for the pumps. R&B recommends using a reset strategy based on demand.

Response: Chilled water differential pressure control sequence has been updated so that we are resetting the setpoints based off of valve position to match the rest of the campus.

Process Chilled Water Loop

4.1 Process loop on source side has 2 pumps in series and no isolation valve. When the pumps are off there will still be flow thru the pumps creating a short circuit at no load.

Response: Isolation valve has been added to the flow diagram and the sequence reflects that as well.

4.1 Points list doesn't completely match WTA specification, missing points.

Response: I went back to the specification and reviewed the points that are being asked for, for the process loop and found that we do have the correct points that are required per specification.

4.1 Make-Up water pressure shown on the process chilled water loop diagram is not referenced in the sequence of operations. Confirm for monitoring purposes only.

Response: Make-up water pressure is to be monitored as shown on M0401. Sequence now reflects that.

4.3 Missing CHW temperature alarm?

Response: CHW Temperature high limit alarm has been added. The sequence now reflects that.

4.3 "The process water pumps will be enabled through a user's defined schedule"
Owner to provide what this schedule is. How critical is the equipment that the pumps serve? Are there any backups or provisions if the pumps are to fail or chilled water from the loop is not maintaining the correct temperature?

Response: The process cooling system will have a manual run switch and also the capabilities to have a user definable schedule. Schedule to be determined by owner. We have also added a temperature deadband so that we can reduce pump cycles on CP-4A and CP-4B. The sequence now reflects that.
As far as how critical the equipment is, that will need to be discussed with the owner and WTA. Currently there are no backup provisions that we are aware of.

Hot Water System

5.1 How are the boilers staged and controlled? No isolation valves shown on boilers, limiting the ability to run only one boiler.

Response: The boilers are controlled and staged by their own internal controls and safeties. We will provide an enable and a hot water reset.
Boiler isolation valves have been added to the hot water system. Isolation valves will be controlled by its respected boiler. Drawings now reflect that.

5.1 The "boiler low water level" is not shown on the boiler wiring diagram as an independent hardware point.

Response: This point is not available as a hardwired point. This will be accomplished via the BACnet interface, if available.

5.1 The heating water differential pressure reset uses 3 separate sensors. How will the sensors be utilized?

Response: We will look at all (3) and select the lowest reading and it will be used to control the pressure setpoint. The sequence now reflects that.

5.4 The alarms list does not include high or low heating water loop supply temperature.

Response: The alarms have been added. The sequence now reflects that.

5.4 Provide heating water supply temperature reset based on heating demand from initial setting of 140 deg. F down to 80 deg. F. Heating demand from the terminal units or reset based off of outside air temperature? Is 80 too low of a starting minimum?

Response: OA run conditions and OA reset schedule has been added per recommendations. 90°F will be the starting point. The reset parameters will be fully adjustable. The sequence now reflects that.

Heat Recovery System

Response: No Comments

Air Handling Unit (AHU-1 & AHU-2)

7.2 AHU-1 has two filters shown on the diagram that are not referenced in the sequence of operation. Is the pressure measured across the filter alarmed for changing the filter? Or is there a schedule in place for when to change?

Response: The pressure will be monitored across the prefilter and final filter. Alarms will be provided based on runtime status and will not be based on differential pressure. The sequence now reflects that.

7.8 "Coordinate damper speed with fan starting speed to prevent recirculation if one AHU is already operating" - Does this apply to both supply and return isolation dampers?

Response: The dampers will be sequenced so that they operate in parallel to prevent recirculation. The sequence now reflects that.

7.9 The sequence mentions enabling the heating valve if SAT air temperature drops from 40 deg. F. to 35 deg. F. (adj.). We believe this is a typo.

Response: The sequence mentioned is an additional freeze protection sequence in the case of a freezestat failure. The heating valve does control to maintain the setpoint when in heating mode. The sequence was per specification and believe it should stay. See specification section 239500 (239500-26) item (12. b. 1).

7.8 How does the operator remove problem VAV zones that may be affecting fan static pressure reset?

Response: The logic does have a parameter that can be removed.

Air Handling Unit (AHU-3 & AHU-4)

8.3 Will the static pressure reset control create issues with phoenix valve operation and actuator timing?

Response: Yes. The reset of static pressure has been removed and it will now be controlled to a fixed setpoint. The sequence now reflects that.

8.4 The sequence mentions enabling the heating valve is SAT air temperature drops from 40 deg. F. to 35 deg. F. (adj.). We believe this is a typo.

Response: The sequence mentioned is an additional freeze protection sequence in the case of a freezestat failure. The heating valve does control to maintain the setpoint when in heating mode. The sequence was per specification and believe it should stay. See specification section 239500 (239500-31) item (10. b. 1).

8.3 Filter shown on the diagram that are not referenced in the sequence of operation. Is the pressure measured across the filter alarmed for changing the filter? Or is there a schedule in place for when to change?

Response: The pressure will be monitored across the filter. Alarms will be provided based on runtime status and will not be based on differential pressure. The sequence now reflects that.

Air Handling Unit (AHU-5)

9.1 Pumps are labeled as "freeze pumps", however this is not a freeze pump.

Response: The pump has been relabeled as a recirculation pump and will be enabled based on a call for cooling. The sequence now reflects that.

9.3 Indicates that the supply fan will run anytime the unit is commanded to run, does not define what commands the unit.

Response: Unit is stated to run continuously unless commanded off from the workstation. See Run Conditions.

Soffit Finned Tube Radiation

10.3 Sequence for the FTR does not reference that it will fully close when it is within 2F of any associated VAV unit cooling set point in order to avoid simultaneous heating and cooling as indicated in the engineer's VAV sequence.

Response: The noted sequence was stated under the perimeter heating sequence per ASI-028 and was not noted anywhere in the soffit finned tube radiation sequence. The soffits are controlling to a 65°F setpoint (adjustable) when the outside air temperature is below 45°F (adjustable). The soffit finned tube should not affect the zone temperature inside the building envelope.

Variable Air Volume Units

11.4 The sequence mentions a minimum un-occupied airflow. Where is this airflow setpoint defined?

Response: The airflow setpoints will be coordinated with WTA and that information will be available to the Cx Agent.

11.4 How long will units run in occupied mode when triggered by the occupancy sensor?

Response: This delay will be fully adjustable and will be determined during the Cx process. As-Built documentation will note the time delays in the sequence of operation.
Note: This will be a delay once the occupancy sensor is in the unoccupied state. Typically, we will wait 10 minutes (adj.) to reset the box to unoccupied conditions.

11.4 Sequence does not mention the use of a limit on the discharge air temperature in order to prevent stratification of the air while in heating mode.

Response: The program will now have an option for discharge high limit. This option can be turned off if WTA does not consider the recommendation. The sequence now reflects that.

Exhaust Fans

14.4 There is a statement under "Run Conditions" that says fans will be off if un- occupied and chemicals are stored properly.

Response: WTA is still reviewing and will provide clarification.

14.4 Is there going to be a sensor that measures the wind speed?

Response: Weather app will determine the wind speed. System default will be max speed if network is down.

14.1 EF-4 is referenced on sheet 14.1 however is not listed in sequence 14.4.

Response: Exhaust fan EF-4 will run continuously. Sequence now reflects that.

Phoenix System

17.4 ROOM SCHEDULE SHEET (RSS) is referenced in the ACES drawings but cannot be found in the submittal

Response: The Room Schedule Sheet has been added to the submittal document.

17.14 Sequence mentions that hoods will have a motion sensor for standby levels, of the 4 details that include fume hoods only one of them shows an occupancy sensor being tied to the fume hood.

Response: The detail that shows an occupancy sensor also mentions point exhaust. These drawings were taken directly from the phoenix submittal drawings and as mentioned in comment 17.7, there is no point exhaust in this design. Details to be removed.
NOTE: IF MOTION SENSORS ARE NECESSARY TO MEET SPECIFICATION, THAT WILL NEED TO BE COORDINATED WITH PHOENIX CONTROLS AND/OR VENDOR. ACES TO INTERFACE AND WIRE THE PHOENIX CONTROLS ONLY. ALL COMPONENTS/CONTROLS TO BE PROVIDED BY OUTSIDE VENDOR.

17.7 Celers 2 Lab Detail 4 includes point exhaust. Could not locate any point exhaust in the design drawings or schedule.

Response: Celers 2 lab Detail 4 has been deleted from the submittal documents.

- The design docs suggest that the fume hood valves can go to 0 flow based on the schedule. There is not reference to this in the Phoenix sequence.

Response: Waiting on WTA to clarify intent. Once clarified, the documents will be marked up for as-built documentation.

- WTA specs provide a list of read/write points that come with phoenix valves. It's not clear from the Phoenix submittal which points and/or alarms will be utilized on the ACES interface.

Response: Interface and final points list will be coordinated with WTA. I have added the recommended points list from the Phoenix submittal.