Network Diagram

Work Stations, Servers, Computers

Operator Work Station (OWS)
Functions and details as noted

Existing Siemens Operator Work Station
Located in FS10

Rack Mounted Server
Functions and details as noted

Existing Siemens Server
Furnish and install a new 3TB
RAID array to be dedicated to FS18
archival data storage for LEED M&V

To other facilities with
Siemens and Alerton
control Systems

Siemens P2/IP

Existing City of Seattle
DOIT Data Center
Router
DIOT to provide routing
table/path from the new
Mitsubishi OWS to FS18

Siemens P2/IP
BACnet/IP

Field Panels and Equipment

Siemens Modular PXM Controller

Located in Mech 005
Serves the following equipment and functions:

1. Mitsubishi monitoring, B, and 1st Floor
2. DHW monitoring
3. EH-1 and 2
4. UH-1 and 3

Control System Field Panels
Function and details as noted

Mitsubishi GB-50 Central Controller with:
PC Monitoring software option
PC Scheduling software option
Error e-mail software optoin
Online Maintenance Tool software option
Personal We Browser software option
BACnet Interface software option
Locate the controller in a NEMA 1 enclosure in the Com 003.

Mitsubishi PUY-A12 Outdoor
Unit ACC-2 with MNet Adapter

Mitsubishi PURY-P192
Outdoor Unit ACC-1

Controlled Equipment
Function and details as noted

Mitsubishi PKFY-P06 Fan
Coil Unit FCU-7

Mitsubishi PAC-SF46EPA
Transmission Booster
Located with FCU-7

Wiring and Field Devices

Wire and Cable

BACnet/IP
MNet/IP
Siemens P2/IP
MNet

Management and Automation Level Network Cabling
Function as indicated, typically Ethernet CAT5 or CAT6. See specifications for detailed requirements. Light line weights indicate existing cabling

Mitsubishi VRF system proprietary network cable, typcially #16 Twisted Shielded Pair (TSP). Coordinate with Mitsubishi during submittals to verify cable specifics. See the specifications and drawing details for additional information regarding wiring requirements.

Mc

Mitsubishi VRF remote controller cable, typically #18 TSP. Coordinate with Mitsubishi during submittals to verify cable specifics. See the specifications and drawing details for additional information regarding wiring requirements.

5 #18TSP, 1 Spare

Low voltage cable bundle; #18 TSP. "xx" indicates the number of cables, typically 1 cable per I/O device unless otherwise noted.

Line voltage conduit and wire providing interlock and line voltage control functions. Hash mark indicates one conductor. A short hash mark indicates a green grounding conductor. An "S" next to a hash mark indicates a spare conductor. Contractor to coordinate conduit and concuit size with the requirements of the branch circuit associated with the function based on the requirements of the National Electric Code and the requirements of the requirements of the electrical other applicable codes and the requirements of the electrical divisions of the specifications.

Lines cross each other at different elevations

AHU1

Line broken for presentation purposes to show something that is below it more clearly

Field Devices

Space temperature sensor with set point adjustment

Remote space temperature controller with multiple functions including On/Off, operating mode, set point adjustment, fan speed adjustment, and air flow direction (where available)

Damper with actuator; see point list and narrative for details

Air differential pressure switch or transmitter; see point list and narrative for details

Duct humidity transmitter

Duct temperature transmitter; rigid averaging sensor

Freezestat; Hardwired safety interlock

Spring wound interval timer switch

Relay interlocking hardwired safties with a motor starter or VFD and providing a mointoring input to the DDC system

Relay interfacing the DDC system with the control system in a piece of equipment to enable the equipment for operation under the control of its own control and safety interlock system

Motor starter or Variable Speed Drive with indicated control functions and interfaces

Supply fan start/stop
Supply fan proof of operation
Supply fan speed command
Supply fan speed feedback
Network card

Analog position feedback signal from actuator

Momentary Single Pole Double Throw Center Off Switch

Maintained Double Pole Single Throw Switch

Pilot Light

End switch; Digital input changes state at the end of the actuator stroke

Duct temperature transmitter - high temperature thermocouple sensing element

Emergency stop switch; Mushroom head emergency stop switch hard wired to shut down the indicated equipment

Specialty switch provided by the referenced equipment factory; Hardwired; Function as indicated

Current transformer; analog sensor used for proof and approximate power consumption calculation

Freezestat; Hardwired interlock; Responds to the coldest temperature over 1 foot of the element

Flexible averaging duct temperature sensor; Provide 1 foot of sensing element for every 4 sq.ft. of duct/coil/AHU cross-section

Surface Temperature Sensor; Adhere to clean pipe per manufacturer's instructions; Insulate and vapor seal; See detail

Liquid or gas pressure transmitter; provide service valve and a tee with a test port and service valve on the test port.

Pipe temperature transmitter with well and a second calibration well

Field Devices (Continued)

Retransmitted signal from a utility meter

Analog output driving a Silicon Controlled Rectifier (SCR) in an electric heater or similar final control element. Coordinate output type (1-5 vdc, 4-20 ma, etc.) with equipment vendor.

Relay interfacing the DDC system with a piece of equipment that has staged capacity control; one relay per stage, coordinate with equipment vendor for contact requirements.

Carbon Monoxide detector/transmitter

Nitrous Oxide detector/transmitter

Carbon Dioxide detector/transmitter

Combination Nitrous Oxide and Carbon Monoxide alarm and ventilation controller with outputs re-transmitting the gas levels for monitoring by the Siemens system.

Electric meter; See specs, point list and metering detail for requirements

Voltage meter; See specs, point list and metering detail for requirements

Phase angle/power factor meter; See specs, point list and metering detail for requirements

Positive displacement gas meter with pulse output See specs, point list and metering details for requirements

Compound water meter with pulse output; See specs, point list, and metering detail for requirements

Position switch; Analog input, changes value as the actuator strokes to provide position feedback

Occupancy sensor; automatically turns on immediately and off after an adjustable time limit based on motion detection

Vacancy sensor; manually turned on by occupant, automatically turns of if not motion is detected after an adjustable time limit

Mod, NC

Modulating damper; NO = Normally Open, NC = Normally Closed, NS = No Spring Return

2Pos, NO

Two Position damper; NO = Normally Open, NC = Normally Closed, NS = No Spring Return

Outdoor air temperature and relative humidity transmitter

Analog output interface to a modulating controlled device

Dry contact monitor

Drawing List	
Number	Description
TC0.00	Drawing list, Symbols General Notes
TC0.10	Heat Recovery Ventilator HRV-1 Point List
TC0.11	Heat Recovery Ventilator HRV-2 Point List
TC0.12	Heat Recovery Ventilator HRV-3 Point List
TC0.20	MUAU-1 Point List
TC0.21	VRF Indoor Unit Point List
TC0.22	VRF Outdoor Unit Point List
TC0.31	Apparatus Bay Point List
TC0.40	ODU-1 and IDU-1 Point List
TC0.41	Miscelleneous Point List
TC0.42	Miscelleneous Point List Notes
TC2.11	Basement Floor Plan
TC2.21	First Floor Plan
TC2.31	Second Floor Plan
TC2.41	Roof Plan
TC5.11	Installation Details
TC5.21	Wiring Details
TC5.22	Wiring Details
TC6.00	Control System Network Diagram - Overview
TC6.01	Control System Network Diagram - Details
TC6.10	HRV-1 System Diagram - Overview
TC6.11	HRV-1 System Diagram - NW
TC6.12	HRV-1 System Diagram NE
TC6.13	HRV-1 System Diagram NE and SE
TC6.14	HRV-1 System Diagram SE
TC6.15	HRV-1 System Diagram SW
TC6.16	HRV-1 and MUAU Sequence of Operation
TC6.17	HRV-1 and MUAU Sequence of Operation (Continued)
TC6.19	HRV-2 and 3Sequence of Operation
TC6.191	HRV-2 and 3Sequence of Operation (Continued)
TC6.20	Variable Flow Refrigeration System Diagram and Sequence
TC6.21	Variable Flow Refrigeration Sequence Continued

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Add. 05

Miscellaneous

10 Sheet note reference; see the number specified in the list of sheet specific notes.

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100% CD SET

DAVID A. SELLERS
STATE OF WASHINGTON
52574
REGISTERED PROFESSIONAL ENGINEER
1/11/16

100% CONSTRUCTION DOCUMENTS

PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE
1 Revision 1 - Addendum 5 - 2016-02-19	

SHEET TITLE
Symbols and Abbreviations, Drawing List

SHEET NUMBER
TC 0.00

HRV-1 Point List

Point Name	Number [BACnet Object ID], Note 7	System and Service	Sensor Type	Accuracy	Alarms Limit Hi	Limit Lo	Warning Hi	Warning Lo	Trending Samples1	Commissioning5 Time2	Commissioning5 Local3	Commissioning5 Archive4	Operating5 Time2	Operating5 Local3	Operating5 Archive4	Notes
Analog Inputs																
Outdoor air temperature		Outdoor air temperature	Vaisala HMT 330						60	1 min	✓	✓	1 min	✓	✓	Note 18, 21
Outdoor air humidity		OA humidity for reference/performance assessment	Vaisala HMT 330						60	1 min	✓	✓	1 min	✓	✓	
Supply filter differential pressure		Supply filter differential pressure	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	Note 6
Enthalpy wheel supply side leaving air temperature		Heat wheel discharge temperature	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 18
Supply air temperature		Electric heating coil leaving air temperature	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 18
Entering exhaust air temperature		Exhaust air temperature entering the heat wheel	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 22
Exhaust filter differential pressure		Exhaust filter differential pressure	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	Note 6
Leaving exhaust air temperature		Exhaust air temperature leaving the heat wheel	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 22
Supply fan amps		Supply fan amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Exhaust fan amps		Exhaust fan amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Heat wheel amps		Heat wheel amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Enthalpy wheel pressure drop - Supply side		Enthalpy wheel supply side pressure drop	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	
Enthalpy wheel pressure drop - Exhaust side		Enthalpy wheel exhaust side pressure drop	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	
EF-1 inlet static pressure		Static on building side of back draft damper	0-0.25 in.w.c. input,, 4-20 ma output transmitter, Dwyer MS-121	+/-1% full scale					60	1 min	✓	✓	1 min	✓	✓	Note 19
EF-2 inlet static pressure		Static on building side of back draft damper	0-0.25 in.w.c. input,, 4-20 ma output transmitter, Dwyer MS-121	+/-1% full scale					60	1 min	✓	✓	1 min	✓	✓	Note 19
EF-3 inlet static pressure		Static on building side of back draft damper	0-0.25 in.w.c. input,, 4-20 ma output transmitter, Dwyer MS-121	+/-1% full scale					60	1 min	✓	✓	1 min	✓	✓	Note 19
EF-6 inlet static pressure		Static on building side of back draft damper	0-0.25 in.w.c. input,, 4-20 ma output transmitter, Dwyer MS-121	+/-1% full scale					60	1 min	✓	✓	1 min	✓	✓	Note 19
EF-7 inlet static pressure		Static on building side of back draft damper	0-0.25 in.w.c. input,, 4-20 ma output transmitter, Dwyer MS-121	+/-1% full scale					60	1 min	✓	✓	1 min	✓	✓	Note 19
EF-8 inlet static pressure		Static on building side of back draft damper	0-0.25 in.w.c. input,, 4-20 ma output transmitter, Dwyer MS-121	+/-1% full scale					60	1 min	✓	✓	1 min	✓	✓	Note 19
Analog Outputs																
Electric heat stage 1 SCR		Modulates 1st stage of electric heat	4-20 ma output	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 13
Digital Inputs																
HRV-11 safety trip		Annunciates a safety shut down of the AHU	Note 10	N/A					10	COV	✓	✓	COV	✓	✓	
Frost control indication		Annunciates when a frost control cycle is in progress	Note 11	N/A					10	COV	✓	✓	COV	✓	✓	
Digital Outputs (All digital outputs to include local override capability and indication)																
HRV-1 Enable		AHU-1 supply fan start/stop command	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	Note 12
Electric heat enable		Enables electric heat	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	Note 13
Outdoor air damper		HRV-1 Outdoor air damper	Factory mounted and wired	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 12
Exhaust air damper		HRV-1 Exhaust air damper	Factory mounted and wired	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 13
EF-1 start/stop		Starts and stops EF-1	Relay output	N/A					10	COV	ü	ü	COV	ü	ü	Note 20
EF-2 start/stop		Starts and stops EF-1	Relay output	N/A					10	COV	ü	ü	COV	ü	ü	Note 20
EF-3 start/stop		Starts and stops EF-1	Relay output	N/A					10	COV	ü	ü	COV	ü	ü	Note 20
EF-7 start/stop		Starts and stops EF-1	Relay output	N/A					10	COV	ü	ü	COV	ü	ü	Note 20
EF-8 start/stop		Starts and stops EF-1	Relay output	N/A					10	COV	ü	ü	COV	ü	ü	Note 20
Hardwired and Safety Interlocks (Hardwired to shut down the system. Safeties shall function no matter what position the equipment's Hand-Off-Auto, Inverter-Bypass, or other selector switches are in)																
Freezestat		Low discharge temperature safety	Hardwired	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 15
Electric heat high limit		High limit lock-out	Hardwired	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	
Hoistway Vent Damper Interlock		Hoistway Vent	Hardwired	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 16
EF-6 start/stop		Starts and stops EF-1	Hardwired interlock from switch at the hood.	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 17
Virtual Points																
Supply air temperature set point		Heat wheel leaving air temperature set point	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	
Fire alarm shut down		Fire alarm system interlock	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 14

Notes:

1. Samples indicates the minimum number of data samples that must be held in the local controller if it is trending the point.
2. Time indicates the required sampling time for the trending function.
3. A check in the local column indicates that the trending only needs to be running in the local controller and the most recent value can write over the last value when the trend buffer fills up.
4. A check in the archive column indicates that the trend data must be archived to the system hard disc when trend buffer fills up so that a continuous trend record is maintained.
5. Commissioning trending requirements only need to be implemented during the start-up and warranty year. After the start-up and warranty process, the control contractor should set the trending parameters to the operating requirements listed if they differ from the commissioning requirements.
6. Use flow and pressure drop to trend filter life cycle cost and trigger filter changes based on life cycle cost. See control logic and narrative for additional information.
7. Monitor amps to provide a proof of operation in put and create a virtual meter to track energy use using voltage and power factor constants determined during commissioning. Accumulate and display current demand level, kWh for the day, and kWh for the previous day, calendar month, and calendar year. Archive data to the data to the dedicated archival data storage drive in the City's Data Center. See Network Diagram.
8. 0.75% of span for sensor plus transmitter combined.
9. 2 feet of element for every 4 sq.ft. of duct area, 6 ft. minimum length.
10. Wire safety devices to pilot a relay and keep it energized in normal operation so that a safety trip de-energizes the relay. Use relay contacts to interlock the supply fan VFD, the exhaust fan VFD, and to provide a digital status input to the DDC system. Safeties shall function no matter what the position of the starter Hand-Off-Auto selector switch is.
11. Provide interface relay (one per point) wired per vendor wiring diagrams. Verify the interface relay current draw with both relays energized will not overload the vendor's control power transformer.
12. Enable point allows factory control circuit to start and stop the various motors, drives and actautors associated with the AHU.
13. Multistage electric resitance heater shall have an SCR for the first stage. Logic shall be arranged to provide modulated capacity through the entire operating range by coordinating the operation of the SCR controlled stage with the remaining across the line stages.
14. A common signal from a dry contact on the fire alarm control panel shall be used by the DDC system to triger a fire alarm shut down of all HVAC systems on alarm. Systems to go through a normal restart when the fire alarm is cleared.
15. Respond to the coldest temperature over 12 continuous inches of the element.
16. Wired to the fire alarm system and arranged to open the vent damper on alarm. Coordinate with the fire alarm contractor and City of Seattle Code requiements.
17. Hard wire the hood switch to interlock it with the exhaust fan, the intake damper and the MUAU.
18. Perform a relative calibration of this point relative to the other temperature points in the same air stream using the outdoor air temperature sensor as a reference. Adjust the zero of the other sensors so all sensors agree when immersed in a well stirred bucket of ice water. Adjust the span of the other sensors so the all agree when subject to an air stream at the same temperature (heat wheel off, electric heat off).
19. Monitor pressure to provide a proof of operation in put and create a virtual meter to track energy use using amperage, voltage and power factor constants determined during commissioning.. Accumulate and display current demand level, kWh for the day, and kWh for the previous day, calendar month, and calendar year. Archive data to the data to the dedicated archival data storage drive in the City's Data Center. See Network Diagram.
20. Provide horspower rated relay at the exhaust fan location, functional devices RIBM24ZL or equal. See detail on M5.11.
21. Coordinate with the Architect, mechanical designer, commissioning provider, control designer, and operating team to select a location for the outdoor air conditions sensor in the field during construction. Anticipate a wiring run with-in 25 feet of the sensor location shown on the drawings.
22. Perform a relative calibration of this point relative to the other temperature points in the same air stream using the heat wheel entering air temperature sensor as a reference. Adjust the zero of the other sensors so all sensors agree when immersed in a well stirred bucket of ice water. Adjust the span of the other sensors so the all agree when subject to an air stream at the same temperature (heat wheel off, electric heat off).
23. Create a virtual proof of operation point based on this analog input. Coordinate with the balancer and commissioning provider during start-up to determine the appropriate set point.

100% CONSTRUCTION DOCUMENTS

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1/11/16

PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE

SHEET TITLE
HRV-1 Point List

SHEET NUMBER
TC 0.10

HRV-2 Point List

Point Name	Number [BACnet Object ID], Note 7	System and Service	Sensor Type	Sensor Accuracy	Alarms Limit Hi	Alarms Limit Lo	Alarms Warning Hi	Alarms Warning Lo	Trending Samples1	Commissioning5 Time2	Commissioning5 Local3	Commissioning5 Archive4	Operating5 Time2	Operating5 Local3	Operating5 Archive4	Notes
Analog Inputs																
Supply filter differential pressure		Supply filter differential pressure	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	Note 6
Heat exchanger supply side leaving air temperature		Heat exchanger discharge temperature	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 18
Entering exhaust air temperature		Exhaust air temperature entering the heat wheel	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 19
Exhaust filter differential pressure		Exhaust filter differential pressure	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	Note 6
Leaving exhaust air temperature		Exhaust air temperature leaving the heat wheel	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 19
Supply fan amps		Supply fan amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Exhaust fan amps		Exhaust fan amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Supply fan speed command		Commands fan speed for different operating modes	4-20 ma output						60	1 min	✓	✓	1 min	✓	✓	Note 7
Exhaust fan speed command		Commands fan speed for different operating modes	4-20 ma output						60	1 min	✓	✓	1 min	✓	✓	Note 7
Heat exchanger pressure drop - Supply side		Enthalpy wheel supply side pressure drop	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	
Heat exchanger pressure drop - Exhaust side		Enthalpy wheel exhaust side pressure drop	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	
Space temperature		Bunker area space temperature	1,000 Ω Pt RTD space with close coupled transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	
Space temperature set point adjustment		Set point adjustment on space temperature sensor	Integral with space temperature sensor						60	1 min	✓	✓	1 min	✓	✓	
Unit Heater 1 Flue Temperature		Thermocouple with 4-20 ma transmitter	+/- 3°F					60	1 min	✓	✓	5 min	✓	✓	Note 7	
Destratification fan amps		Fan amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Digital Inputs																
Spring wound interval timer		AHU-2 high speed operating mode control	12 hour, No hold, DPDT Spring Wound Timer	N/A					10	COV	✓	✓	COV	✓	✓	
HRV-2 safety trip		Annunciates a safety shut down of the AHU	Note 10	N/A					10	COV	✓	✓	COV	✓	✓	
Digital Outputs (All digital outputs to include local override capability and indication)																
HRV-2 Enable		Enables HRV-2 fans and internal interlocks	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	Note 12
UH-1 Fan Start/Stop		Starts and stops the unit heater fan	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
UH-1 Stage 1 Heat		Turns the gas valve on and off	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
DF-1 Enable		Enables destratification fan SF-1	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	Note 12
Safety Interlocks (Hardwired to shut down the system. Safeties shall function no matter what position the equipment's Hand-Off-Auto, Inverter-Bypass, or other selector switches are in)																
Fire alarm shut down		Fire alarm system interlock	Software programmed based on fire alarm system input	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 14
Freezestat		Low discharge temperature safety	Hardwired	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 15
Network Points																
Supply fan VFD network card		Provides access to onboard VFD data and diagnostics	BACnet or Siemens P2 Network Card	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 17
Exhaust fan VFD network card		Provides access to onboard VFD data and diagnostics	BACnet or Siemens P2 Network Card	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 17
Virtual Points																
High speed cycle temperature set point		Controls UH-2 during the high speed cycle	Logic generated, Note 18	N/A					5	COV	✓	✓	COV	✓	✓	
Normal cycle temperature set point		Controls UH-2 during the normal cycle	Logic generated, Note 18	N/A					5	COV	✓	✓	COV	✓	✓	
UH-2 temperature control differential		Supply flow set point	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	
Low speed supply fan set point		Heat wheel leaving air temperature set point	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	
High speed supply fan set point		Frost control set point for leaving exhaust air	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	
Low speed exhaust fan set point		Supply flow set point	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	
High speed exhaust fan set point		Exhaust flow set point	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	
Power failiure recovery		Internal point monitoring controller power	Used to trigger a power failure recovefry sequence	N/A					5	COV	✓	✓	COV	✓	✓	

Notes:

1. Samples indicates the minimum number of data samples that must be held in the local controller if it is trending the point.
2. Time indicates the required sampling time for the trending function.
3. A check in the local column indicates that the trending only needs to be running in the local controller and the most recent value can write over the last value when the trend buffer fills up.
4. A check in the archive column indicates that the trend data must be archived to the system hard disc when trend buffer fills up so that a continuous trend record is maintained.
5. Commissioning trending requirements only need to be implemented during the start-up and warranty year. After the start-up and warranty process, the control contractor should set the trending parameters to the operating requirements listed if they differ from the commissioning requirements.
6. Use flow and pressure drop to trend filter life cycle cost and trigger filter changes based on life cycle cost. See control logic and narrative for additional information.
7. Monitor amps to provide a proof of operation in put and create a virtual meter to track energy use. Monitor amps to provide a proof of operation in put and create a virtual meter to track energy use. Accumulate and display current demand level, kWh for the day, and kWh for the previous day, calendar month, and calendar year. Archive data to the data to the dedicated archival data storage drive in the City's Data Center. See Network Diagram.
8. 0.75% of span for sensor plus transmitter combined.
9. 2 feet of element for every 4 sq.ft. of duct area, 6 ft. minimum length.
10. Wire safety devices to pilot a relay and keep it energized in normal operation so that a safety trip de-energizes the relay. Use relay contacts to interlock the supply fan VFD, the exhaust fan VFD, and to provide a digital status input to the DDC system. Safeties shall function no matter what the position of the starter Hand-Off-Auto selector switch is.
11. Provide interface relay (one per point) wired per vendor wiring diagrams. Verify the interface relay current draw with both relays energized will not overload the vendor's control power transformer.
12. Enable point allows factory control circuit to start and stop the various motors, drives and actautors associated with the AHU.
13. Multistage electric resitance heater shall have an SCR for the first stage. Logic shall be arranged to provide modulated capacity through the entire operating range by coordinating the operation of the SCR controlled stage with the remaining across the line stages.
14. Wire to contacts in a device furnished and installed by fire alarm contractor in the supply duct per the requirements of NFPA 90A, NFPA 72 and the City of Seattle Fire Code.
15. Respond to the coldest temperature over 12 continuous inches of the element.
16. Wired to the fire alarm system and arranged to open the vent damper on alarm. Coordinate with the fire alarm contractor and City of Seattle Code requirements.
17. Provide BACnet or Siemens P2 network card. Coordinate communication protocol/networking requirements with City of Seattle DOIT. Map all internally available points across the interface so they are visible at the Facility Operations OWS. Coordinate presentation details during submittals.
18. Perform a relative calibration of this point relative to the other temperature points in the same air stream using the outdoor air temperature sensor as a reference. Adjust the zero of the other sensors so all sensors agree when immersed in a well stirred bucket of ice water. Adjust the span of the other sensors so they all agree when subject to an air stream at the same temperature (heat wheel off, electric heat off).
19. Perform a relative calibration of this point relative to the other temperature points in the same air stream using the heat exchanger entering air temperature sensor as a reference. Adjust the zero of the other sensors so all sensors agree when immersed in a well stirred bucket of ice water. Adjust the span of the other sensors so they all agree when subject to an air stream at the same temperature (heat wheel off, electric heat off).
20. Used as a proof of operation input and also as a loss of efficiency alarm. Also use the proof of operation input to create a virtual meter to track energy use. Accumulate and display current demand level, kWh for the day, and kWh for the previous day, calendar month, and calendar year. Archive data to the data to the dedicated archival data storage drive in the City's Data Center. See Network Diagram.

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CITY OF SEATTLE

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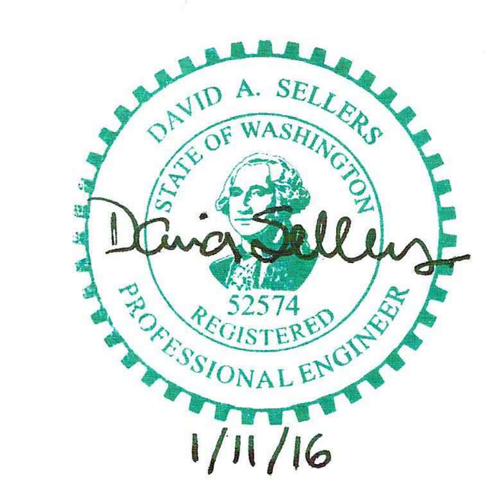

PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE

SHEET TITLE
HRV-2 Point List

SHEET NUMBER
TC 0.11

HRV-3 Point List

Point Name	Number [BACnet Object ID], Note 7	System and Service	Sensor Type	Sensor Accuracy	Features: Alarms Limit Hi	Alarms Limit Lo	Alarms Warning Hi	Alarms Warning Lo	Trending Samples1	Trending Commissioning5 Time2	Trending Commissioning5 Local3	Trending Commissioning5 Archive4	Trending Operating5 Time2	Trending Operating5 Local3	Trending Operating5 Archive4	Notes
Analog Inputs																
Supply filter differential pressure		Supply filter differential pressure	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	Note 6
Heat exchanger supply side leaving air temperature		Heat exchanger discharge temperature	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 18
Entering exhaust air temperature		Exhaust air temperature entering the heat exchanger	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 19
Exhaust filter differential pressure		Exhaust filter differential pressure	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	Note 6
Leaving exhaust air temperature		Exhaust air temperature leaving the heat exchanger	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 19
Supply fan amps		Supply fan amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Exhaust fan amps		Exhaust fan amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Heat exchanger pressure drop - Supply side		Heat exchanger supply side pressure drop	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	
Heat exchanger pressure drop - Exhaust side		Heat exchangerexhaust side pressure drop	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	
Space temperature		Decontamination area space temperature	1,000 Ω Pt RTD space with close coupled transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	
Space temperature set point adjustment		Set point adjustment on space temperature sensor	Integral with space temperature sensor						60	1 min	✓	✓	1 min	✓	✓	
Digital Inputs																
HRV-3 safety trip		Annunciates a safety shut down of the AHU	Note 10	N/A					10	COV	✓	✓	COV	✓	✓	
Digital Outputs (All digital outputs to include local override capability and indication)																
HRV-3 Enable		Enables HRV-2 fans and internal interlocks	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	Note 12
Safety Interlocks (Hardwired to shut down the system. Safeties shall function no matter what position the equipment's Hand-Off-Auto, Inverter-Bypass, or other selector switches are in)																
Freezestat		Low discharge temperature safety	Hardwired	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 15
Virtual Points																
Power failiure recovery		Internal point monitoring controller power	Used to trigger a power failure recovefry sequence	N/A					5	COV	✓	✓	COV	✓	✓	

Notes:

1. Samples indicates the minimum number of data samples that must be held in the local controller if it is trending the point.
2. Time indicates the required sampling time for the trending function.
3. A check in the local column indicates that the trending only needs to be running in the local controller and the most recent value can write over the last value when the trend buffer fills up.
4. A check in the archive column indicates that the trend data must be archived to the system hard disc when trend buffer fills up so that a continuous trend record is maintained.
5. Commissioning trending requirements only need to be implemented during the start-up and warranty year. After the start-up and warranty process, the control contractor should set the trending parameters to the operating requirements listed if they differ from the commissioning requirements.
6. Use flow and pressure drop to trend filter life cycle cost and trigger filter changes based on life cycle cost. See control logic and narrative for additional information.
7. Monitor amps to provide a proof of operation in put and create a virtual meter to track energy use. Monitor amps to provide a proof of operation in put and create a virtual meter to track energy use. Accumulate and display current demand level, kWh for the day, and kWh for the previous day, calendar month, and calendar year. Archive data to the data to the dedicated archival data storage drive in the City's Data Center. See Network Diagram.
8. 0.75% of span for sensor plus transmitter combined.
9. 2 feet of element for every 4 sq.ft. of duct area, 6 ft. minimum length.
10. Wire safety devices to pilot a relay and keep it energized in normal operation so that a safety trip de-energizes the relay. Use relay contacts to interlock the supply fan VFD, the exhaust fan VFD, and to provide a digital status input to the DDC system. Safeties shall function no matter what the position of the starter Hand-Off-Auto selector switch is.
11. Provide interface relay (one per point) wired per vendor wiring diagrams. Verify the interface relay current draw with both relays energized will not overload the vendor's control power transformer.
12. Enable point allows factory control circuit to start and stop the various motors, drives and actautors associated with the AHU.
13. Multistage electric resitance heater shall have an SCR for the first stage. Logic shall be arranged to provide modulated capaicty through the entire operating range by coordinating the operation of the SCR controlled stage with the remaining across the line stages.
14. Wire to contacts in a device furnished and installed by fire alarm contractor in the supply duct per the requirements of NFPA 90A, NFPA 72 and the City of Seattle Fire Code.
15. Respond to the coldest temperature over 12 continuous inches of the element.

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100% CD SET

DAVID A. SELLERS · STATE OF WASHINGTON · 52574 · REGISTERED · PROFESSIONAL ENGINEER
1/11/16

100% CONSTRUCTION DOCUMENTS

PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE
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SHEET TITLE
HRV-3 Point List

SHEET NUMBER
TC 0.12

MUAU Point List

Point: Name	Point: Number [BACnet Object ID], Note 7	System and Service	Sensor: Type	Sensor: Accuracy	Alarms Limit Hi	Alarms Limit Lo	Alarms Warning Hi	Alarms Warning Lo	Trending Samples1	Commissioning5 Time2	Commissioning5 Local3	Commissioning5 Archive4	Operating5 Time2	Operating5 Local3	Operating5 Archive4	Notes
Analog Inputs																
Supply filter differential pressure		Supply filter differential pressure	0-2 in.w.c. input,, 4-20 ma output transmitter	+/-1% full scale					24	1 hour	✓	✓	1 day	✓	✓	Note 6
Supply air temperature		Air temperature leaving the furnace	Flexible averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 8, 9					60	1 min	✓	✓	1 min	✓	✓	Note 18
Supply fan amps		Supply fan amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Exhaust fan amps		Exhaust fan amps for proof of operation and energy	Current transformer						60	1 min	✓	✓	1 min	✓	✓	Note 7
Analog Outputs																
Gas Heat Modulation		Modulates gas burner	4-20 ma output	N/A					60	1 min	✓	✓	1 min	✓	✓	
Digital Inputs																
MUAU-1 safety trip		Annunciates a safety shut down of the AHU	Note 10	N/A					10	COV	✓	✓	COV	✓	✓	
Digital Outputs (All digital outputs to include local override capability and indication)																
HRV-3 Enable		Enables HRV-2 fans and internal interlocks	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	Note 12
Safety Interlocks (Hardwired to shut down the system. Safeties shall function no matter what position the equipment's Hand-Off-Auto, Inverter-Bypass, or other selector switches are in)																
Fire alarm shut down		Fire alarm system interlock	Software programmed based on fire alarm system input	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 14
Freezestat		Low discharge temperature safety	Hardwired	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 15
Furnace high limit		High limit switch safety on furnace	Hardwired	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 14
Virtual Points																
Supply air temperature set point		Set point	Control process set point	N/A					5	COV	ü	ü	COV	ü	ü	
Power failiure recovery		Internal point monitoring controller power	Used to trigger a power failure recovefry sequence	N/A					5	COV	✓	✓	COV	✓	✓	

Notes:

1. Samples indicates the minimum number of data samples that must be held in the local controller if it is trending the point.
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CITY OF SEATTLE

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David A. Sellers, State of Washington, 52574, Registered Professional Engineer
1/11/16

PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE

SHEET TITLE
MUAU Point List

SHEET NUMBER
TC 0.20

Mitsubishi Indoor Unit Point List

Point		System and Service	Sensor		Features											Notes
Name	Number [BACnet Object ID], Note 11		Type	Accuracy	Alarms				Trending							
					Limit		Warning		Samples1	Commissioning5			Operating5			
					Hi	Lo	Hi	Lo		Time2	Local3	Archive4	Time2	Local3	Archive4	
Analog Inputs																
Carbon Dioxide Level		Zone carbon dioxide level	4-20 ma CO2 sensor	+/- 50 ppm					60	1 min	✓	✓	1 min	✓	✓	Note 18
Carbon Monoxide Level		Zone carbon monoxide level	4-20 ma = 0-200 ppm from local monitor/controller, Note 6	+/- 5% Full scale					60	1 min	✓	✓	1 min	✓	✓	Notes 19, 20
Digital Outputs																
Minimum Outdoor Air Damper Command		Closes MOA damper when the VRF fan is off	2 Position, Normally Open damper	N/A					20	COV	✓	✓	COV	✓	✓	Note 21
Digital Inputs																
VRF Fan Proof of Operation		Positive proof of operation	Current Transformer	2% Full Scale	9				60	1 min	✓	✓	1 min	✓	✓	Note 22
Hardwired Points																
Multi-function controller		Fan coil unit multi-function controller	Mitsubishi PAR-U01MEDU remote controller	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 17
BACnet Points																
On/Off Set-up	[BO_01xx01}	Start/stop fan coil unit	Binary Output Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
On/Off State	[BI_01xx02]	Operating status feedback	Binary Input Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Alarm Signal	[BI_01xx03]	Alarm signal	Binary Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Error Code	[MI_01xx04]	General indication of an error, Note 9	Multistate Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Operating Mode Set-up	[MO_01xx05	Sets the unit into 1 of 6 operating states, Note 10, 11	Multistate Output Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Operating Mode State	[MI_01xx06]	Operating status feedback; Note 10, 11	Multistate Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Fan Speed Set-up	[MO_01xx07]	Allows fan speed to be set; Note 11	Multistate Output Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Fan Speed State	[MI_01xx08]	Fan speed status feedback	Multistate Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Room Temperature	[AI_01xx09]	Space temperature indication	Analog Input Network point	N/A					60	1 min	✓	✓	1 min	✓	✓	Notes 7, 8
Set Temperature	[AV_01xx10]	Space temperature set point adjustment	Analog Command or Value Network point	N/A					60	1 min	✓	✓	1 min	✓	✓	Notes 7, 8
Filter Sign	[BI_01xx11]	Change filter indication	Binary Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Filter Sign Reset	[BV_401xx12]	Change filter indication reset	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Prohibit On/Off	[BV_01xx13]	Prohibits a remote control over ride of On/Off state	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Prohibit Mode	[BV_01xx14]	Prohibits a remote control over ride of operating mode	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Prohibit Filter Sign Reset	[BV_01xx15]	Prohibits a remote control reset of filter alarm	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Prohibit Set Temperature	[BV_01xx16]	Prohibits a remote control from adjusting set point	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
MNet Communication State	[BI_01xx20]	Indicates if there is an MNet error	Binary Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
System Force Off	[BV_01xx21]	Forces the unit to the off state	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Air Direction Set	[MO_0xx22)	Sets air flow direction; Note 12	Multistate Output Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Air Direction State	[MI_01xx23]	Flow direction feedback, Note 12	Multistate Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set Temp Cool	[AV_01xx24]	Sets a temporary cooling set point	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set Temp Heat	[AV_01xx25]	Sets a temporary heating set point	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set Temp Auto	[AV_01xx26]	Sets a temporary set point for Auto mode	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set High Limit Set Back Temp	[AV_01xx27]	Sets the high limit during the unoccupied cycle	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set Low Limit Set Back Temp	[AV_01xx28]	Set the low limit during the unoccupied cycle	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Virtual Points																
Operating mode failure		Uses multiple points to determine operating mode	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	Note 6

1 Add. 05

Notes:

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5. Commissioning trending requirements only need to be implemented during the start-up and warranty year. After the start-up and warranty process, the control contractor should set the trending parameters to the operating requirements listed if they differ from the commissioning requirements.
6. See narrative sequence and logic diagrams for diagnostic definition.
7. Unit specific point numbers to be developed by the control contractor based on the Owner's point naming standard and included with the programming submittal for review and approval. For BACnet points, "xx" refers to the equipment's "group number". For the purposes of this project, each indoor unit will be considered to be a group.
8. The Mitsubishi system works on a "Last Command Wins" methodology. Meaning that the last command that a remote unit receive, be it from the DDC system via BACnet or via the remote control unit will be the command that is executed. So, if the DDC system refreshes its commands ever minute, an occupant who is, for instance, trying to adjust the set point, will not be able to get their adjustment to "stick" longer than one minute. Programming logic that manipulates this point should take this contingency into account to ensure local commands by the occupants are not immediately over-ridden by a DDC system command that was intended to only be a one time command.
9. This error code indicates an error in a certain category has occurred with the text parameter indicating the category as follows: 01 = Normal; 02 = Other error; 03 = Refrigeration system fault; 05; 06 = Electronic system error; 07 = Sensor fault; 08 = Communication error; 09 = System error. For each unit, if this point is set by the Mitsubishi system, the Siemens control programming should annunciate the specific alarm condition indicated by the parameter code and advice that the operator log into the Mitsubishi maintenance tool for additional information.
10. Possible states are 01 = Cooling, 02 = Heating, 03 - Fan only, 04 = Auto fan control, 05 = Dry, and 06 = Setback. The Siemens logic shall be arranged to allow the remote operator to select any of the operating modes via a graphic button. Note that to use the Dry feature, it must be must be enabled by selecting the "Use Mode Type Dry" option in the BAC-HD150.
11. "Dry Mode" provides additional dehumidification two things. One is that it locks the fan to low speed. As a result, all other things being equal, the air spends more time passing through the coil and comes off of it at a lower dry bulb and dew point temperature, which will tend to dehumidify the space (due to the lower leaving air temperature) with out over-cooling it (due to the reduced flow rate). The function also causes the fan and compressor to cyle on for three minutes out of every 10 minutes once the system has reached your desired space temperature set point, even if the space temperature has not gone up significantly. As a result, at low load conditions, "Dry Mode" can drop the space temperature significantly below set point, which can be confusing if you do not understand what is going on.
12. Applies only to units with movable vanes. Possible states are Horizontal, Down blow 60°. Down blow 80°, Down blow 100°, and swing. For the units associated with this point list, the function is not profided and no programming will be required to support it.
13. Possible states are 01 = Cooling, 02 = Heating, 03 - Fan only, 04 = Auto fan control, 05 = Dry, and 06 = Setback. Note that the Dry feature must be enabled by selecting the "Use" option.
14. Dry mode provides additional dehumidification by reducing the fan speed. As a result, all other things being equal, the air comes off the evaporator coil at a lower dry bulb and dew point temperature, which will tend to dehumidify the space (due to the lower leaving air temperature) with out over-cooling it (due to the reduced flow rate).
15. Possible states are 01 = Low, 02 = High, 03 - Mid 2, and 05 = Mid 1. Note that the Mid1 and Mid2 settings must be enabled by selecting the "Use" option.
16. Possible states are Horizontal, Down blow 60°. Down blow 80°, Down blow 100°, and swing
17. Two wire remote controller wired directly to the fan coil unit controller board.
18. VRF 1, 2 and 7 only.
19. VRF 3, 4, 5, and 9 only.
20. Electro-chemical gas detector sensors provide 4-20 ma outputs that are run through the Siemens system in series with the detector for monitoring and control purposes. Local control and alarm functions to be hard wired and provided by the gas detector contacts.
21. Furnish and install a two position minimum outdoor air damper and actuator in the minimum outdoor air connection to the VRF indoor unit.
22. Proves fan operation for the minimum outdoor air damper interlock;

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CITY OF SEATTLE

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PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE
1 Revision 1 - Addendum 5 - 2016-02-19	

SHEET TITLE

VFR Indoor Unit Point List

SHEET NUMBER

TC 0.21

Mitsubishi Typical Outdoor Unit Point List

Point Name	Number [BACnet Object ID] (Notes 11, 12)	System and Service	Sensor Type	Accuracy	Alarms Limit Hi	Alarms Limit Lo	Alarms Warning Hi	Alarms Warning Lo	Samples1	Commissioning5 Time2	Commissioning5 Local3	Commissioning5 Archive4	Operating5 Time2	Operating5 Local3	Operating5 Archive4	Notes
Analog Inputs																
Compressor 1 high side pressure		Compressor 1 high side refrigerant pressure	Ashcroft A2	.25% Accuracy Class					60	1 sec	✓	✓	1 sec	✓	✓	Note 8
Compressor 1 low side pressure		Compressor 1 low side refrigerant pressure	Ashcroft A2	.25% Accuracy Class					60	1 sec	✓	✓	1 sec	✓	✓	Note 8
Compressor 1 high side temperature		Compressor 1 high side refrigerant line temperature	1,000 Ω 4-wire Pt RTD with 4-20 ma transmitter	Note 6					60	1 sec	✓	✓	1 sec	✓	✓	Note 9
Compressor 1 low side temperature		Compressor 1 low side refrigerant line temperature	1,000 Ω 4-wire Pt RTD with 4-20 ma transmitter	Note 6					60	1 sec	✓	✓	1 sec	✓	✓	Note 9
Compressor 2 high side pressure		Compressor 2 high side refrigerant pressure	Ashcroft A2	.25% Accuracy Class					60	1 sec	✓	✓	1 sec	✓	✓	Note 8
Compressor 2 low side pressure		Compressor 2 low side refrigerant pressure	Ashcroft A2	.25% Accuracy Class					60	1 sec	✓	✓	1 sec	✓	✓	Note 8
Compressor 2 high side temperature		Compressor 2 high side refrigerant line temperature	1,000 Ω 4-wire Pt RTD with 4-20 ma transmitter	Note 6					60	1 sec	✓	✓	1 sec	✓	✓	Note 9
Compressor 2 low side temperature		Compressor 2 low side refrigerant line temperature	1,000 Ω 4-wire Pt RTD with 4-20 ma transmitter	Note 6					60	1 sec	✓	✓	1 sec	✓	✓	Note 9
Compressor 1 crankcase temperature		Compressor 1 crankcase temperature on the bottom half	1,000 Ω 4-wire Pt RTD with 4-20 ma transmitter	Note 6					60	1 sec	✓	✓	1 sec	✓	✓	Note 9
Compressor 1 amps		Pre-VSD amps to the compressor	Current transformer, 1 phase						60	1 sec	✓	✓	1 sec	✓	✓	Note 10
Condenser fan 1 amps		Pre-VSD amps to the condenser fan	Current transformer, 1 phase						60	1 sec	✓	✓	1 sec	✓	✓	Note 10
Compressor 2 crankcase temperature		Compressor 2 crankcase temperature on the bottom half	1,000 Ω 4-wire Pt RTD with 4-20 ma transmitter	Note 6					60	1 sec	✓	✓	1 sec	✓	✓	Note 9
Compressor 2 amps		Pre-VSD amps to the compressor	Current transformer, 1 phase						60	1 sec	✓	✓	1 sec	✓	✓	Note 10
Condenser fan 2 amps		Pre-VSD amps to the condenser fan	Current transformer, 1 phase						60	1 sec	✓	✓	1 sec	✓	✓	Note 10
Virtual Points																
Low charge diagnostic		Uses multiple points to determine low charge	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	Note 7
Overcharge diagnostic		Uses multiple points to determine high charge	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	Note 7
Defrost cycle failure		Uses multiple points to determine defrost failed	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	Note 7

Notes:

1. Samples indicates the minimum number of data samples that must be held in the local controller if it is trending the point.
2. Time indicates the required sampling time for the trending function.
3. A check in the local column indicates that the trending only needs to be running in the local controller and the most recent value can write over the last value when the trend buffer fills up.
4. A check in the archive column indicates that the trend data must be archived to the system hard disc when trend buffer fills up so that a continuous trend record is maintained.
5. Commissioning trending requirements only need to be implemented during the start-up and warranty year. After the start-up and warranty process, the control contractor should set the trending parameters to the operating requirements listed if they differ from the commissioning requirements.
6. 0.12% of reading for the RTD, .012% of span for the transmitter.
7. See narrative sequence and logic diagrams for diagnostic definition.
8. Install a tee with two service valves on the existing pressure connection. Install a service fitting on the branch of the tee and connect the pressure transmitter to the other side of the tee. Coordinate with Mitsubishi as required to verify and prove the integrity of the piping connections when they charge the system.
9. Install pipe surface temperature RTDs adjacent to the Mitsibusihi temperature sensors at these locations. Route RTD leads to the 4-20 ma transmitters located in a stainless steel NEMA4 enclosure adjacent to ACC-1. Coordinate with the mechanical contractor to support the enclosure from the same roof curb system that is used for ACC-1 and to penetrate the roof with cables to the control panel along with the refrigeration piping. See detail.
10. Coordinate with Mitsubishi to mount CTs in their wiring compartment as required to pick up the indicated data. Monitor amps to provide a proof of operation in put and create a virtual meter to track energy use. Accumulate and display current demand level, kWh for the day, and kWh for the previous day, calendar month, and calendar year. Archive data to the data to the dedicated archival data storage drive in the City's Data Center. See Network Diagram.
11. Point numbers will be determined once the Owner's point naming standard is finalized. And this list will be updated at that time. For BACnet points, "xx" refers to the equipment's "group number". For the purposes of this project, each indoor unit will be considered to be a group.
12. The BACnet data and error codes associated with the outdoor unit and branch controller are passed to the system via BACnet objects associated with the indoor units.

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PROFESSIONAL ENGINEER
1/11/16

PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE

SHEET TITLE
VRF Outdoor Unit Point List

SHEET NUMBER
TC 0.22

Apparatus Bay Point List

Point Name	Number [BACnet Object ID], Note 7	System and Service	Sensor Type	Sensor Accuracy	Features: Alarms Limit Hi	Alarms Limit Lo	Alarms Warning Hi	Alarms Warning Lo	Trending Samples1	Commissioning5 Time2	Commissioning5 Local3	Commissioning5 Archive4	Operating5 Time2	Operating5 Local3	Operating5 Archive4	Notes
Analog Inputs																
Space temperature		Apparatus bay space temperature	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	Note 6					30	2 min	✓	✓	5 min	✓	✓	
Space temperature set point		Apparatus Bay space temperature set point	Integral with space temperature sensor	N/A					10	COV	✓	✓	COV	✓	✓	
UH-2flue gas temperature		IH-1 flue gas temperature	Thermocouple with 4-20 ma transmitter	+/- 3°F					60	1 min	✓	✓	5 min	✓	✓	Note 8
UH-3 flue gas temperature		IH-1 flue gas temperature	Thermocouple with 4-20 ma transmitter	+/- 3°F					60	1 min	✓	✓	5 min	✓	✓	Note 8
UH-4flue gas temperature		IH-1 flue gas temperature	Thermocouple with 4-20 ma transmitter	+/- 3°F					60	1 min	✓	✓	5 min	✓	✓	Note 8
UH-5 flue gas temperature		IH-1 flue gas temperature	Thermocouple with 4-20 ma transmitter	+/- 3°F					60	1 min	✓	✓	5 min	✓	✓	Note 8
Apparatus Bay Nitros Oxide Level		Indication signal from the ventilation controller	Brash GSE NCM 0 gas detector analog output	+/-5%					60	1 min	✓	✓	5 min	✓	✓	Note 10
Apparatus Bay Carbon Monoxide Level		Indication signal from the ventilation controller	Brash GSE NCM 0 gas detector analog output	+/-5%					60	1 min	✓	✓	5 min	✓	✓	Note 10
EF-5 Fan Amps		Exhaust fan amps for proof of operation and energy	Current Transformer	+/- 10% Full scale					60	1 min	✓	✓	1 min	✓	✓	Note 12, 13
Vehical Exaust Fan Amps		Exhaust fan amps for proof of operation and energy	Current Transformer	+/- 10% Full scale					60	1 min	✓	✓	1 min	✓	✓	Note 13, 15
Analog Outputs																
Ventialtion Air Intake Damper Command		Intake hood RV-2	4-20 ma output	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 18
Digital Inputs																
Northwest App Bay Door Switch		Shuts down UH-2 -5 if the App Bay doors are open	End switch, Note 9	N/A					10	COV	✓	✓	COV	✓	✓	
Southwest App Bay Door Switch		Shuts down UH-2 -5 if the App Bay doors are open	End switch, Note 9	N/A					10	COV	✓	✓	COV	✓	✓	
Northeast App Bay Door Switch		Shuts down UH-2 -5 if the App Bay doors are open	End switch, Note 9	N/A					10	COV	✓	✓	COV	✓	✓	
Southeast App Bay Door Switch		Shuts down UH-2 -5 if the App Bay doors are open	End switch, Note 9	N/A					10	COV	✓	✓	COV	✓	✓	
EF-5 Start High/Low Speed Request		Provides manual request for EF-5 speed change	SPDT momentary wall switch	N/A					10	COV	✓	✓	COV	✓	✓	Note 10, 11
Apparatus Bay High Gas Level Alarm		Apparatus Bay gas monitoring system	Brash GSE NCM 0 gas detector dry contact	N/A					10	COV	✓	✓	COV	✓	✓	Note 10
Digital Outputs (All digital outputs to include local override capability and indication)																
UH-2 Fan Start/Stop		Starts and stops the unit heater fan	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
UH-2 Stage 1 Heat		Turns the gas valve on and off	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
UH-3 Fan Start/Stop		Starts and stops the unit heater fan	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
UH-3 Stage 1 Heat		Turns the gas valve on and off	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
UH-4 Fan Start/Stop		Starts and stops the unit heater fan	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
UH-4 Stage 1 Heat		Turns the gas valve on and off	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
UH-5 Fan Start/Stop		Starts and stops the unit heater fan	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
UH-5 Stage 1 Heat		Turns the gas valve on and off	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
EF-5 High Speed Command		EF-5 hi speed trigger for Brash controller interlock	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	Note 10
Vehical Exhaust Fan Enable		Enables local vehical exhaust fan control system	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
Safety Interlocks (Hardwired to shut down r otherwise manipulate the system. Safeties shall function no matter what position the equipment's Hand-Off-Auto, Inverter-Bypass, or other selector switches are in)																
EF-5 Low Speed Command		Hardwired Brash ventilation controller output	N/A	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 10, 11
EF-5 High Speed Command		Hardwired Brash ventilation controller output	N/A	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 10, 11
EF-5 Backdraft Damper Command		Hardwired interlock with ECM motor controller	N/A	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 14
Destratification Fan Speed Control		Hardwired factory switch	N/A	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 15
Virtual Points																
Space Temperature Set point - Low End		Low end of space temperature span	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 17
Space Temperature Set Point - Low end		High end of space temperature span	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 17
Gas Transmitter Recalibration Timer		Triggers a calibration alarm every 2 years	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	
CO Sensor Replacement Timer		Triggers a maintenance alarm, Note 19.	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	
NO2 Sensor Replacement Timer		Triggers a maintenance alarm, Note 19.	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	
EF-5 kw and kWH Acculation		Virtual enegy meter	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	
EF-5 Run Time Accumulation - Low Speed		Hours of operation accumulation	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	
EF-5 Run Time Accumulation - High Speed		Hours of operation accumulation	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	
RV-2 Intake Damper EF-5 Low Speed Position		Damper position at low exhaust flow rates	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 18
RV-2 Intake Damper EF-5 High Speed Position		Damper position at high exhaust flow rates	Logic generated	N/A					0	N/A	N/A	N/A	N/A	N/A	N/A	Note 18

Notes:

1. Samples indicates the minimum number of data samples that must be held in the local controller if it is trending the point.
2. Time indicates the required sampling time for the trending function.
3. A check in the local column indicates that the trending only needs to be running in the local controller and the most recent value can write over the last value when the trend buffer fills up.
4. A check in the archive column indicates that the trend data must be archived to the system hard disc when trend buffer fills up so that a continuous trend record is maintained.
5. Commissioning trending requirements only need to be implemented during the start-up and warranty year. After the start-up and warranty process, the control contractor should set the trending parameters to the operating requirements listed if they differ from the commissioning requirements.
6. Not used
7. Point numbers will be determined once the Owner's point naming standard is finalized. And this list will be updated at that time. For BACnet points, "xx" refers to the equipment's "group number". For the purposes of this project, each indoor unit will be considered to be a group.
8. Used as a proof of operation input and also as a loss of efficiency alarm. Also use the proof of operation input to create a virtual meter to track energy use. Accumulate and display current demand level, kWh for the day, and kWh for the previous day, calendar month, and calendar year. Archive data to the data to the dedicated archival data storage drive in the City's Data Center. See Network Diagram.
9. Coordinate with door supplier for a dry contact that indicates the door has fully opened.
10. Furnish and install a Brash GSE stand alone gas detector and ventioation controller. Wire the controller outputs to allow the Siemens system to moniotor the real time nitrous oxide and carbon monoxide levels via 4-20 ma current loops, and the alarm state via a dry contact. Wire the Siemens EF-5 high speed request output to trigger high speed fan operation based on the Siemens logic. Provide 24 vac power from the Siemens BC-1 location. Wire the output relays to trigger low or high speed operation based on safe gas levels (low speed) or hazardous gas levels (hight speed) or a manual request for high speed operation from the Siemens system. Coordinate with the EF-5 vendor to ensure the ECM motor supplied with the fan is arranged for two speed operation via contact closure inputs to the motor controller.
11. Arrange logic so that each button push changes the fan speed from the current state to the other available state; i.e. if the fan is on high speed, it goes to low speed and if the fan is on low speed it goes to high speed. The hard wired interlocks from the ventilation controller shall be arranged to over-ride the manually initiated speed requests from the Siemens system and keep EF-5 on high speed if the controller is in an alarm state.
12. Siemens logic shall use this input to create a proof of operation virtual point for EF-5 showing the off state, low speed state and high speed state.
13. Siemens logic shall use this value along with voltage and powerfactor costants to create a virtual meter for this piece of equipment. Voltage and power factor constants shall be determined during the commissioning process via a joint effort between Siemens, the commissioning provider and Division 26
14. Provide motorized backdraft damper actuator power to the ECM motor controller back draft damper control output. Coordinate with the fan supplier as required.
15. Typical for 4 fans. Submit proposed wiring for approval prior to installing the switch and raceway system.
16. Siemens logic shall use this input to create a proof of operation virtual point for this piece of equipment.
17. Sets the span over which the unit heaters will go from fan only operation and stage up to all four units in operation.
18. Coordinate with the balancing contractor and commissioning provider to determine the positions required for this output when EF-5 is on low speed with the Vehicle Exhaust Fan in operation (position 1) and when EF-5 is on high speed with the Vehcle Exhaust Fan in operation (position 2) to ensure the design flows and pressure relationships are achived. Coordinate with the open the damper when EF-5 is on high speed. Close the damper with EF-5 and the Vehicle Exhaust Fan are off.
19. The electro-chemical sensors used by the detector have a useful lifetime and must be replaced occasionally. This point is a timer that is set based on the recommended replacement date shown on the electro-chemical sensor board.

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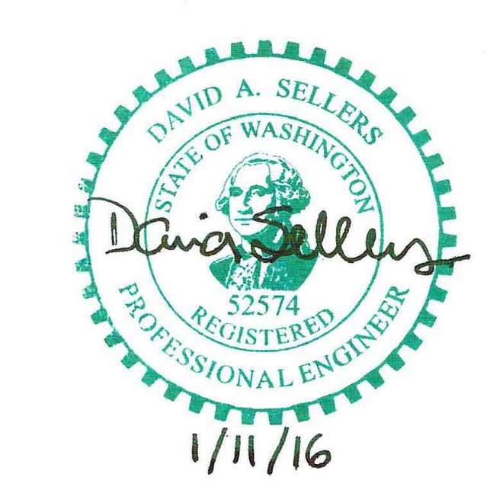

PROJECT-NO	13004
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SHEET TITLE
Apparatus Bay Point List

SHEET NUMBER
TC 0.31

Split System Outdoor Unit ODU-1 and Indoor Unit 1 Point List

Point: Name	Number [BACnet Object ID] (Notes 22, 23)	System and Service	Sensor: Type	Accuracy	Features: Alarms: Limit: Hi	Limit: Lo	Warning: Hi	Warning: Lo	Trending: Samples1	Commissioning5: Time2	Commissioning5: Local3	Commissioning5: Archive4	Operating5: Time2	Operating5: Local3	Operating5: Archive4	Notes
Analog Inputs																
Compressor 1 high side pressure		Compressor 1 high side refrigerant pressure	Ashcroft A2	.25% Accuracy Class					60	1 sec	✓	✓	1 sec	✓	✓	Note 19
Compressor 1 low side pressure		Compressor 1 low side refrigerant pressure	Ashcroft A2	.25% Accuracy Class					60	1 sec	✓	✓	1 sec	✓	✓	Note 19
Compressor 1 high side temperature		Compressor 1 high side refrigerant line temperature	1,000 Ω 4-wire Pt RTD with 4-20 ma transmitter	Note 6					60	1 sec	✓	✓	1 sec	✓	✓	Note 20
Compressor 1 low side temperature		Compressor 1 low side refrigerant line temperature	1,000 Ω 4-wire Pt RTD with 4-20 ma transmitter	Note 6					60	1 sec	✓	✓	1 sec	✓	✓	Note 20
Compressor 1 crankcase temperature		Compressor 1 crankcase temperature on the bottom half	1,000 Ω 4-wire Pt RTD with 4-20 ma transmitter	Note 6					60	1 sec	✓	✓	1 sec	✓	✓	Note 20
Compressor 1 amps		Pre-VSD amps to the compressor	Current transformer, 1 phase						60	1 sec	✓	✓	1 sec	✓	✓	Note 21
Condenser fan 1 amps		Pre-VSD amps to the condenser fan	Current transformer, 1 phase						60	1 sec	✓	✓	1 sec	✓	✓	Note 21
Hardwired Points																
Multi-function controller		Fan coil unit multi-function controller	Mitsubishi PAR-U01MEDU remote controller	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 17
BACnet Points																
On/Off Set-up	[BO_01xx01}	Start/stop fan coil unit	Binary Output Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
On/Off State	[BI_01xx02]	Operating status feedback	Binary Input Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Alarm Signal	[BI_01xx03]	Alarm signal	Binary Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Error Code	[MI_01xx04]	General indication of an error, Note 9	Multistate Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Operating Mode Set-up	[MO_01xx05	Sets the unit into 1 of 6 operating states, Note 10, 11	Multistate Output Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Operating Mode State	[MI_01xx06]	Operating status feedback; Note 10, 11	Multistate Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Fan Speed Set-up	[MO_01xx07]	Allows fan speed to be set; Note 11	Multistate Output Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Fan Speed State	[MI_01xx08]	Fan speed status feedback	Multistate Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Room Temperature	[AI_01xx09]	Space temperature indication	Analog Input Network point	N/A					60	1 min	✓	✓	1 min	✓	✓	Notes 7, 8
Set Temperature	[AV_01xx10]	Space temperature set point adjustment	Analog Command or Value Network point	N/A					60	1 min	✓	✓	1 min	✓	✓	Notes 7, 8
Filter Sign	[BI_01xx11]	Change filter indication	Binary Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Filter Sign Reset	[BV_401xx12]	Change filter indication reset	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Prohibit On/Off	[BV_01xx13]	Prohibits a remote control over ride of On/Off state	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Prohibit Mode	[BV_01xx14]	Prohibits a remote control over ride of operating mode	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Prohibit Filter Sign Reset	[BV_01xx15]	Prohibits a remote control reset of filter alarm	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Prohibit Set Temperature	[BV_01xx16]	Prohibits a remote control from adjusting set point	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
MNet Communication State	[BI_01xx20]	Indicates if there is an MNet error	Binary Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
System Force Off	[BV_01xx21]	Forces the unit to the off state	Binary Value Network Point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Air Direction Set	[MO_0xx22}	Sets air flow direction; Note 12	Multistate Output Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Air Direction State	[MI_01xx23]	Flow direction feedback, Note 12	Multistate Input Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set Temp Cool	[AV_01xx24]	Sets a temporary cooling set point	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set Temp Heat	[AV_01xx25]	Sets a temporary heating set point	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set Temp Auto	[AV_01xx26]	Sets a temporary set point for Auto mode	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set High Limit Set Back Temp	[AV_01xx27]	Sets the high limit during the unoccupied cycle	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Set Low Limit Set Back Temp	[AV_01xx28]	Set the low limit during the unoccupied cycle	Analog Command or Value Network point	N/A					20	COV	✓	✓	COV	✓	✓	Notes 7, 8
Virtual Points																
Low charge diagnostic		Uses multiple points to determine low charge	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	Note 18
Overcharge diagnostic		Uses multiple points to determine high charge	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	Note 18
Defrost cycle failure		Uses multiple points to determine defrost failed	Logic generated	N/A					5	COV	✓	✓	COV	✓	✓	Note 18

Notes:

1. Samples indicates the minimum number of data samples that must be held in the local controller if it is trending the point.
2. Time indicates the required sampling time for the trending function.
3. A check in the local column indicates that the trending only needs to be running in the local controller and the most recent value can write over the last value when the trend buffer fills up.
4. A check in the archive column indicates that the trend data must be archived to the system hard disc when trend buffer fills up so that a continuous trend record is maintained.
5. Commissioning trending requirements only need to be implemented during the start-up and warranty year. After the start-up and warranty process, the control contractor should set the trending parameters to the operating requirements listed if they differ from the commissioning requirements.
6. 0.12% of reading for the RTD, .012% of span for the transmitter.
7. Unit specific point numbers to be developed by the control contractor based on the Owner's point naming standard and included with the programming submittal for review and approval. For BACnet points, "xx" refers to the equipment's "group number". For the purposes of this project, each indoor unit will be considered to be a group.
8. The Mitsubishi system works on a "Last Command Wins" methodology. Meaning that the last command that a remote unit receive, be it from the DDC system via BACnet or via the remote control unit will be the command that is executed. So, if the DDC system refreshes its commands ever minute, an occupant who is, for instance, trying to adjust the set point, will not be able to get their adjustment to "stick" longer than one minute. Programming logic that manipulates this point should take this contingency into account to ensure local commands by the occupants are not immediatly over-ridden by a DDC system command that was intended to only be a one time command.
9. This error code indicates an error in a certain category has occurred with the text parameter indicating the category as follows: 01 = Normal; 02 = Other error; 03 = Refrigeration system fault; 05; 06 = Electronic system error; 07 = Sensor fault; 08 = Communication error; 09 = System error. For each unit, if this point is set by the Mitsubishi system, the Siemens control programming should annunciate the specific alarm condition indicated by the parameter code and advice that the operator log into the Mitsubishi maintenance tool for additional information.
10. Possible states are 01 = Cooling, 02 = Heating, 03 - Fan only, 04 = Auto fan control, 05 = Dry, and 06 = Setback. The Siemens logic shall be arranged to allow the remote operator to select any of the operating modes via a graphic button. Note that to use the Dry feature, it must be must be enabled by selecting the "Use Mode Type Dry" option in the BAC-HD150.
11. "Dry Mode" provides additional dehumidification two things. One is that it locks the fan to low speed. As a result, all other things being equal, the air spends more time passing through the coil and comes off of it at a lower dry bulb and dew point temperature, which will tend to dehumidify the space (due to the lower leaving air temperature) with out over-cooling it (due to the reduced flow rate). The function also causes the fan and compressor to cyle on for three minutes out of every 10 minutes once the system has reached your desired space temperature set point, even if the space temperature has not gone up significantly. As a result, at low load conditions, "Dry Mode" can drop the space temperature significantly below set point, which can be confusing if you do not understand what is going on.
12. Applies only to units with movable vanes. Possible states are Horizontal, Down blow 60°. Down blow 80°, Down blow 100°, and swing. For the units associated with this point list, the function is not profided and no programming will be required to support it.
13. Possible states are 01 = Cooling, 02 = Heating, 03 - Fan only, 04 = Auto fan control, 05 = Dry, and 06 = Setback. Note that the Dry feature must be enabled by selecting the "Use" option.
14. Dry mode provides additional dehumidification by reducing the fan speed. As a result, all other things being equal, the air comes off the evaporator coil at a lower dry bulb and dew point temperature, which will tend to dehumidify the space (due to the lower leaving air temperature) with out over-cooling it (due to the reduced flow rate).
15. Possible states are 01 = Low, 02 = High, 03 - Mid 2, and 05 = Mid 1. Note that the Mid1 and Mid2 settings must be enabled by selecting the "Use" option.
16. Possible states are Horizontal, Down blow 60°. Down blow 80°, Down blow 100°, and swing
17. Two wire remote controller wired directly to the fan coil unit controller board.
18. See narrative sequence and logic diagrams for diagnostic definition.
19. Install a tee with two service valves on the existing pressure connection. Install a service fitting on the branch of the tee and connect the pressure transmitter to the other side of the tee. Coordinate with Mitsubishi as required to verify and prove the integrity of the piping connections when they charge the system.
20. Install pipe surface temperature RTDs adjacent to the Mitsibusihi temperature sensors at these locations. Route RTD leads to the 4-20 ma transmitters located in a stainless steel NEMA4 enclosure adjacent to ACC-1. Coordinate with the mechanical contractor to support the enclosure from the same roof curb system that is used for ACC-1 and to penetrate the roof with cables to the control panel along with the refrigeration piping. See detail.
21. Coordinate with Mitsubishi to mount CTs in their wiring compartment as required to pick up the indicated data. Monitor amps to provide a proof of operation in put and create a virtual meter to track energy use. Accumulate and display current demand level, kWh for the day, and kWh for the previous day, calendar month, and calendar year. Archive data to the data to the dedicated archival data storage drive in the City's Data Center. See Network Diagram.
22. Point numbers will be determined once the Owner's point naming standard is finalized. And this list will be updated at that time. For BACnet points, "xx" refers to the equipment's "group number". For the purposes of this project, each indoor unit will be considered to be a group.
23. The BACnet data and error codes associated with the outdoor unit and branch controller are passed to the system via BACnet objects associated with the indoor units.

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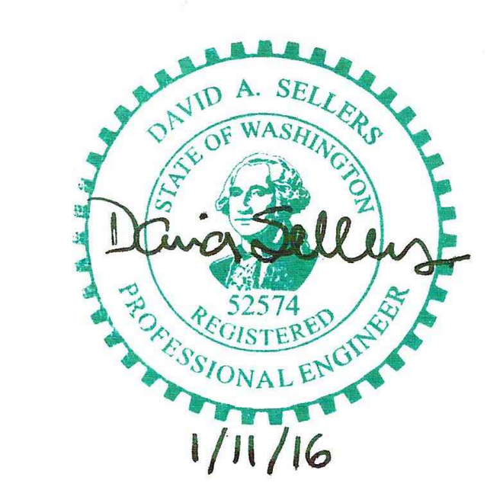

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SHEET TITLE
ODU-1 and IDU-1 Point List

SHEET NUMBER
TC 0.40

Misc. Point List

Point Name	Number [BACnet Object ID], Note 7	System and Service	Sensor Type	Sensor Accuracy	Features: Alarms Limit Hi	Alarms Limit Lo	Alarms Warning Hi	Alarms Warning Lo	Trending Samples1	Trending Commissioning5 Time2	Trending Commissioning5 Local3	Trending Commissioning5 Archive4	Trending Operating5 Time2	Trending Operating5 Local3	Trending Operating5 Archive4	Notes
Analog Inputs																
Electric heater EH-1 space temperature		Restroom 112 space temperature sensor	1,000 Ω Pt RTD with close coupled transmitter	Note 6					30	2 min	✓	✓	5 min	✓	✓	
Electric heater EH-1 set point adjustment		EH-1 set point adjustment	Set point adjustment						30	2 min	✓	✓	1 min	✓	✓	Note 10
Electric heater EH-3 space temperature		Lobby space temperature sensor	1,000 Ω Pt RTD with close coupled transmitter	Note 6					30	2 min	✓	✓	5 min	✓	✓	
Electric heater EH-3 set point adjustment		EH-3 set point adjustment	Set point adjustment						30	2 min	✓	✓	1 min	✓	✓	Note 10
Electric heater EH-4 space temperature		Maintenance 108 space temperature sensor	1,000 Ω Pt RTD with close coupled transmitter	Note 6					30	2 min	✓	✓	5 min	✓	✓	
Electric heater EH-4 set point adjustment		EH-4 set point adjustment	Set point adjustment						30	2 min	✓	✓	1 min	✓	✓	Note 10
Electric heater EH-7 space temperature		MDS Storage space temperature sensor	1,000 Ω Pt RTD with close coupled transmitter	Note 6					30	2 min	✓	✓	5 min	✓	✓	
Electric heater EH-7 set point adjustment		EH-7 set point adjustment	Set point adjustment						30	2 min	✓	✓	1 min	✓	✓	Note 10
Domestic hot water supply temperature		Domestic water temperature to the loads	Insertion 1,000 Ω Pt RTD with close coupled transmitter	Note 6					60	1 sec	✓	✓	1 min	✓	✓	
Domestic hot water return temperature		Domestic water temperature at the return pump	Insertion 1,000 Ω Pt RTD with close coupled transmitter	Note 6					60	1 sec	✓	✓	1 min	✓	✓	
Domestic hot water pump amps		Pump amps	Set point adjustment						60	1 min	✓	✓	1 min	✓	✓	
Battery Charger Proof		Generator Battery Charger Proof of Operation	DC voltage transmitter	+/- 0.5% Full Scale					60	1 min	✓	✓	1 min	✓	✓	
Heater Proof of Operation		Generator Block Heater Proof of Operation	Surface temperature transmitter	+/- 0.5% Full Scale					60	1 min	✓	✓	1 min	✓	✓	
Whole Building Electric Meter		Whole building electrical consumption	Pick up retransmitted signal from the utiltiy						60	1 min	✓	✓	1 min	✓	✓	Note 13, 14
Whole Building Gas Meter		Whole building gas consumption	Pick up retransmitted signal from the utiltiy						60	1 min	✓	✓	1 min	✓	✓	Note 13, 15
UH-1 Gas Meter		UH-1 gas consumption	Sensus M-1002 with RIOtronics pulser						60	1 min	✓	✓	1 min	✓	✓	Note 14, 15, 17
UH-2 through 5 and DHW Gas Meter		UH-2 through 5 and DHW gas consumption	Sensus M-1002 with RIOtronics pulser						60	1 min	✓	✓	1 min	✓	✓	Note 14 - 17
MUAU Gas Meter		MUAU gas consumption	Sensus M-1002 with RIOtronics pulser						60	1 min	✓	✓	1 min	✓	✓	Note 14, 15, 17
Domestic Hot Water Gas Meter		Domestic hot water heater gas consumption	Sensus M-1002 with RIOtronics pulser						60	1 min	✓	✓	1 min	✓	✓	Note 14, - 17
Whole Building Water Meter WM-1		Whole building water consumption	Line size Neptune Tru/Flo Compound Meter	1%/1-1/2%					60	1 min	✓	✓	1 min	✓	✓	Note 12, 14
Rain Water Prefilter Differential Pressure		Rainwater Harvesting System	Differential Pressure Transmitter	+/- 2% Full Scale					10	COV	✓	✓	COV	✓	✓	Note 25
Rain Water Final Filter Differential Pressure		Rainwater Harvesting System	Differential Pressure Transmitter	+/- 2% Full Scale					10	COV	✓	✓	COV	✓	✓	Note 25
Rain Water System Supply Pressure		Rainwater Harvesting System	Pressure Transmitter	+/- 2% Full Scale					10	COV	✓	✓	COV	✓	✓	Note 25
Digital Inputs																
Transfer Switch Proof of Operation		Automatic transfer switch status	Isolated contact	N/A					10	COV	✓	✓	COV	✓	✓	Note 18
Fitness Center occupancy sensor		North Fitness Center occupancy detection	Occupancy switch	N/A					10	COV	✓	✓	COV	✓	✓	
Beanery occupancy sensor		North Fitness Center occupancy detection	Occupancy switch	N/A					10	COV	✓	✓	COV	✓	✓	
Day Room occupancy sensor		North Fitness Center occupancy detection	Occupancy switch	N/A					10	COV	✓	✓	COV	✓	✓	
Fire alarm indication		Fire alarm status	Isolated contact	N/A					10	COV	✓	✓	COV	✓	✓	Nnote 21
Rain Water System Tank Level Alarm		Rainwater Harvesting System	Isolated contact	N/A					10	COV	✓	✓	COV	✓	✓	Note 24
Rain Water System General Alarm		Rainwater Harvesting System	Isolated contact	N/A					10	COV	✓	✓	COV	✓	✓	Note 24
Digital Outputs (All digital outputs to include local override capability and indication)																
EH-1 On/Off		EH-1 space temperature control	Relay output, Note 9	N/A					10	COV	✓	✓	COV	✓	✓	
EH-3 On/Off		EH-3 space temperature control	Relay output, Note 9	N/A					10	COV	✓	✓	COV	✓	✓	
EH-4 On/Off		EH-4 space temperature control	Relay output, Note 9	N/A					10	COV	✓	✓	COV	✓	✓	
EH-6 On/Off		EH6 space temperature control	Relay output, Note 9, 10	N/A					10	COV	✓	✓	COV	✓	✓	
EH-7 On/Off		EH-7 space temperature control	Relay output, Note 9	N/A					10	COV	✓	✓	COV	✓	✓	
Domestic hot water pump start/stop		Domestic hot water recirculation pump command	Relay output	N/A					10	COV	✓	✓	COV	✓	✓	
Hard Wired Points																
Rainwater tank 1 level sensor		Interlock wiring for the rain water system	By Rainwater Harvesting System Vendor	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 22
Rainwater harvesting flush water make up meter		Interlock wiring for the rain water system	By Rainwater Harvesting System Vendor	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 22
Rainwater harvesting irrigation make up meter		Interlock wiring for the rain water system	By Rainwater Harvesting System Vendor	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 22
Rainwater harvesting flush water make up alarm		Interlock wiring for the rain water system	By Rainwater Harvesting System Vendor	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 22
Rainwater harvesting irrigation make up alarm		Interlock wiring for the rain water system	By Rainwater Harvesting System Vendor	N/A					N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 22
Safety Interlocks (Hardwired to shut down the system. Safeties shall function no matter what position the equipment's Hand-Off-Auto, Inverter-Bypass, or other selector switches are in)																
Air compressor emergency stop		Hardwired emergency stop switch at door	Mushroom switch as required by code	N/A					10	COV	✓	✓	COV	✓	✓	
Virtual Points																
Domestic hot water set point		Set point for cycling domestic water pump	N/A	N/A					5	COV	✓	✓	COV	✓	✓	
Network Points																
Emergency Generator Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Panel M2 Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Panel G2 Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Panel G1 Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Vehical Charging Station Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Panel ELB Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Panel MB Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Panel LB Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Panel GB Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Photovoltaic Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Rainwater Harvesting System Energy		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19
Power Monitoring Points 1 - 20		LEED Monitoring and Verification	Modbus Interface to the Electrical Power Monitoring System	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 14, 19, 20
Tank 1 level		Rainwater Harvesting System	BACnet Point	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 23
Tank 2 level		Rainwater Harvesting System	BACnet Point	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 23
Rainwater Flow		Rainwater Harvesting System	BACnet Point	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 23
Irrigation Make Up Flow		Rainwater Harvesting System	BACnet Point	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 23
Flush Water Make Up Flow		Rainwater Harvesting System	BACnet Point	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 23
UV Fault		Rainwater Harvesting System	BACnet Point	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 23
Rainwater pump speed		Rainwater Harvesting System	BACnet Point	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 23
Rainwater pump differential pressure		Rainwater Harvesting System	BACnet Point	N/A					60	1 min	✓	✓	1 min	✓	✓	Note 23

See sheet TC 042 for Notes

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1/11/16

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PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
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1	Revision 1 - Addendum 5 - 2016-02-19

SHEET TITLE
Miscellaneous Point List

SHEET NUMBER
TC0.41

1
Add. 05

Rainwater pump differential pressure	Rainwater Harvesting System	BACnet Point	N/A	60	1 min	√	√	1 min	√	√	Note 25

Notes:

1.	Samples indicates the minimum number of data samples that must be held in the local controller if it is trending the point.
2.	Time indicates the required sampling time for the trending function.
3.	A check in the local column indicates that the trending only needs to be running in the local controller and the most recent value can write over the last value when the trend buffer fills up.
4.	A check in the archive column indicates that the trend data must be archived to the system hard disc when trend buffer fills up so that a continuous trend record is maintained.
5.	Commissioning trending requirements only need to be implemented during the start-up and warranty year. After the start-up and warranty process, the control contractor should set the trending parameters to the operating requirements listed if they differ from the commissioning requirements.
6.	0.75% of span for sensor plus transmitter combined; provide a 2nd calibration well along with the well for the sensor for pipe mounted sensors.
7.	Point numbers will be determined once the Owner's point naming standard is finalized. And this list will be updated at that time. For BACnet points, "xx" refers to the equipment's "group number". For the purposes of this project, each indoor unit will be considered to be a group.
8.	Coordinate with the utiltiy to pick up an isolated retransmitted signal from their meter
9.	Coordinate relay contact rating with heater requirements
10.	Sequence the unit heater with the operation of HRV-3 controls serving the area in software. Cycle the heater on if the space temperature drops 2°F (adjustable) below the current HRV heating set point.
11.	Coordinate with the plumbing contractor to install the meter in the gas service to the water heaters. Use the total gas consumption and the submetered values to create a virtual meter for the cooking gas consumption.
12.	Coordinate with the plumbing contrctor to install the meter in the incoming water service ahead of the back flow preventers.
13.	Coordinate with the utiltiy to pick up an isolated retransmitted signal from their meter.
14.	In addition to indicating current flow integrate the flow reading to provide consumption for the past hour, the past day, the current calendar month, and the current calendar year. Archive data to the data to the dedicated archival data storage drive in the City's Data Center. See Network Diagram.
15.	Coordinate with the plumber to install the meter in the gas service to the existing device or devices.
16.	Use data from this submeter along with the data from the domestic hot water sub-meter to create a virtual meter monitoring the gas consumption of Unit Heaters 2 - through 5.
17.	Use the whole building meter data along with data from the Unit Heater 1 submeter, the Unit Heater 2-5 and Domestic Hot Water submeter, and the MUAU Submeter to create a virtaul meter monitoring gas consumption of the cooking equipment.
18.	Coordinate with Division 16 to pick up transfer switch status to be used to initiate power failure and power failure recovery sequences.
19.	Coordinate with Division 16 define these objects in their power monitoring system network and pass them to the Siemens network via a Modbus link.
20.	These points are placeholders for points o be specified during submittal review and commissioning to provide data for the LEED Monitoring and Verification process and the building energy model. Some points may be totallizations of multiple circuits. For instance, the LEED energy model may need to know the total electrical consumption of the VRF indoor units, which are served by multiple power circuits.
21.	Coordinate with Division 16 to pick up a dry contact that closes if there is a fire alarm.
22.	Furnish interlock wiring as required by the Rainwater Harvesting system; assume 4-#14 conductors per point in conduit.
23.	Coordinate with the Rainwater Harvesting System vendor to define these objects in their control system network and pass them to the Siemens network via a BACnet link.
24.	Coordinate with the Rainwater Harvesting System vendor for isolated dry contacts to monitor for these parameters.
25.	Coordinate with the Rainwater Harvesting System vendor to install these independent sensors on their pump skid for idependent monitoring and alarm generation

1
Add. 05

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CITY OF SEATTLE

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DAVID A. SELLERS
STATE OF WASHINGTON
52574
REGISTERED
PROFESSIONAL ENGINEER
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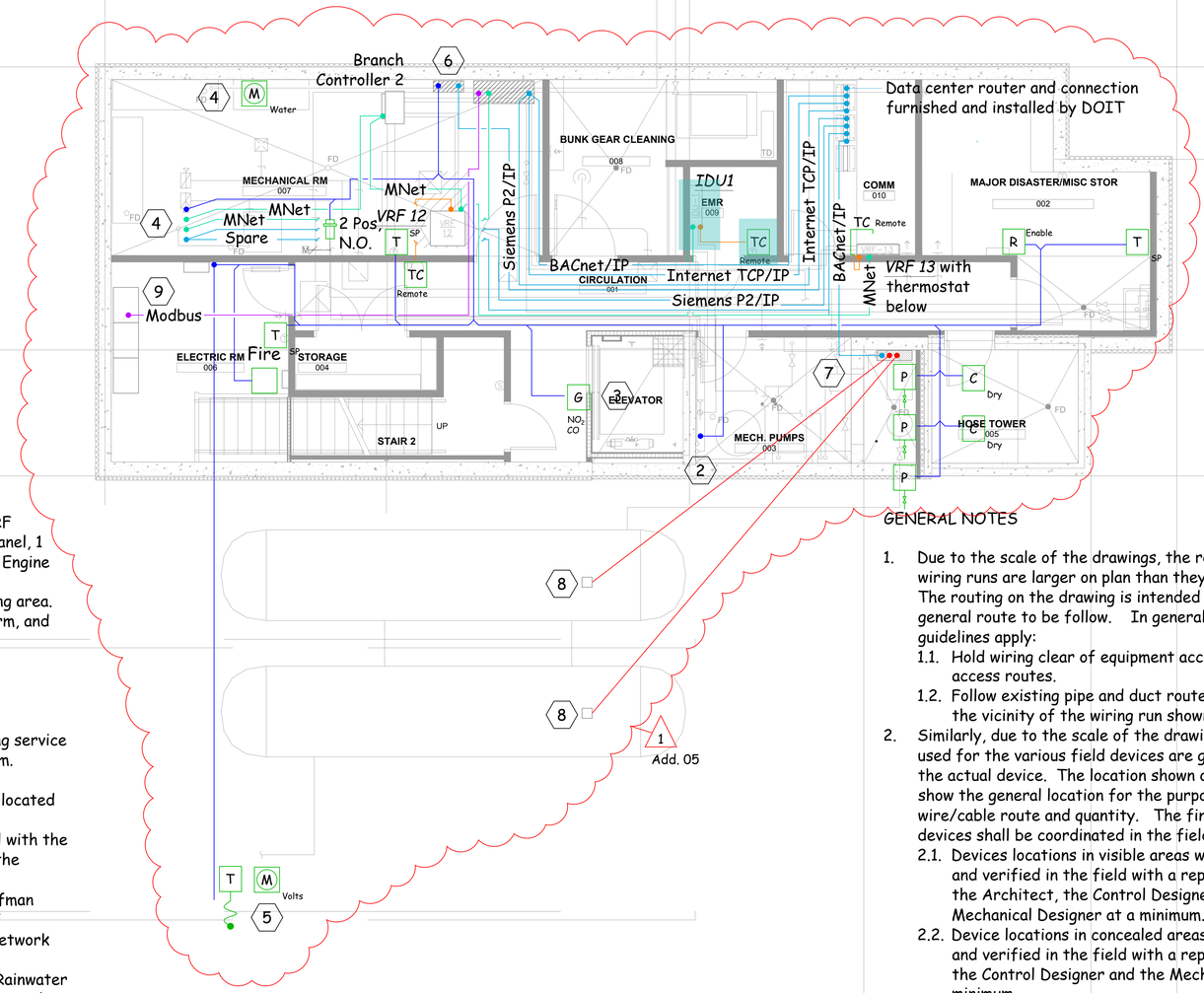
SHEET TITLE
Miscellaneous Point List

SHEET NUMBER
TC0.42



SHEET NOTES

1. 1 MNet up to Branch Controller 1, 1 MNet Up to the Mitsubishi VRF Outdoor Unit, 1 Siemens P2 up to the 2nd floor Siemens control panel, 1 Modbus up to the Electrical Distribution System Data Acquisition Engine and ??#18 TSP up to various devices.
2. 30 #18 TSP up to field devices located in the Apparatus Bay ceiling area.
3. Combination Nitrous Oxide and Carbon Monoxide detectorand alarm, and alarm. Provide 4 #18 TSP to Siemens BC-1 for:
   3.1. 4-20 ma NO_2 level indication
   3.2. 4-20 ma CO level indication
   3.3. Alarm indication
   3.4. 24 vac power
4. Coordinate with Division 23 to install a water meter in the incoming service to allow water consumption to be monitored by the Siemens system.
5. Coordinate with Division 26 to route cables to a generator jacket temperature sensor and a generator battery voltage sensor to be located at the emergency generator. Extend cables to the sensors in a temperature control contractor supplied conduit routed in parallel with the the control conduit provided under Division 26 below grade from the transfer switch in the electrical room to the generator location.
6. Siemens Building Controller BC-1 (left) and locked, ventilated Hoffman enclosure for Siemens Building Controller BC-3 and the Mitsubishi Operator Work Station and related equipment (right). See the Network Riser Diagram TC 6.01 for more information.
7. Rain water harvesting system control panel. Coordinate with the Rainwater Harvesting system vendor to make a BACnet connection to their control system. Furnish and install control points as shown to monitor critical parameters directly with the Siemens system. In addition furnish install and terminate interlock wiring to their field devices as shown. Contact information for the vendor is as follows; Bob Tampa, Braley-Gray & Associates, C: 206-478-0200, BobT@BraleyGray.com.
8. 4-#14 in 1" PVC conduit below grade from the rain water panel to the level sensor/acccess area of the rain water tanks for interlock wiring. Coordinate as required with the Rainwater Harvesting System vendor for the details of final connection requirements. See also the Miscellaneous Point list on TC0.42.
9. Coordinate with Division 26 to integrate the power monitoring system with the Siemens control system using Modbus. See the Network Diagram on TC6.00 and the Miscellaneous Point List on TC0.42 for additional information.
10. Coordinate with Division 26 to pick up an isolated dry contact in their fire alarm panel that changes state on alarm to pilot the fire alarm shutdown sequence in the DDC system.

GENERAL NOTES

1. Due to the scale of the drawings, the routes occupied by wiring runs are larger on plan than they will be in the field. The routing on the drawing is intended to convey the general route to be follow. In general, the following guidelines apply:
   1.1. Hold wiring clear of equipment access panels and access routes.
   1.2. Follow existing pipe and duct routes when they are in the vicinity of the wiring run shown.
2. Similarly, due to the scale of the drawings, the symbols used for the various field devices are generally larger than the actual device. The location shown on plan is intended to show the general location for the purposes of determining wire/cable route and quantity. The final location of all devices shall be coordinated in the field.
   2.1. Devices locations in visible areas will be coordinated and verified in the field with a representative from the Architect, the Control Designer, and the Mechanical Designer at a minimum.
   2.2. Device locations in concealed areas will be coordinated and verified in the field with a representative from the Control Designer and the Mechanical Designer at a minimum.
3. Where conduit is required, furnish and install a separate raceway system for each of the following cable system types.
   3.1. MNet, Siemens P2, and Modbus cables
   3.2. Input/output cables (#18 Twisted Shielded Pairs)
   3.3. VRF Controller cables
4. All Mitsubishi equipment shall be furnished by Mitsubishi under Division 23 of the specifications.
5. Mitsubishi network cabling shall be roughed in by the temperature control contractor along with the cabling required by the temperature control system. But final terminations to the Mitsubishi equipment shall be by Mitsubishi.
6. Coordinate with Mitsubishi as required to provide the necessary rough-in and to mount Mitsubishi equipment. See the TC6.00 and TC 6.01 for additional information regarding the control power and network wiring requirements for the Mitsubishi equipment.

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1/11/16

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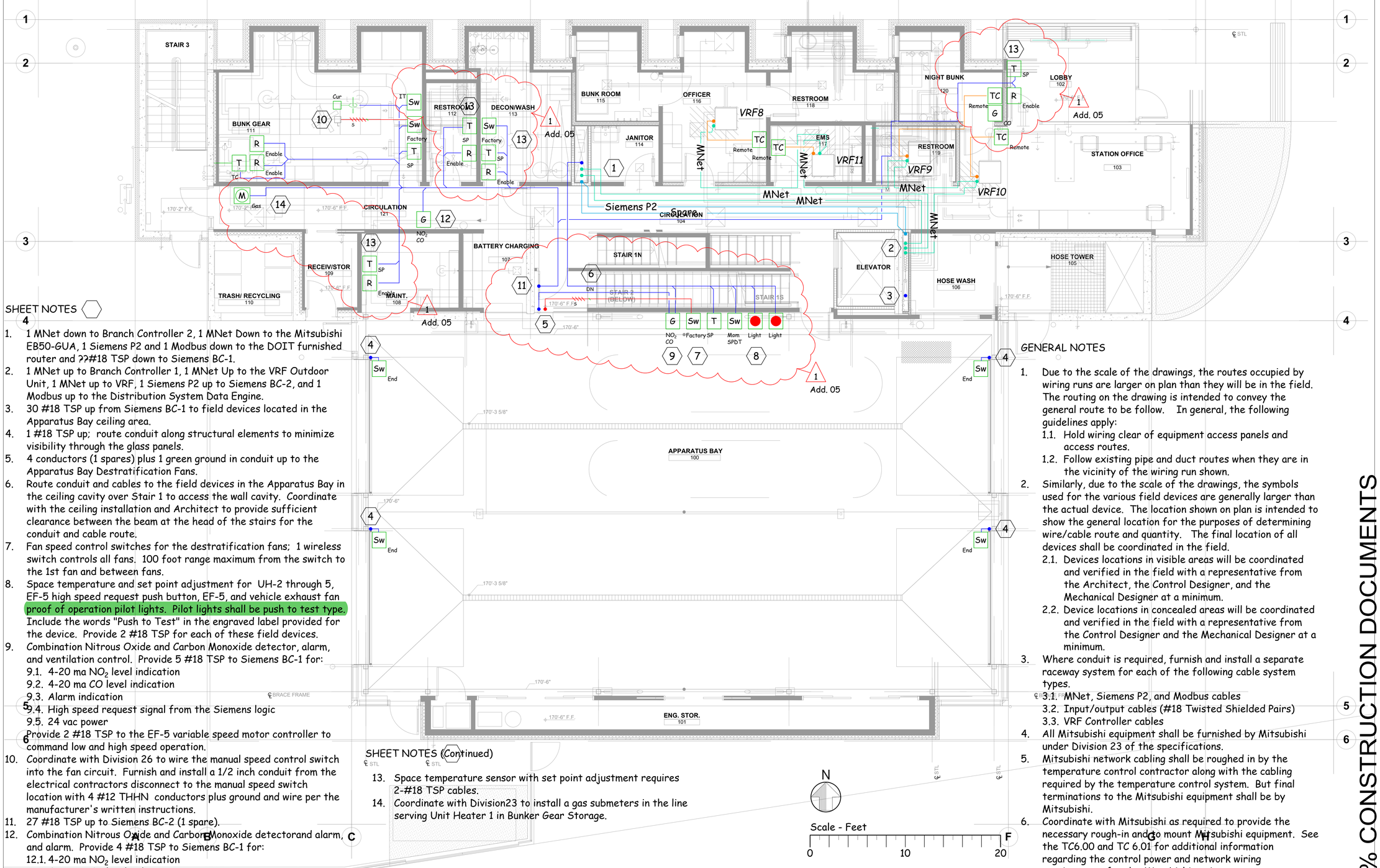
SHEET TITLE
Basement Floor Plan

SHEET NUMBER
TC 2.10



SHEET NOTES

1. 1 MNet down to Branch Controller 2, 1 MNet Down to the Mitsubishi EB50-GUA, 1 Siemens P2 and 1 Modbus down to the DOIT furnished router and ??#18 TSP down to Siemens BC-1.
2. 1 MNet up to Branch Controller 1, 1 MNet Up to the VRF Outdoor Unit, 1 MNet up to VRF, 1 Siemens P2 up to Siemens BC-2, and 1 Modbus up to the Distribution System Data Engine.
3. 30 #18 TSP up from Siemens BC-1 to field devices located in the Apparatus Bay ceiling area.
4. 1 #18 TSP up; route conduit along structural elements to minimize visibility through the glass panels.
5. 4 conductors (1 spares) plus 1 green ground in conduit up to the Apparatus Bay Destratification Fans.
6. Route conduit and cables to the field devices in the Apparatus Bay in the ceiling cavity over Stair 1 to access the wall cavity. Coordinate with the ceiling installation and Architect to provide sufficient clearance between the beam at the head of the stairs for the conduit and cable route.
7. Fan speed control switches for the destratification fans; 1 wireless switch controls all fans. 100 foot range maximum from the switch to the 1st fan and between fans.
8. Space temperature and set point adjustment for UH-2 through 5, EF-5 high speed request push button, EF-5, and vehicle exhaust fan proof of operation pilot lights. Pilot lights shall be push to test type. Include the words "Push to Test" in the engraved label provided for the device. Provide 2 #18 TSP for each of these field devices.
9. Combination Nitrous Oxide and Carbon Monoxide detector, alarm, and ventilation control. Provide 5 #18 TSP to Siemens BC-1 for:
   - 9.1. 4-20 ma NO_2 level indication
   - 9.2. 4-20 ma CO level indication
   - 9.3. Alarm indication
   - 9.4. High speed request signal from the Siemens logic
   - 9.5. 24 vac power

   Provide 2 #18 TSP to the EF-5 variable speed motor controller to command low and high speed operation.
10. Coordinate with Division 26 to wire the manual speed control switch into the fan circuit. Furnish and install a 1/2 inch conduit from the electrical contractors disconnect to the manual speed switch location with 4 #12 THHN conductors plus ground and wire per the manufacturer's written instructions.
11. 27 #18 TSP up to Siemens BC-2 (1 spare).
12. Combination Nitrous Oxide and Carbon Monoxide detectorand alarm, and alarm. Provide 4 #18 TSP to Siemens BC-1 for:
    - 12.1. 4-20 ma NO_2 level indication
    - 12.2.4-20 ma CO level indication
    - 12.3.Alarm indication
    - 12.4.24 vac power

SHEET NOTES (Continued)

13. Space temperature sensor with set point adjustment requires 2-#18 TSP cables.
14. Coordinate with Division23 to install a gas submeters in the line serving Unit Heater 1 in Bunker Gear Storage.

GENERAL NOTES

1. Due to the scale of the drawings, the routes occupied by wiring runs are larger on plan than they will be in the field. The routing on the drawing is intended to convey the general route to be follow. In general, the following guidelines apply:
   - 1.1. Hold wiring clear of equipment access panels and access routes.
   - 1.2. Follow existing pipe and duct routes when they are in the vicinity of the wiring run shown.
2. Similarly, due to the scale of the drawings, the symbols used for the various field devices are generally larger than the actual device. The location shown on plan is intended to show the general location for the purposes of determining wire/cable route and quantity. The final location of all devices shall be coordinated in the field.
   - 2.1. Devices locations in visible areas will be coordinated and verified in the field with a representative from the Architect, the Control Designer, and the Mechanical Designer at a minimum.
   - 2.2. Device locations in concealed areas will be coordinated and verified in the field with a representative from the Control Designer and the Mechanical Designer at a minimum.
3. Where conduit is required, furnish and install a separate raceway system for each of the following cable system types.
   - 3.1. MNet, Siemens P2, and Modbus cables
   - 3.2. Input/output cables (#18 Twisted Shielded Pairs)
   - 3.3. VRF Controller cables
4. All Mitsubishi equipment shall be furnished by Mitsubishi under Division 23 of the specifications.
5. Mitsubishi network cabling shall be roughed in by the temperature control contractor along with the cabling required by the temperature control system. But final terminations to the Mitsubishi equipment shall be by Mitsubishi.
6. Coordinate with Mitsubishi as required to provide the necessary rough-in and to mount Mitsubishi equipment. See the TC6.00 and TC 6.01 for additional information regarding the control power and network wiring requirements for the Mitsubishi equipment.

N

Scale - Feet
0 10 20

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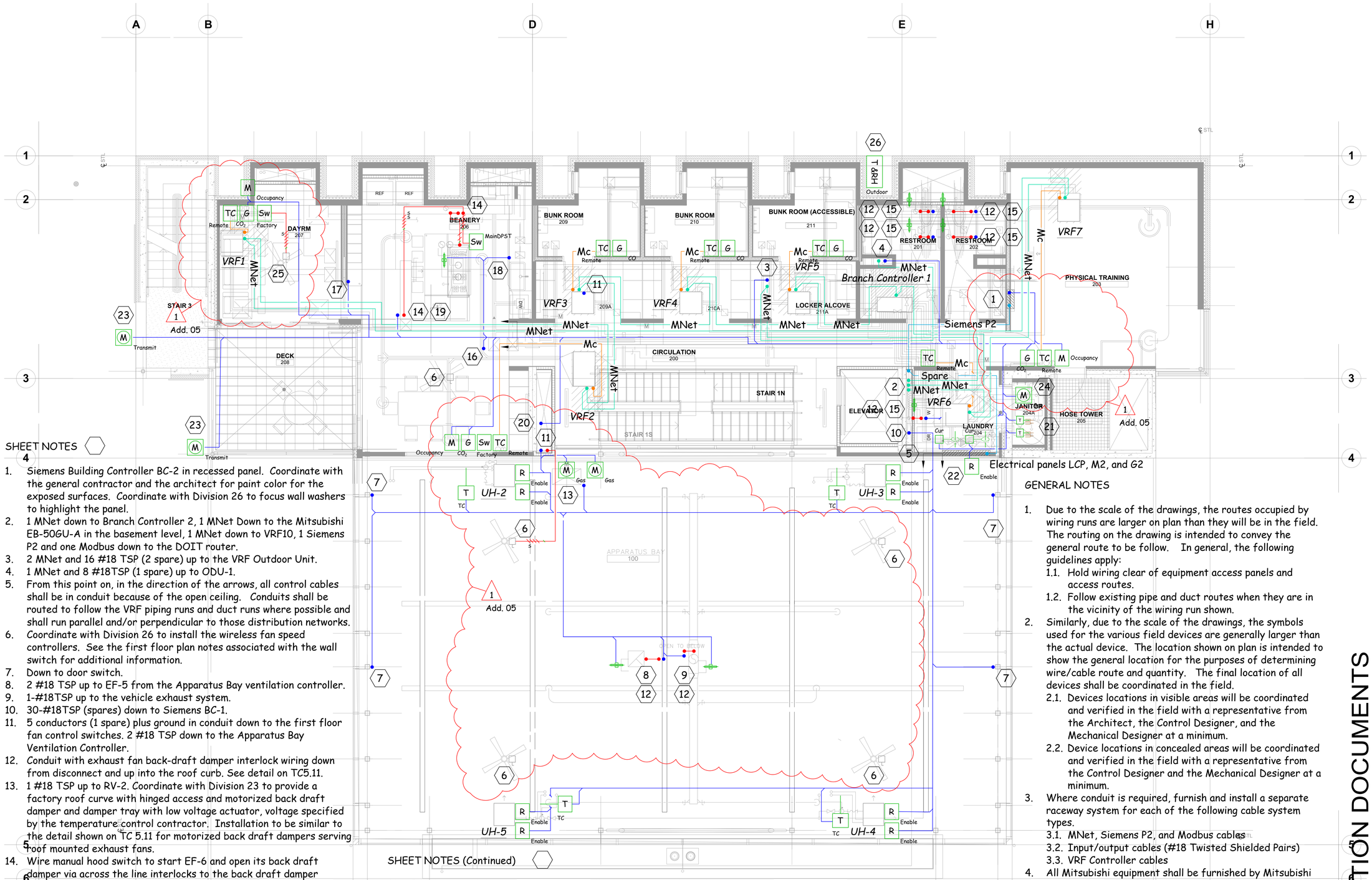
1 Revision 1 - Addendum 5 - 2016-02-19	

SHEET TITLE
First Floor Plan

SHEET NUMBER
TC 2.21



SHEET NOTES

1. Siemens Building Controller BC-2 in recessed panel. Coordinate with the general contractor and the architect for paint color for the exposed surfaces. Coordinate with Division 26 to focus wall washers to highlight the panel.
2. 1 MNet down to Branch Controller 2, 1 MNet Down to the Mitsubishi EB-50GU-A in the basement level, 1 MNet down to VRF10, 1 Siemens P2 and one Modbus down to the DOIT router.
3. 2 MNet and 16 #18 TSP (2 spare) up to the VRF Outdoor Unit.
4. 1 MNet and 8 #18TSP (1 spare) up to ODU-1.
5. From this point on, in the direction of the arrows, all control cables shall be in conduit because of the open ceiling. Conduits shall be routed to follow the VRF piping runs and duct runs where possible and shall run parallel and/or perpendicular to those distribution networks.
6. Coordinate with Division 26 to install the wireless fan speed controllers. See the first floor plan notes associated with the wall switch for additional information.
7. Down to door switch.
8. 2 #18 TSP up to EF-5 from the Apparatus Bay ventilation controller.
9. 1-#18TSP up to the vehicle exhaust system.
10. 30-#18TSP (spares) down to Siemens BC-1.
11. 5 conductors (1 spare) plus ground in conduit down to the first floor fan control switches. 2 #18 TSP down to the Apparatus Bay Ventilation Controller.
12. Conduit with exhaust fan back-draft damper interlock wiring down from disconnect and up into the roof curb. See detail on TC5.11.
13. 1 #18 TSP up to RV-2. Coordinate with Division 23 to provide a factory roof curve with hinged access and motorized back draft damper and damper tray with low voltage actuator, voltage specified by the temperature control contractor. Installation to be similar to the detail shown on TC 5.11 for motorized back draft dampers serving roof mounted exhaust fans.
14. Wire manual hood switch to start EF-6 and open its back draft damper via across the line interlocks to the back draft damper actuator. Coordinate with Division 23 to have EF-6 provided with hinged access and damper tray with motorized back draft damper. Coordinate with Division 23 and 26 to ensure the voltage of the actuator matches the EF-6 line voltage. Interlock RV-1's back draft damper with the EF-6 back draft damper. Coordinate with Division 23 and 26 to ensure the voltage of the actuator matches the EF-6 line voltage. Interlock the MUAU with the hood switch via a hard wired relay piloted interlock. Installation to be similar to what is shown in the detail on TC-5.11.
15. 1 #18 TSP up to the exhaust fan enable relay.
16. 17 #18 TSP up to HRV-1 from Siemens BC-2.
17. 15 #18 TSP up to HRV-2 from Siemens BC-2.
18. 13 #18 TSP up to HRV-3 from Siemens BC-2.
19. 8 #18 TSP up to MUAU from Siemens BC-2.
20. 10 #18 TSP up from the Bunker Storage Room to Siemens BC-2.

SHEET NOTES (Continued)

21. Coordinate with Division 23 to install wells, calibration wells, and temperature sensors in the domestic hot water supply and return lines.
22. Electrical panels LCP2, M2, and G2. Coordinate with Division 26 to install the domestic hot water pump and hot water heater current sensors and the domestic hot water pump enable point.
23. Coordinate with the utility to pick up a retransmitted signal from their meter to monitor electrical kW and gas therms.
24. Coordinate with Division 23 to install gas meters in the piping to UH2 - 5 and the domestic hot water heater, the piping to the domestic hot water heater, and the piping to MUAU 1.
25. Coordinate with Division 26 to install the wired speed control switch.
26. Coordinate with the Architect to install this sensor at or above the level of the outdoor light to avoid any shadows.

N

Scale - Feet

0 10 20

Electrical panels LCP, M2, and G2

GENERAL NOTES

1. Due to the scale of the drawings, the routes occupied by wiring runs are larger on plan than they will be in the field. The routing on the drawing is intended to convey the general route to be follow. In general, the following guidelines apply:
   1.1. Hold wiring clear of equipment access panels and access routes.
   1.2. Follow existing pipe and duct routes when they are in the vicinity of the wiring run shown.
2. Similarly, due to the scale of the drawings, the symbols used for the various field devices are generally larger than the actual device. The location shown on plan is intended to show the general location for the purposes of determining wire/cable route and quantity. The final location of all devices shall be coordinated in the field.
   2.1. Devices locations in visible areas will be coordinated and verified in the field with a representative from the Architect, the Control Designer, and the Mechanical Designer at a minimum.
   2.2. Device locations in concealed areas will be coordinated and verified in the field with a representative from the Control Designer and the Mechanical Designer at a minimum.
3. Where conduit is required, furnish and install a separate raceway system for each of the following cable system types.
   3.1. MNet, Siemens P2, and Modbus cables
   3.2. Input/output cables (#18 Twisted Shielded Pairs)
   3.3. VRF Controller cables
4. All Mitsubishi equipment shall be furnished by Mitsubishi under Division 23 of the specifications.
5. Mitsubishi network cabling shall be roughed in by the temperature control contractor along with the cabling required by the temperature control system. But final terminations to the Mitsubishi equipment shall be by Mitsubishi.
6. Coordinate with Mitsubishi as required to provide the necessary rough-in and to mount Mitsubishi equipment. See the TC6.00 and TC 6.01 for additional information regarding the control power and network wiring requirements for the Mitsubishi equipment.

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SHEET TITLE
Second Floor Plan

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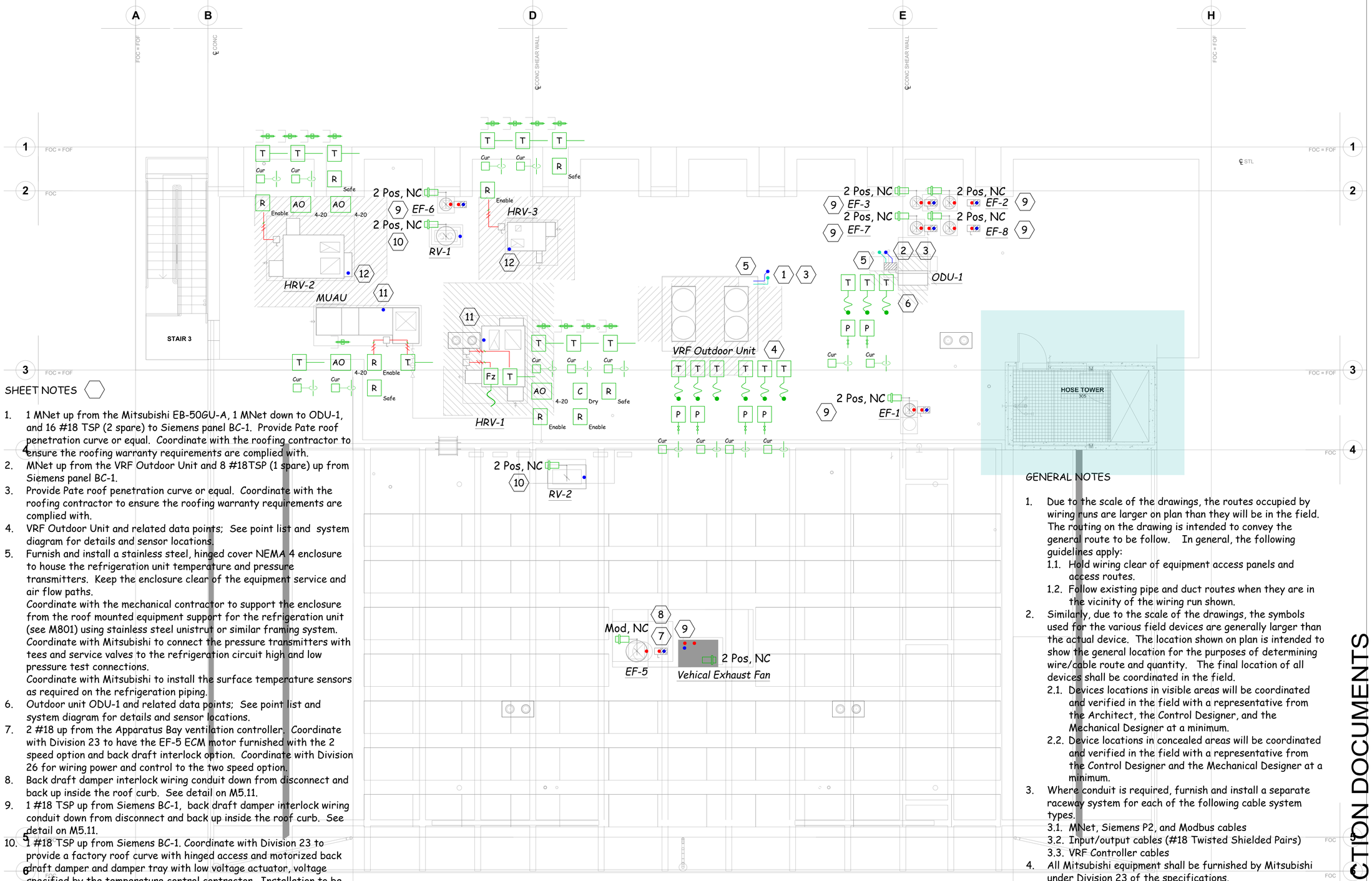
TC 2.31



SHEET NOTES

1. 1 MNet up from the Mitsubishi EB-50GU-A, 1 MNet down to ODU-1, and 16 #18 TSP (2 spare) to Siemens panel BC-1. Provide Pate roof penetration curve or equal. Coordinate with the roofing contractor to ensure the roofing warranty requirements are complied with.
2. MNet up from the VRF Outdoor Unit and 8 #18TSP (1 spare) up from Siemens panel BC-1.
3. Provide Pate roof penetration curve or equal. Coordinate with the roofing contractor to ensure the roofing warranty requirements are complied with.
4. VRF Outdoor Unit and related data points; See point list and system diagram for details and sensor locations.
5. Furnish and install a stainless steel, hinged cover NEMA 4 enclosure to house the refrigeration unit temperature and pressure transmitters. Keep the enclosure clear of the equipment service and air flow paths.
   Coordinate with the mechanical contractor to support the enclosure from the roof mounted equipment support for the refrigeration unit (see M801) using stainless steel unistrut or similar framing system.
   Coordinate with Mitsubishi to connect the pressure transmitters with tees and service valves to the refrigeration circuit high and low pressure test connections.
   Coordinate with Mitsubishi to install the surface temperature sensors as required on the refrigeration piping.
6. Outdoor unit ODU-1 and related data points; See point list and system diagram for details and sensor locations.
7. 2 #18 up from the Apparatus Bay ventilation controller. Coordinate with Division 23 to have the EF-5 ECM motor furnished with the 2 speed option and back draft interlock option. Coordinate with Division 26 for wiring power and control to the two speed option.
8. Back draft damper interlock wiring conduit down from disconnect and back up inside the roof curb. See detail on M5.11.
9. 1 #18 TSP up from Siemens BC-1, back draft damper interlock wiring conduit down from disconnect and back up inside the roof curb. See detail on M5.11.
10. 1 #18 TSP up from Siemens BC-1. Coordinate with Division 23 to provide a factory roof curve with hinged access and motorized back draft damper and damper tray with low voltage actuator, voltage specified by the temperature control contractor. Installation to be similar to the detail shown on TC 5.11 for motorized back draft dampers serving roof mounted exhaust fans.
11. 17 #18 TSP (2 spares) up from Siemens BC-2 inside the roof curb and into the control compartment to serve HRV-1 points
12. 15 #18 TSP (2 spares) up from Siemens BC-2 inside the roof curb and into the control compartment to serve HRV-2 points.
13. 13 #18 TSP (2 spares) up from Siemens BC-2 inside the roof curb and into the control compartment to serve HRV-3 points.
14. #8 TSP (2 spares) up from Siemens BC-2 inside the roof curb and into the control compartment to serve MUAU points.

GENERAL NOTES

1. Due to the scale of the drawings, the routes occupied by wiring runs are larger on plan than they will be in the field. The routing on the drawing is intended to convey the general route to be follow. In general, the following guidelines apply:
   1.1. Hold wiring clear of equipment access panels and access routes.
   1.2. Follow existing pipe and duct routes when they are in the vicinity of the wiring run shown.
2. Similarly, due to the scale of the drawings, the symbols used for the various field devices are generally larger than the actual device. The location shown on plan is intended to show the general location for the purposes of determining wire/cable route and quantity. The final location of all devices shall be coordinated in the field.
   2.1. Devices locations in visible areas will be coordinated and verified in the field with a representative from the Architect, the Control Designer, and the Mechanical Designer at a minimum.
   2.2. Device locations in concealed areas will be coordinated and verified in the field with a representative from the Control Designer and the Mechanical Designer at a minimum.
3. Where conduit is required, furnish and install a separate raceway system for each of the following cable system types.
   3.1. MNet, Siemens P2, and Modbus cables
   3.2. Input/output cables (#18 Twisted Shielded Pairs)
   3.3. VRF Controller cables
4. All Mitsubishi equipment shall be furnished by Mitsubishi under Division 23 of the specifications.
5. Mitsubishi network cabling shall be roughed in by the temperature control contractor along with the cabling required by the temperature control system. But final terminations to the Mitsubishi equipment shall be by Mitsubishi.
6. Coordinate with Mitsubishi as required to provide the necessary rough-in and to mount Mitsubishi equipment. See the TC6.00 and TC 6.01 for additional information regarding the control power and network wiring requirements for the Mitsubishi equipment.

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Roof Plan

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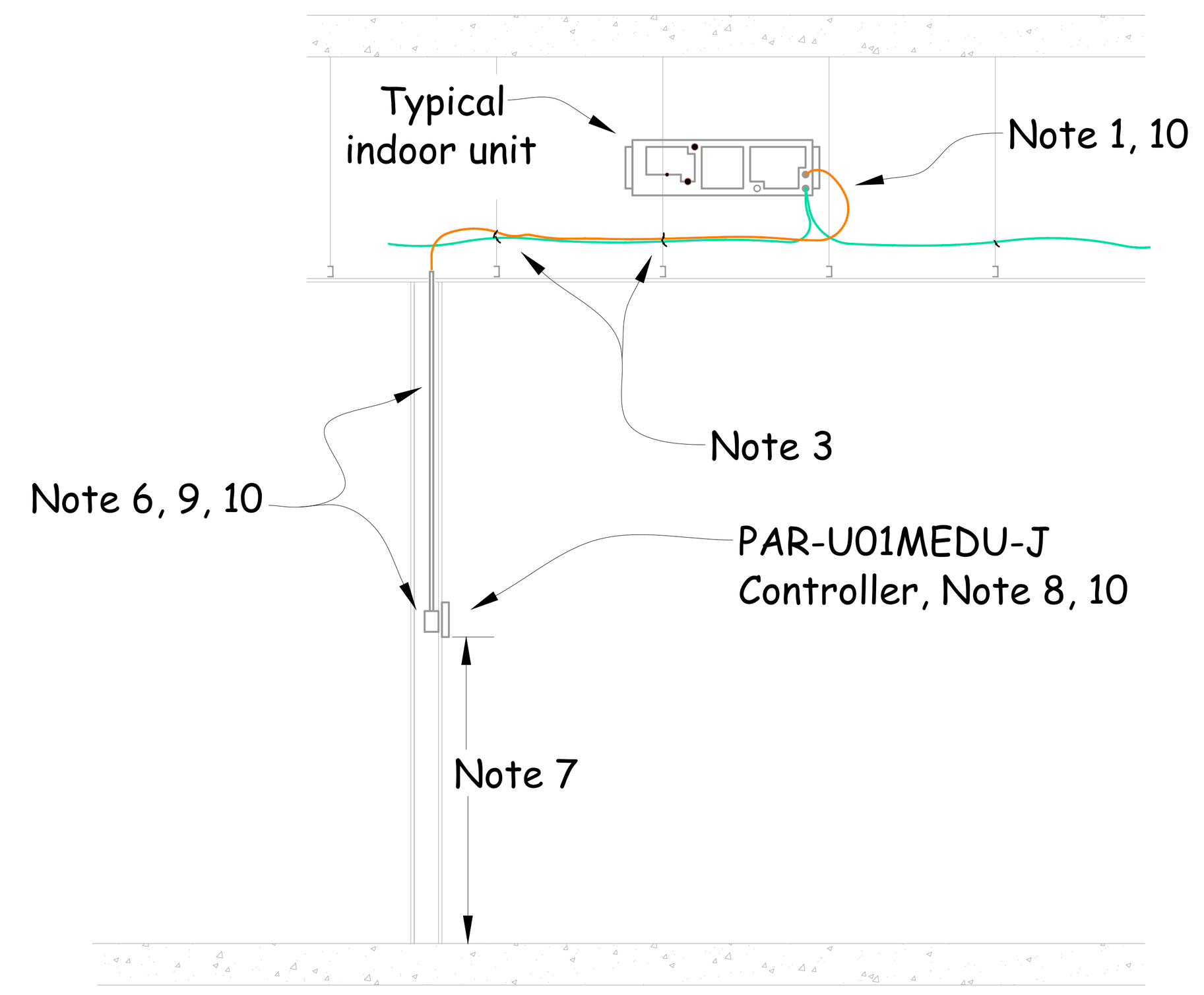
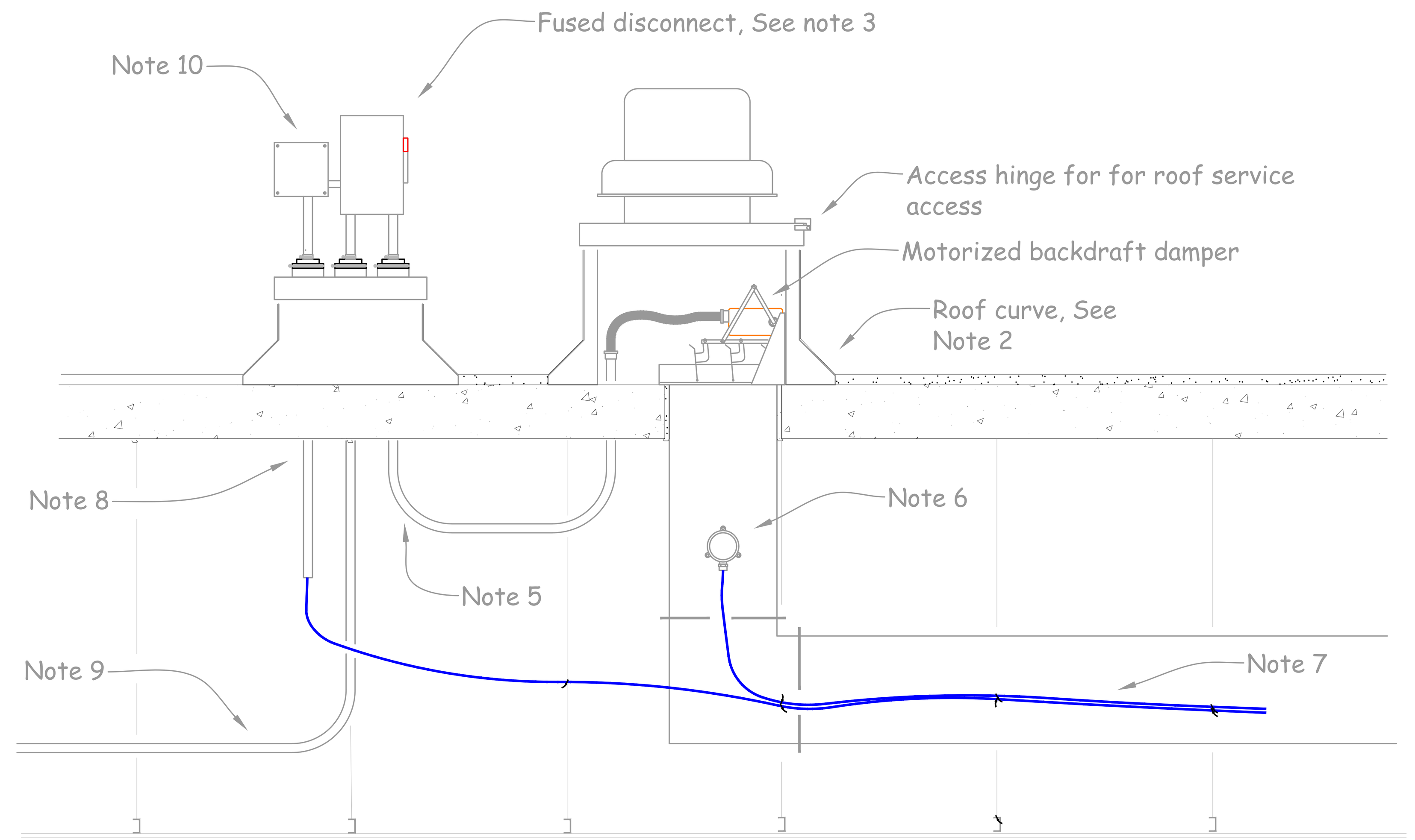


Typical Indoor Unit Control Wiring

No Scale

NOTES:

1. Furnish and install cord and cable connectors where the network and controller wiring enter the VRF unit control compartment.
2. Cables to be plenum rated with electrical characteristics suitable for the application. Verify cable selections with Mitsubishi.
3. Route cables in a neat and orderly fashion where concealed above a ceiling, securing them to structure. Do not secure cables to fire protection system piping or HVAC elements with surface temperatures above 100°F under operating conditions.
4. In areas with open ceiling, run cables in appropriately sized and supported conduit routed parallel or perpendicular to other pipes, ducts, or structural elements in the area.
5. Where possible, follow the variable flow refrigeration piping route for concealed cables and exposed control system conduit.
6. Provide EMT conduit stubs with switch boxes, all securely mounted to structure at all controller locations.
7. Controller mounting heights to be as required by local codes and the Americans with Disabilities Act.
8. Verify controller location in the field with the Architect, Control Designer, and Mechanical Designer prior to installation.
9. Where controllers are mounted on an exterior wall or a wall surrounding or located within an area served by an underfloor air plenum, insulate the switch box with1 inch of fire rated expanding foam on all sides; Abesco FP200 FR or approved equal. After the cable is pulled into the box, seal the conduit where it enters the box with the same product.
10. Siemens to furnish and installation all cable for the control and network system associated with the Mitsubishi VRF system. At each termination point, Siemens shall provide 24" of cable coiled for final termination by Mitsubishi.
11. Where conduit is required, furnish and install a separate raceway system for each of the following cable system types.
    11.1. MNet, Siemens P2, and Modbus cables
    11.2. Input/output cables (#18 Twisted Shielded Pairs)
    11.3. VRF Controller cables



Typical Roof Exhaust Fan Control

(Intake hoods to be similar)

No Scale

1. Coordinate with Division 23 and 26 details for roof mounted equipment and roof penetrations. See specifications,roof plans and M801 details 3 and 4.
2. Coordinate with Division 23 to include with the curb:
    2.1. Factory furnished hinged access.
    2.2. A damper tray with a motorized back-draft damper with the size and number of actuators as required by the specifics of each fan and its duct.
3. Fused disconnect by Division 16. Coordinate with Division 16 to provide one roof curb to serve all control and power conduit penetrations; Pate PCA or equal. Coordinate with the roofing contractor for the installation details and other requirements for the roof curb to ensure the roofing warranty is maintained.
4. Coordinate with Division 23 and 26 to verify the motorized back draft damper is provided for the line voltage associated with the exhaust fan.
5. Conduit with line voltage, across the line back draft damper interlock by the temperature control contractor
6. Duct pressure sensor for fan proof of operation input by the temperature control contractor.
7. Low voltage control cables by the temperature control contractor.
8. Low voltage fan command signal through conduit to roof by the temperature control contractor.
9. Power wiring and conduit by Division 16.
10. Temperature control contractor to furnish and install a stainless steel, hinged cover NEMA 4 enclosure to house fan interface relay and fused terminals for the damper actuator interlock circuit. Keep the enclosure clear of the equipment service and air flow paths.

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Details

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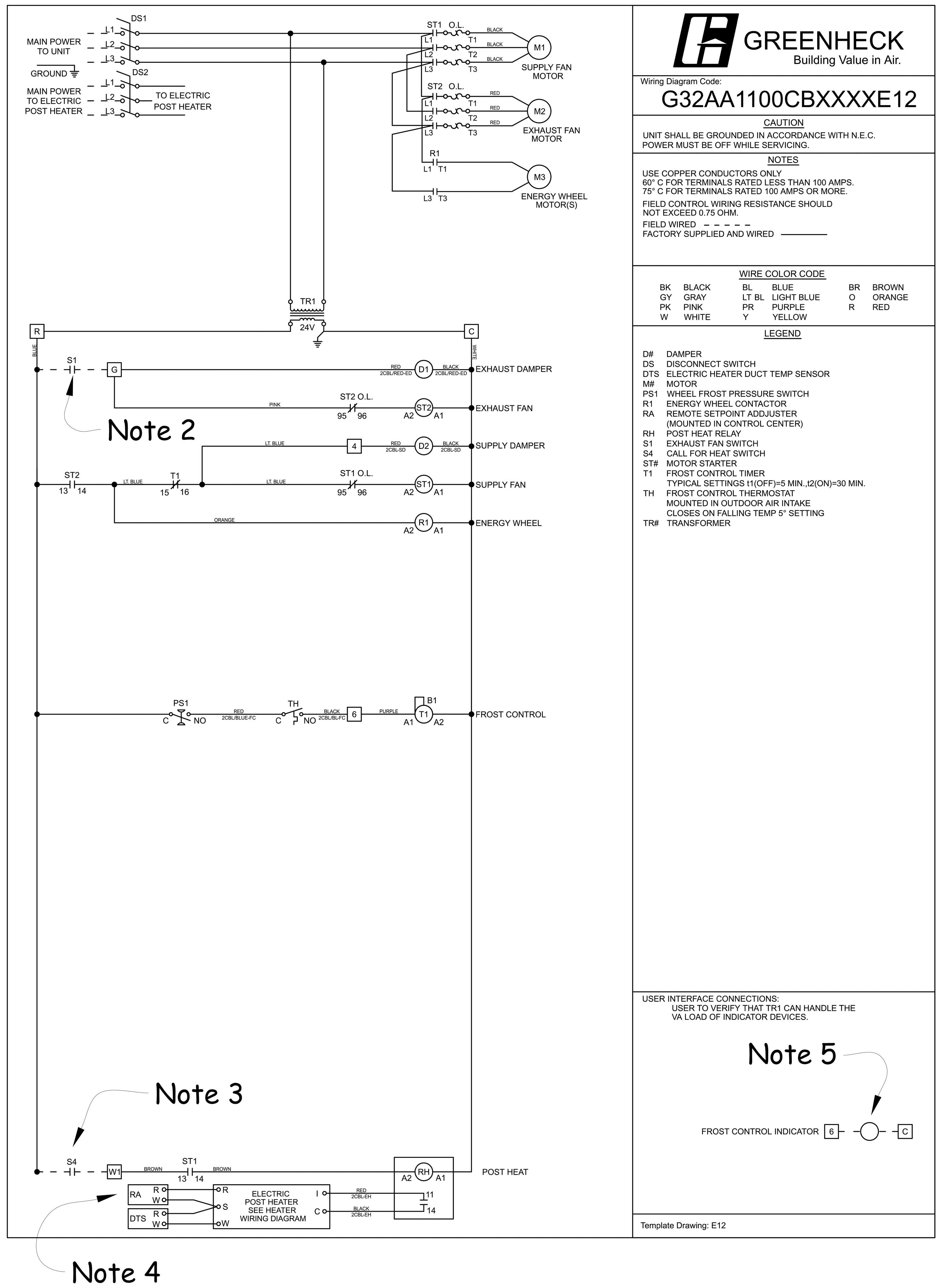
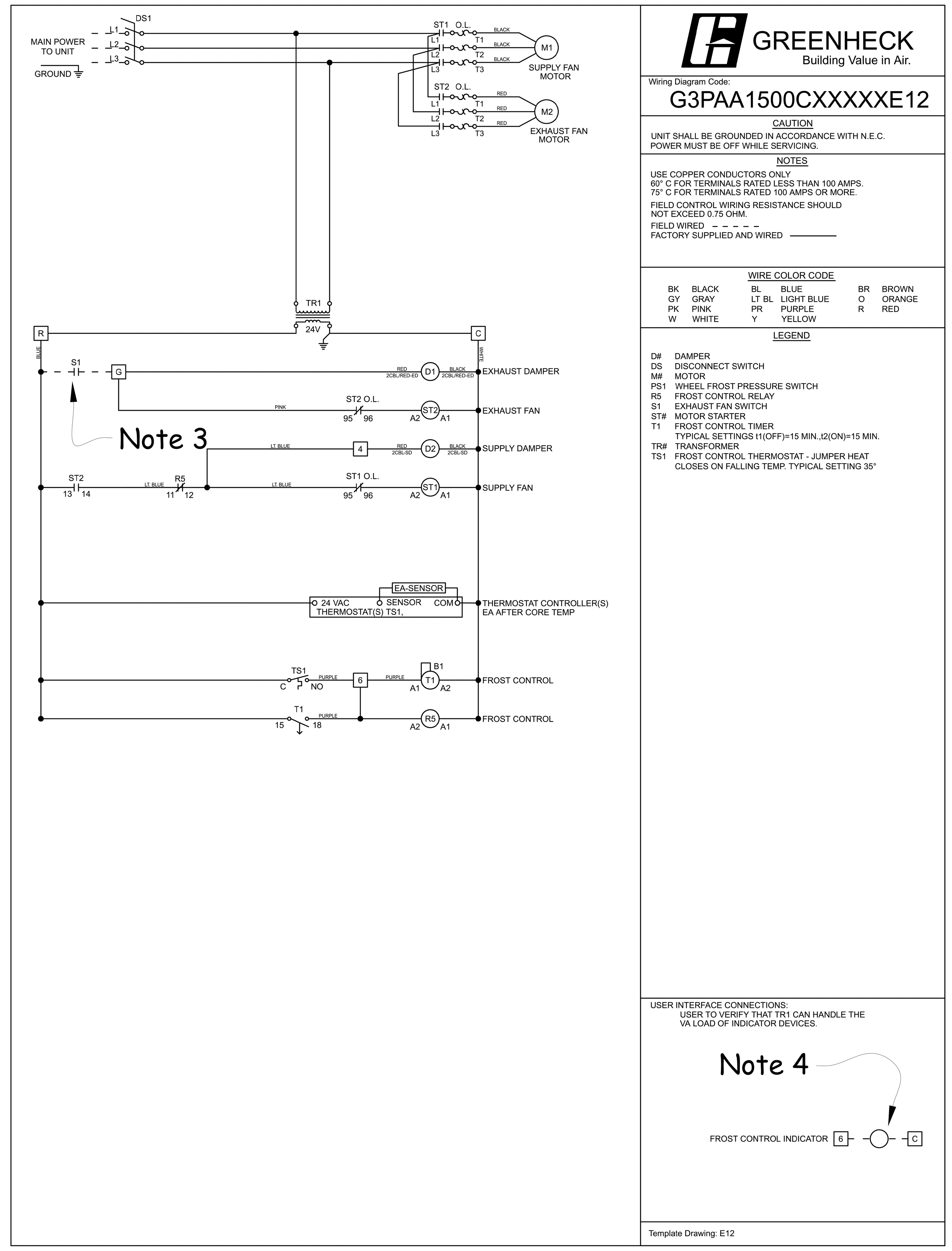
TC 5.11

ERCH-20-15L
WIRING DIAGRAM



PVe-20-SC
WIRING DIAGRAM



HRV-1 Interlock Wiring

No Scale

1. The wiring diagram for the basis of design unit is shown for bidding purposes to illustrate the points of interface betwween the DDC system and the unit's factory installed wiring. A project specific wiring diagram will be furnished by the control system designer subsequent to submittal approval. See the narrative sequence and point list for additional information and requirements.
2. HRV enable contact from the DDC system.
3. Electric heat enable contact from the DDC system.
4. 4-20 ma SCR modulation command from the DDC system.
5. Isolated contact indicating the frost cycle is active, monitored by the DDC System

HRV-2 Interlock Wiring

No Scale

1. HRV-3 to be similar.
2. The wiring diagram for the basis of design unit is shown for bidding purposes to illustrate the points of interface betwween the DDC system and the unit's factory installed wiring. A project specific wiring diagram will be furnished by the control system designer subsequent to submittal approval. See the narrative sequence and point list for additional information and requirements.
3. HRV enable contact from the DDC system.
4. Isolated contact indicating the frost cycle is active, monitored by the DDC System
5. HRV-2 will be equipped with a VFD on the supply fan and an ECM on the exhaust fan, both arranged to provide a two speed operating cycle. See the narrative sequence for the details of the two speed operation and the point list for the details of what will be required to integrate the VFD and the ECM with the DDC system

1 Add. 05

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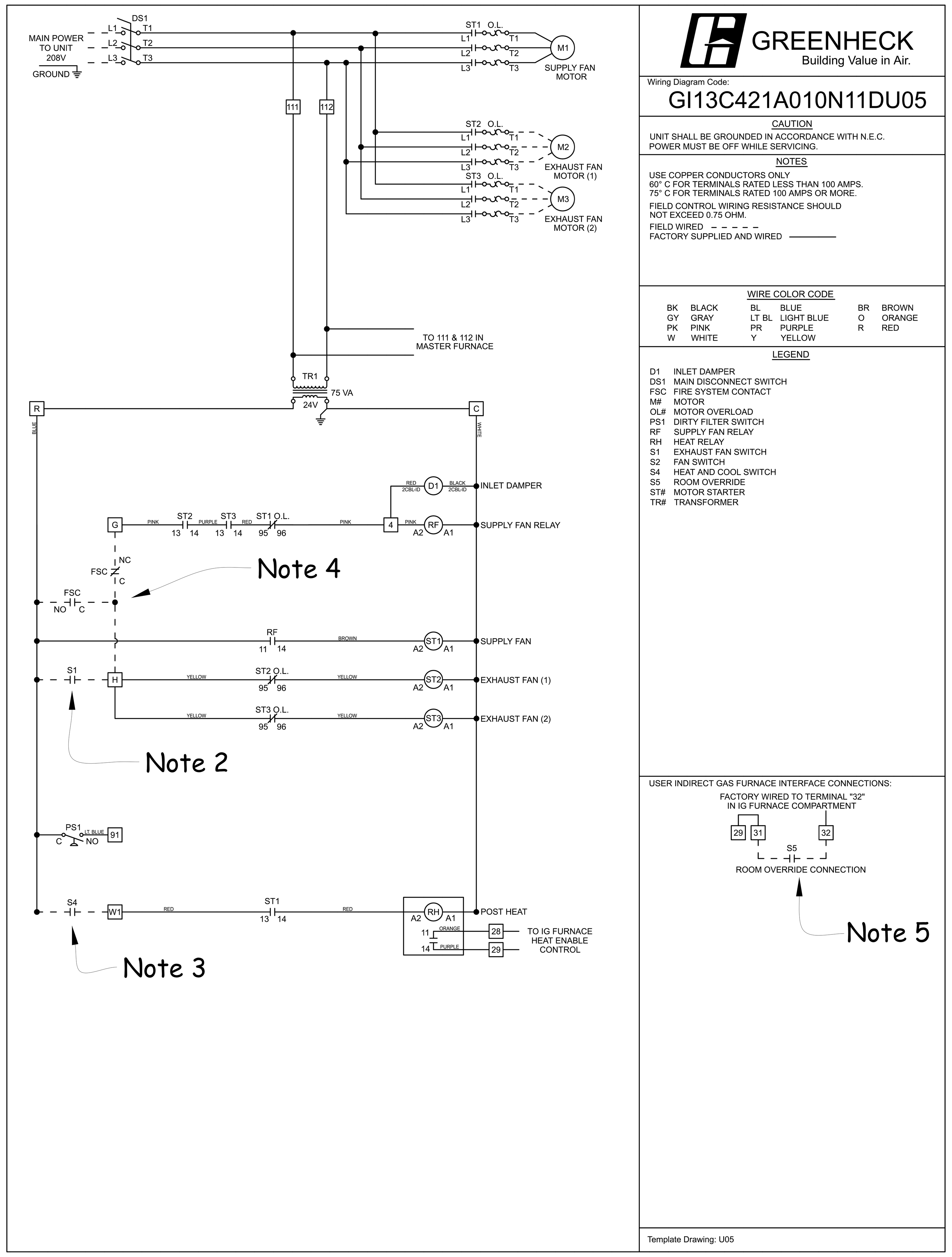
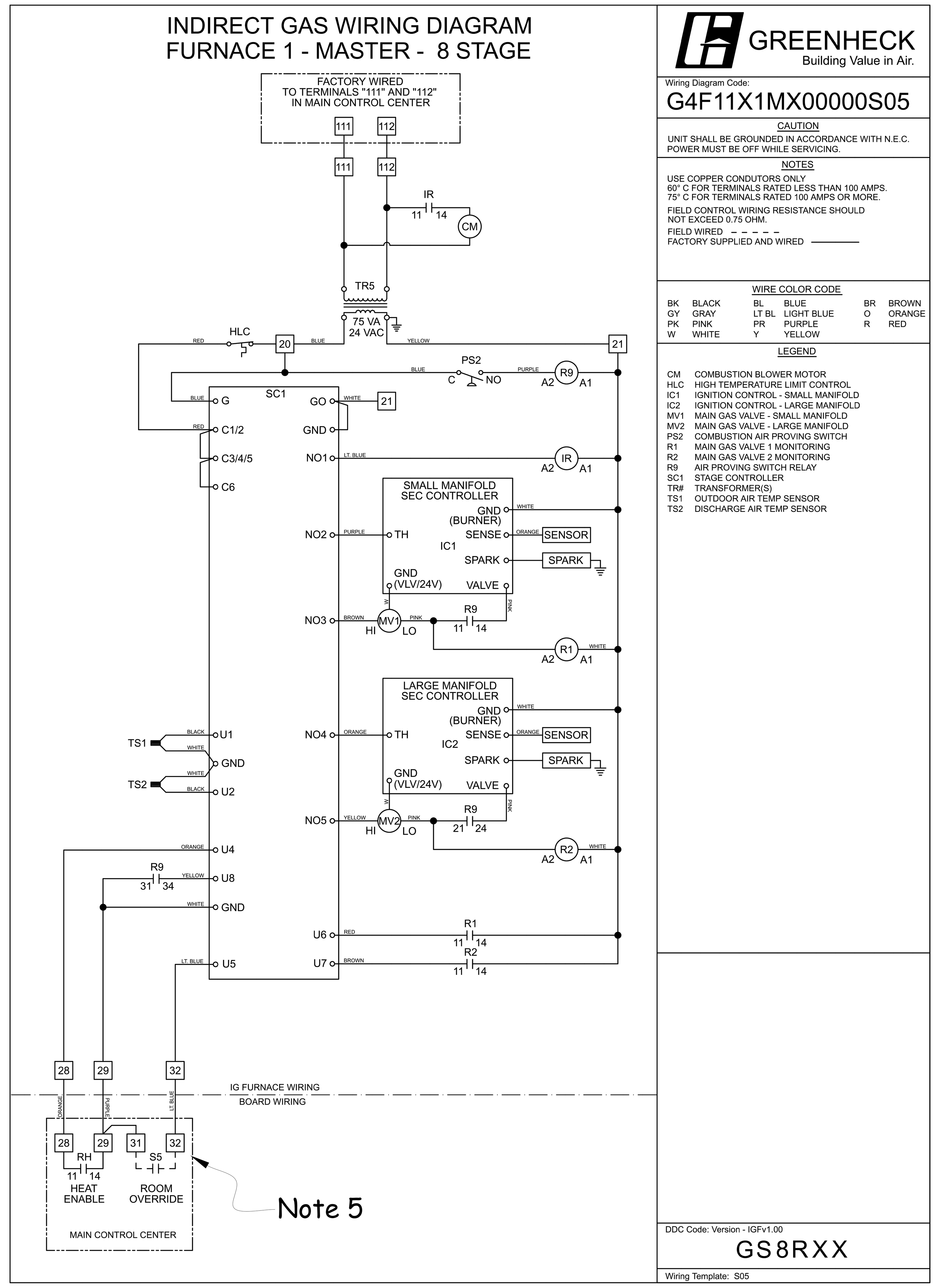
SHEET TITLE
Wiring Details

SHEET NUMBER
TC 5.21



GREENHECK
Building Value in Air.
Wiring Diagram Code:
GI13C421A010N11DU05
CAUTION
UNIT SHALL BE GROUNDED IN ACCORDANCE WITH N.E.C.
POWER MUST BE OFF WHILE SERVICING.
NOTES
USE COPPER CONDUCTORS ONLY
60° C FOR TERMINALS RATED LESS THAN 100 AMPS.
75° C FOR TERMINALS RATED 100 AMPS OR MORE.
FIELD CONTROL WIRING RESISTANCE SHOULD NOT EXCEED 0.75 OHM.
FIELD WIRED
FACTORY SUPPLIED AND WIRED
WIRE COLOR CODE
BK BLACK
GY GRAY
PK PINK
W WHITE
BL BLUE
LT BL LIGHT BLUE
PR PURPLE
Y YELLOW
BR BROWN
O ORANGE
R RED
LEGEND
D1 INLET DAMPER
DS1 MAIN DISCONNECT SWITCH
FSC FIRE SYSTEM CONTACT
M# MOTOR
OL# MOTOR OVERLOAD
PS1 DIRTY FILTER SWITCH
RF SUPPLY FAN RELAY
RH HEAT RELAY
S1 EXHAUST FAN SWITCH
S2 FAN SWITCH
S4 HEAT AND COOL SWITCH
S5 ROOM OVERRIDE
ST# MOTOR STARTER
TR# TRANSFORMER
USER INDIRECT GAS FURNACE INTERFACE CONNECTIONS:
FACTORY WIRED TO TERMINAL "32" IN IG FURNACE COMPARTMENT
ROOM OVERRIDE CONNECTION
Template Drawing: U05
MAIN POWER TO UNIT 208V
GROUND
SUPPLY FAN MOTOR
EXHAUST FAN MOTOR (1)
EXHAUST FAN MOTOR (2)
TO 111 & 112 IN MASTER FURNACE
75 VA
24V
INLET DAMPER
SUPPLY FAN RELAY
SUPPLY FAN
EXHAUST FAN (1)
EXHAUST FAN (2)
POST HEAT
TO IG FURNACE HEAT ENABLE CONTROL
Note 4
Note 2
Note 3
Note 5



INDIRECT GAS WIRING DIAGRAM
FURNACE 1 - MASTER - 8 STAGE
FACTORY WIRED TO TERMINALS "111" AND "112" IN MAIN CONTROL CENTER
75 VA
24 VAC
SMALL MANIFOLD SEC CONTROLLER
LARGE MANIFOLD SEC CONTROLLER
IG FURNACE WIRING
BOARD WIRING
HEAT ENABLE
ROOM OVERRIDE
MAIN CONTROL CENTER
Note 5
GREENHECK
Building Value in Air.
Wiring Diagram Code:
G4F11X1MX00000S05
CAUTION
UNIT SHALL BE GROUNDED IN ACCORDANCE WITH N.E.C.
POWER MUST BE OFF WHILE SERVICING.
NOTES
USE COPPER CONDUCTORS ONLY
60° C FOR TERMINALS RATED LESS THAN 100 AMPS.
75° C FOR TERMINALS RATED 100 AMPS OR MORE.
FIELD CONTROL WIRING RESISTANCE SHOULD NOT EXCEED 0.75 OHM.
FIELD WIRED
FACTORY SUPPLIED AND WIRED
WIRE COLOR CODE
LEGEND
CM COMBUSTION BLOWER MOTOR
HLC HIGH TEMPERATURE LIMIT CONTROL
IC1 IGNITION CONTROL - SMALL MANIFOLD
IC2 IGNITION CONTROL - LARGE MANIFOLD
MV1 MAIN GAS VALVE - SMALL MANIFOLD
MV2 MAIN GAS VALVE - LARGE MANIFOLD
PS2 COMBUSTION AIR PROVING SWITCH
R1 MAIN GAS VALVE 1 MONITORING
R2 MAIN GAS VALVE 2 MONITORING
R9 AIR PROVING SWITCH RELAY
SC1 STAGE CONTROLLER
TR# TRANSFORMER(S)
TS1 OUTDOOR AIR TEMP SENSOR
TS2 DISCHARGE AIR TEMP SENSOR
DDC Code: Version - IGFv1.00
GS8RXX
Wiring Template: S05

MUAU Interlock Wiring

No Scale

1. The wiring diagram for the basis of design unit is shown for bidding purposes to illustrate the points of interface betwween the DDC system and the unit's factory installed wiring. A project specific wiring diagram will be furnished by the control system designer subsequent to submittal approval. See the narrative sequence and point list for additional information and requirements.
2. HRV enable contact from the DDC system.
3. Gas furnace enable contact from the DDC system.
4. Jumper H to G. The fire alarm shutdown is provided in software via the DDC system.
5. Unused on this project.

1 Add. 05

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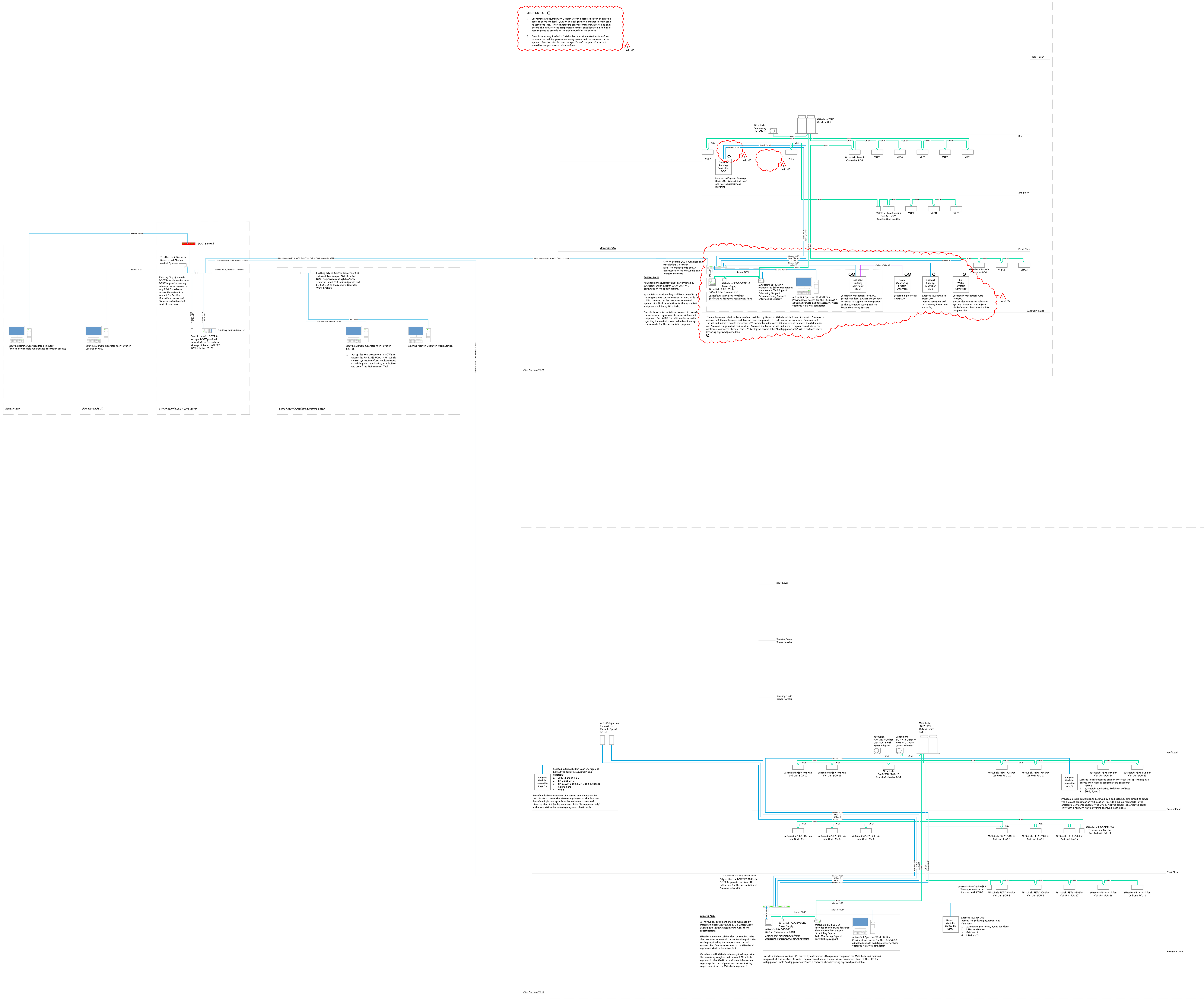
SHEET TITLE
Wiring Details

SHEET NUMBER
TC 5.22



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SHEET TITLE

Network Diagram - Overview

SHEET NUMBER

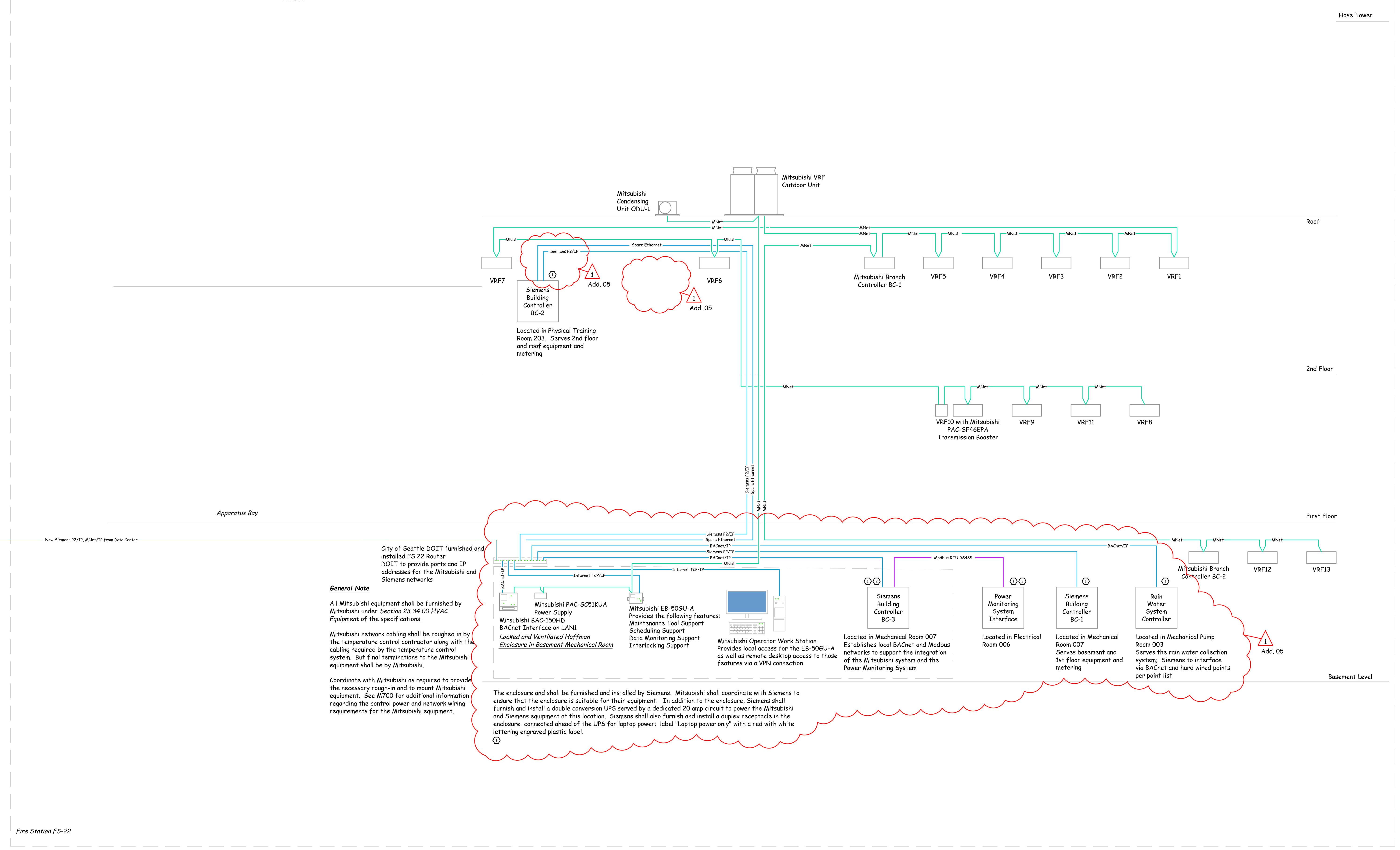
TC 6.00

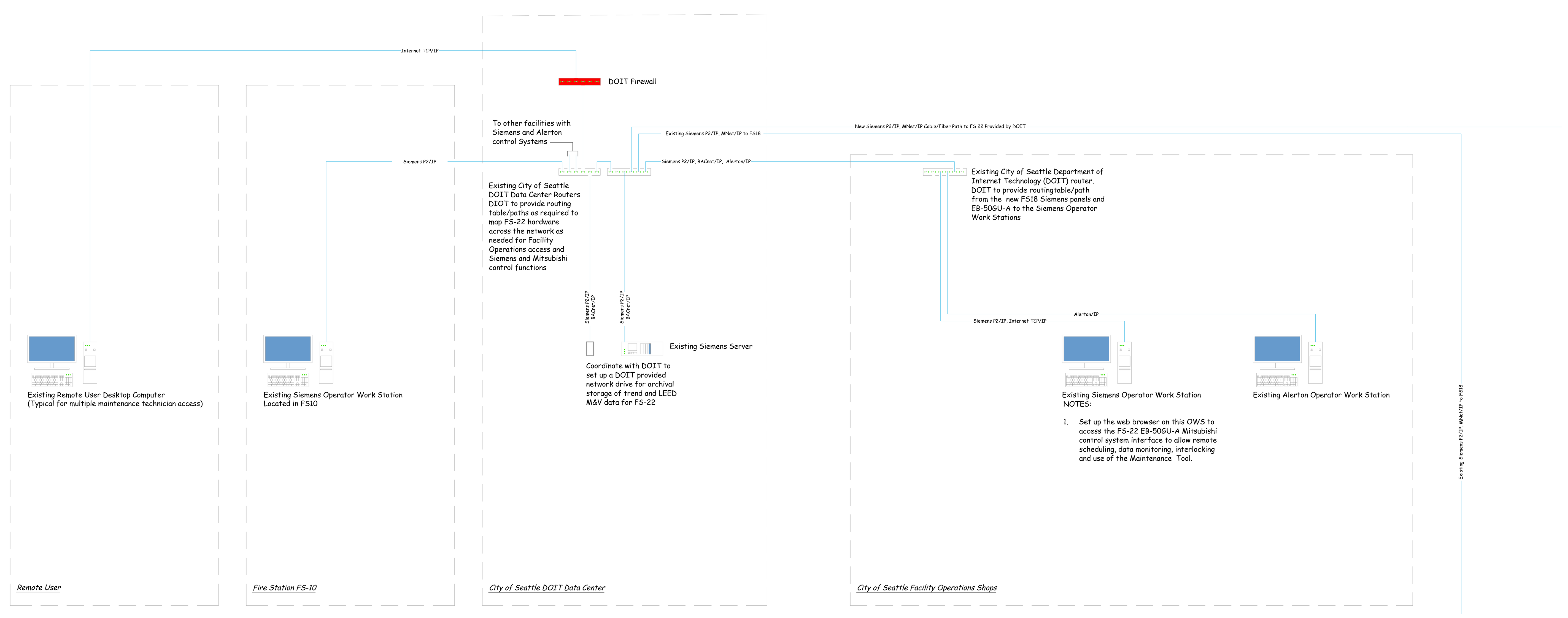
SHEET NOTES

1. Coordinate as required with Division 26 for a spare circuit in an existing panel to serve the load. Division 26 shall furnish a breaker in their panel to serve the load. The temperature control contractor/Division 25 shall extend the circuit to the temperature control panel location including all requirements to provide an isolated ground for the service.

2. Coordinate as required with Division 26 to provide a Modbus interface between the building power monitoring system and the Siemens control system. See the point list for the specifics of the points/data that should be mapped across this interface.

1 Add. 05





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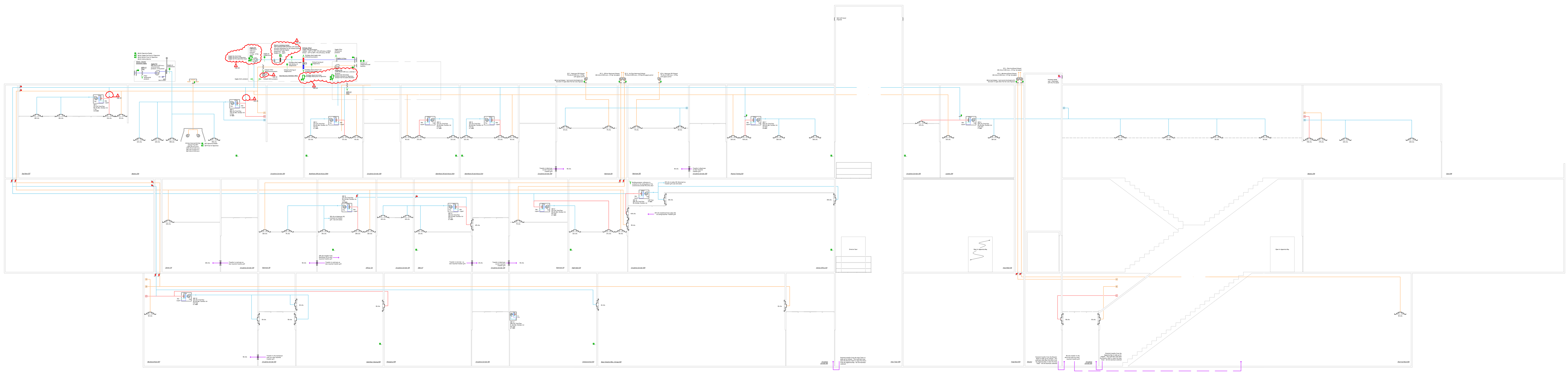
SHEET TITLE

Network Details

SHEET NUMBER

TC 6.01



Heat Recovery Ventilator HRV1 and Make Up Air Unit MUAU Zone Summary (Includes Variable Flow Refrigeration Zones VRF-1 Through 13)																			
Outdoor Unit Number	Branch Controller	Floor	Unit	VRF Indoor Unit Flows				Room Number	Service	Room Flows								Interconnected Area Outdoor air to Exhaust Imbalance (Note 1, 2)	Notes
				Supply cfm	Return cfm	Outdoor Air cfm	Imbalance, cfm (Note 1)			Indoor Unit Supply cfm	Return cfm	Transfer Air, cfm (+ is in and - is out)	Outdoor Air Directly from HRV or MAU, cfm	HRV Exhaust, cfm	Direct Exhaust, cfm	Infiltrate (+) or Exfiltrte (-)	Imbalance, cfm (Note 1)		
Outdoor Unit	BC-1	2nd	VRF-1	371	316	55	0	207	Day Room	371	316	0	0	55	0	0	0	(310)	
	BC-1	2nd	VRF-2	883	708	175	0	206	Beanery	883	708	0	900	175	900	0	0		Note 3
	BC-1	2nd	VRF-3	212	172	40	0	209/209A	Bunk Room	212	172	0	0	40	0	0	0		
	BC-1	2nd	VRF-4	212	172	40	0	210/210A	Bunk Room	212	172	0	0	40	0	0	0		
	BC-1	2nd	VRF-5	212	172	40	0	209/209A	Bunk Room	212	172	0	0	40	0	0	0		
	BC-1	2nd	VRF-6	494	129	55	310	204	Laundry	184	0	0	0	215	0	0	(31)		Note 4,5
								200	Circulation Corridor	260	129	(100)	0	0	0	0	31		
								201	Restroom	25	0	50	0	0	75	0	0		
								202	Restroom	25	0	50	0	0	75	0	0		
	BC-1	2nd	VRF-7	600	435	165	0	203	Physical Training	600	435	0	0	165	0	0	0		
	None	1st Floor	None	N/A	N/A	N/A	N/A	114	Janitor	0	0	100	0	100	0	0	0	(215)	
	BC-1	1st Floor	VRF- 8	371	250	55	66	115	Bunk Room	150	0	(150)	0	0	0	0	0		
								116	Officer	146	250	100	0	100	0	0	(104)		
								118	Restroom	75	0	50	0	0	100	0	25		
	None	1st Floor	None	N/A	N/A	N/A	N/A	119	Restroom	0	0	50	0	0	75	0	(25)		
	BC-1	1st Floor	VRF -9	212	172	40	0	120	Night Bunk	212	172	0	0	40	0	0	0		
	BC-1	1st Floor	VRF-10	494	439	55	0	103	Station Office	300	439	144	0	0	0	0	5		
								102	Lobby	194	0	(144)	0	0	0	(50)	0		
	BC-1	1st Floor	VRF-11	300	125	100	75	117	EMS	20	0	(20)	0	0	0	0	0		
								104	Corridor	280	125	(130)	0	0	0	0	25		
	BC-2	Basement	VRF-12	212	162	40	10	001	Corridor	122	72	(50)	0	0	0	0	0	(60)	
								008	Bunk Gear Cleaning	90	90	0	0	0	0	0	0		
	None	Basement	None	N/A	N/A	N/A	N/A	006	Electrical Room	0	0	50	0	0	50	0	0		
	None	Basement	None	N/A	N/A	N/A	N/A	007	Mechanical	0	0	50	0	0	50	0	0		
	None	Basement	Direct from HRV-1	N/A	N/A	N/A	N/A	002	Major Disaster	0	0	0	30	30	0	0	0		
	BC-2	Basement	VRF-13					010	Comm	208	208	0	0	0	0	0	0		
ODU-1	None	Basement	None	N/A	N/A	N/A	N/A	9	Emergency	399	0	0	0	0	0	0	0		
	MUAH Supply Flow - cfm -	900																	
	HRV-1 Total Supply Flow, cfm -	890																	
	HRV-1 Total Exhaust Flow, cfm-	1,325																	
	HRV-1 Imbalance, cfm -	(435)																	

Notes
1. This should be zero
2. An interconnected area is an area served by one or more system where air could transfer from one system to another to achieve an over-all flow balance
3. The directly introduced outdoor air totals include the flow from the kitchen makeup unit MUAU.
4. Does not inlcude the impact of the dryer vent when the dryer is running.
5. Does not include combustion air for the domestic hot water heater.

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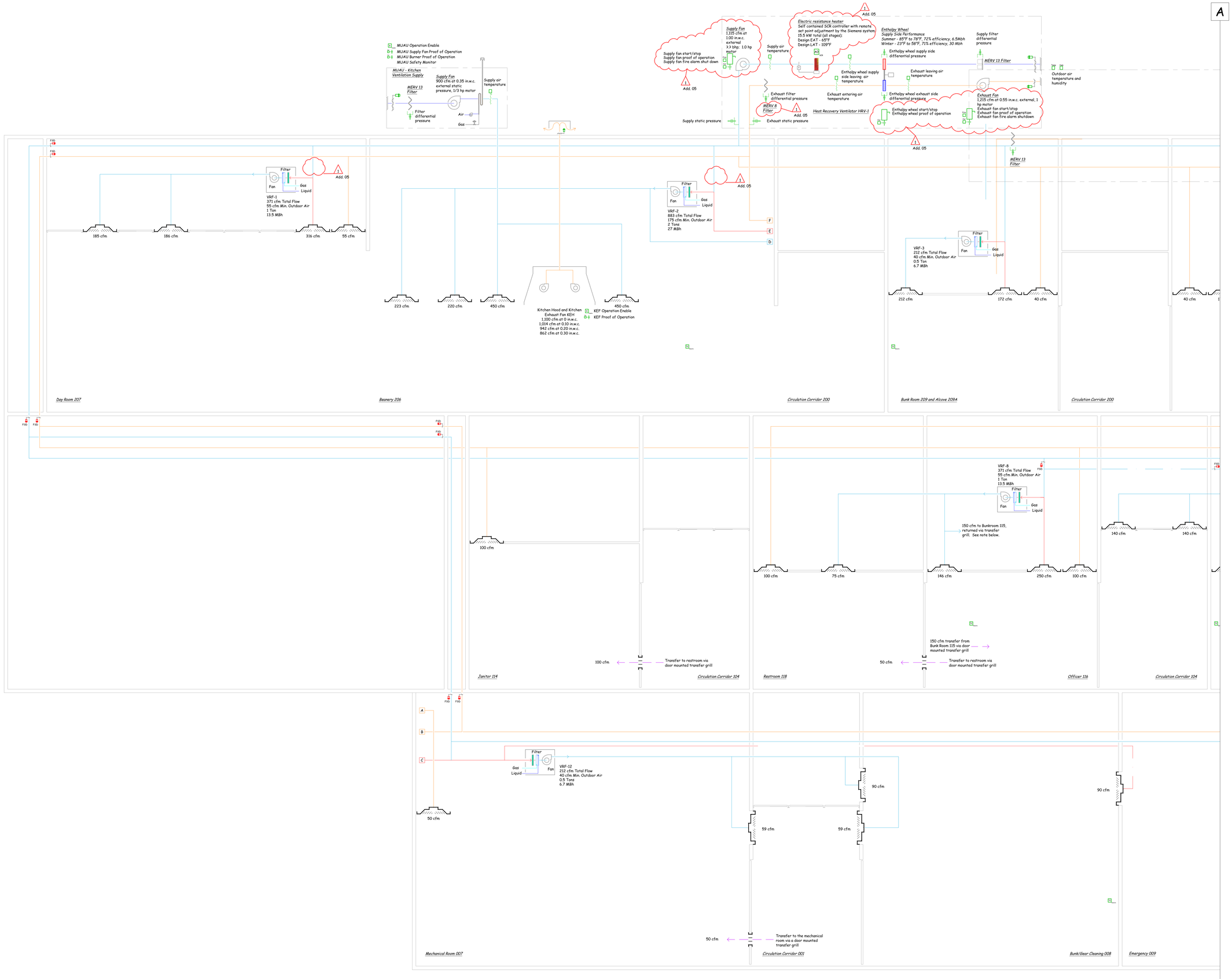
1	Revision 1 - Addendum 5 - 2016-02-19

SHEET TITLE
HRV1 and MUAU System Diagram

SHEET NUMBER
TC 6.10



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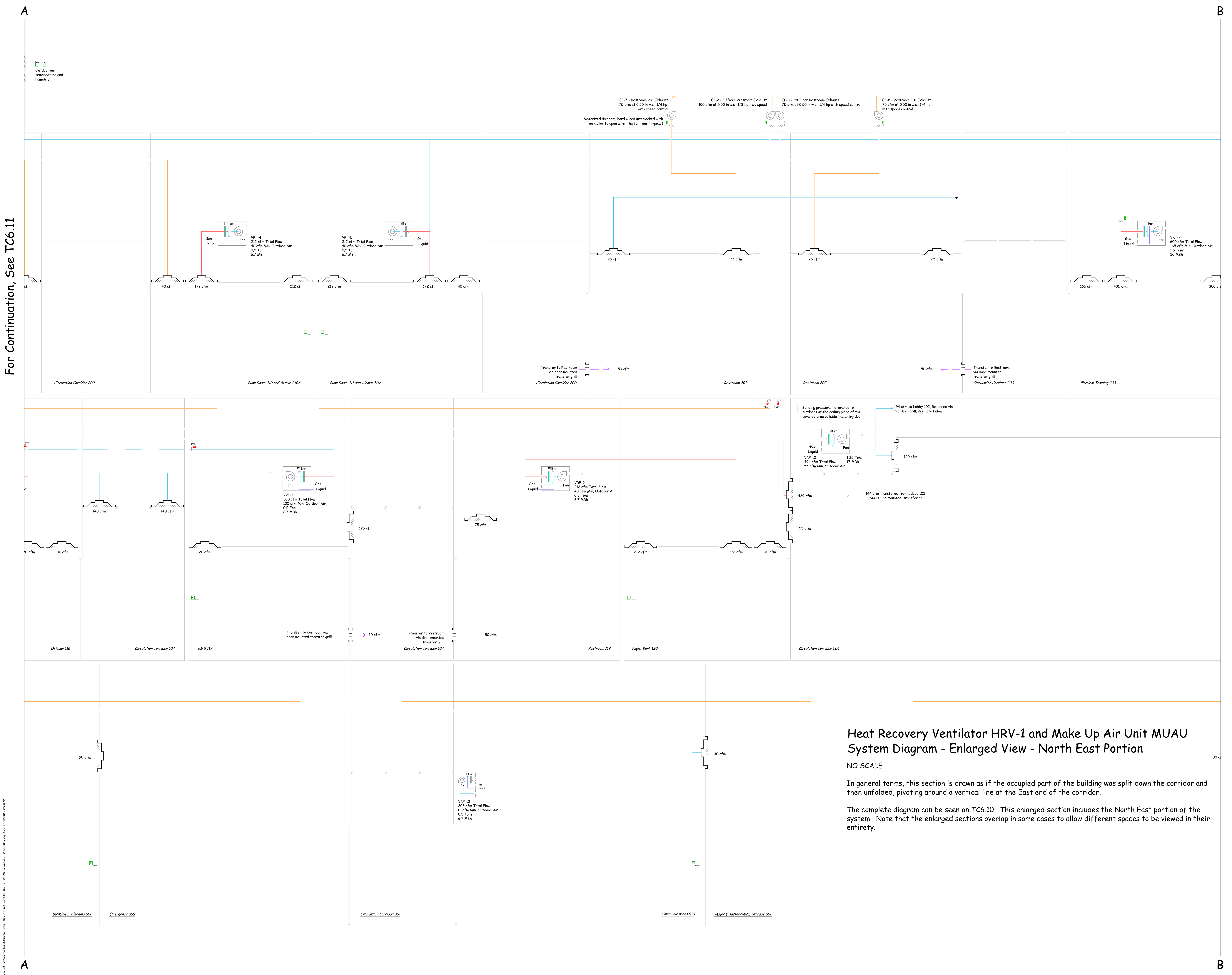
SHEET TITLE
HRV1 and MUAU System Diagram -NW Detail

SHEET NUMBER
TC 6.11



Heat Recovery Ventilator HRV-1 and Make Up Air Unit MUAU System Diagram - Enlarged View - North East Portion

NO SCALE

In general terms, this section is drawn as if the occupied part of the building was split down the corridor and then unfolded, pivoting around a vertical line at the East end of the corridor.

The complete diagram can be seen on TC6.10. This enlarged section includes the North East portion of the system. Note that the enlarged sections overlap in some cases to allow different spaces to be viewed in their entirety.

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SHEET TITLE
HRV1 and MUAU System Diagram NE Detail

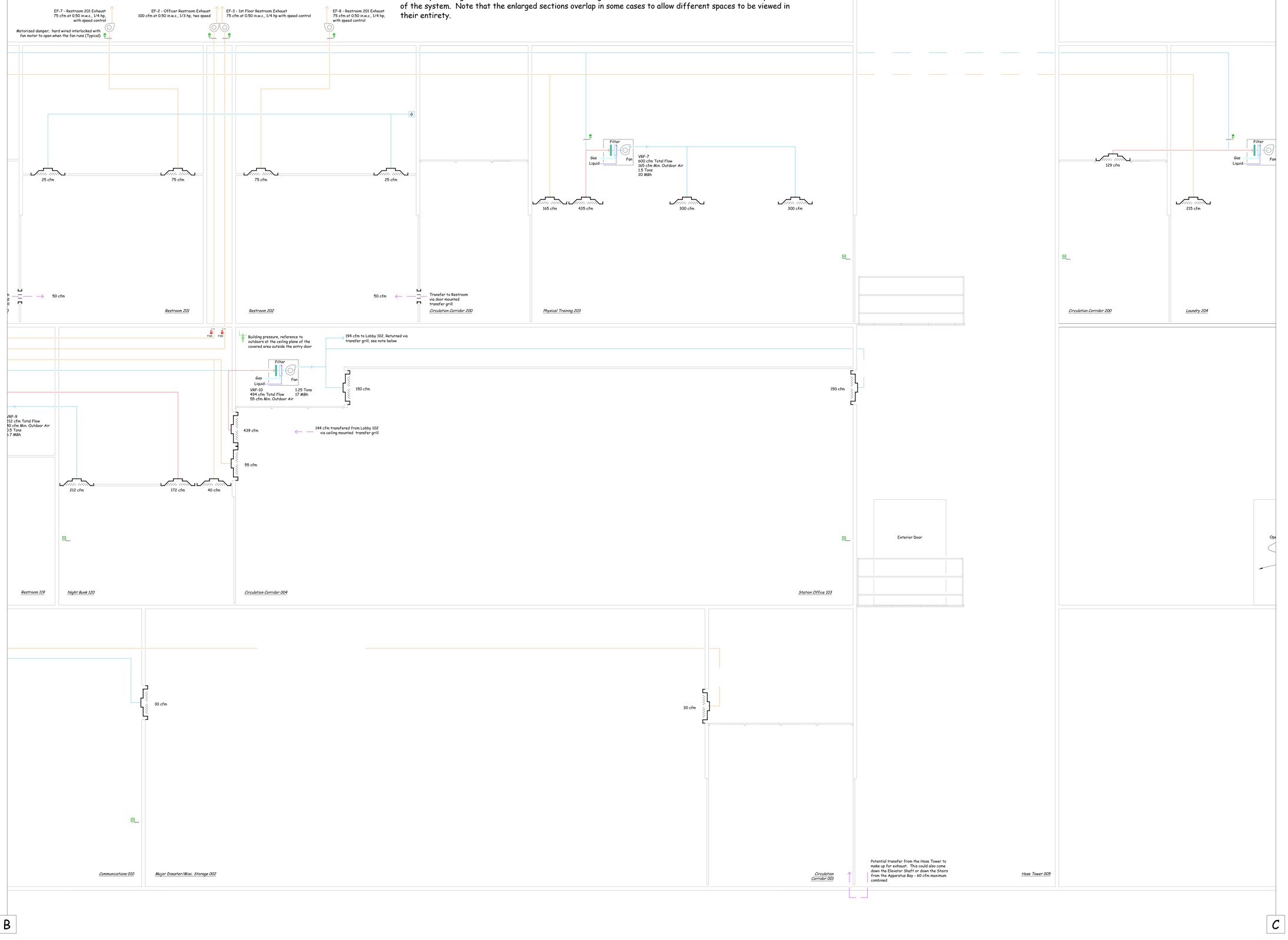
SHEET NUMBER
TC 6.12

Heat Recovery Ventilator HRV-1 and Make Up Air Unit MUAU System Diagram - Enlarged View - North and South East Portion

NO SCALE

In general terms, this section is drawn as if the occupied part of the building was split down the corridor and then unfolded, pivoting around a vertical line at the East end of the corridor.

The complete diagram can be seen on TC6.10. This enlarged section includes the North and South East portion of the system. Note that the enlarged sections overlap in some cases to allow different spaces to be viewed in their entirety.



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SHEET TITLE
HRV1 and MUAU System Diagram NE and SE Detail

SHEET NUMBER
TC 6.13

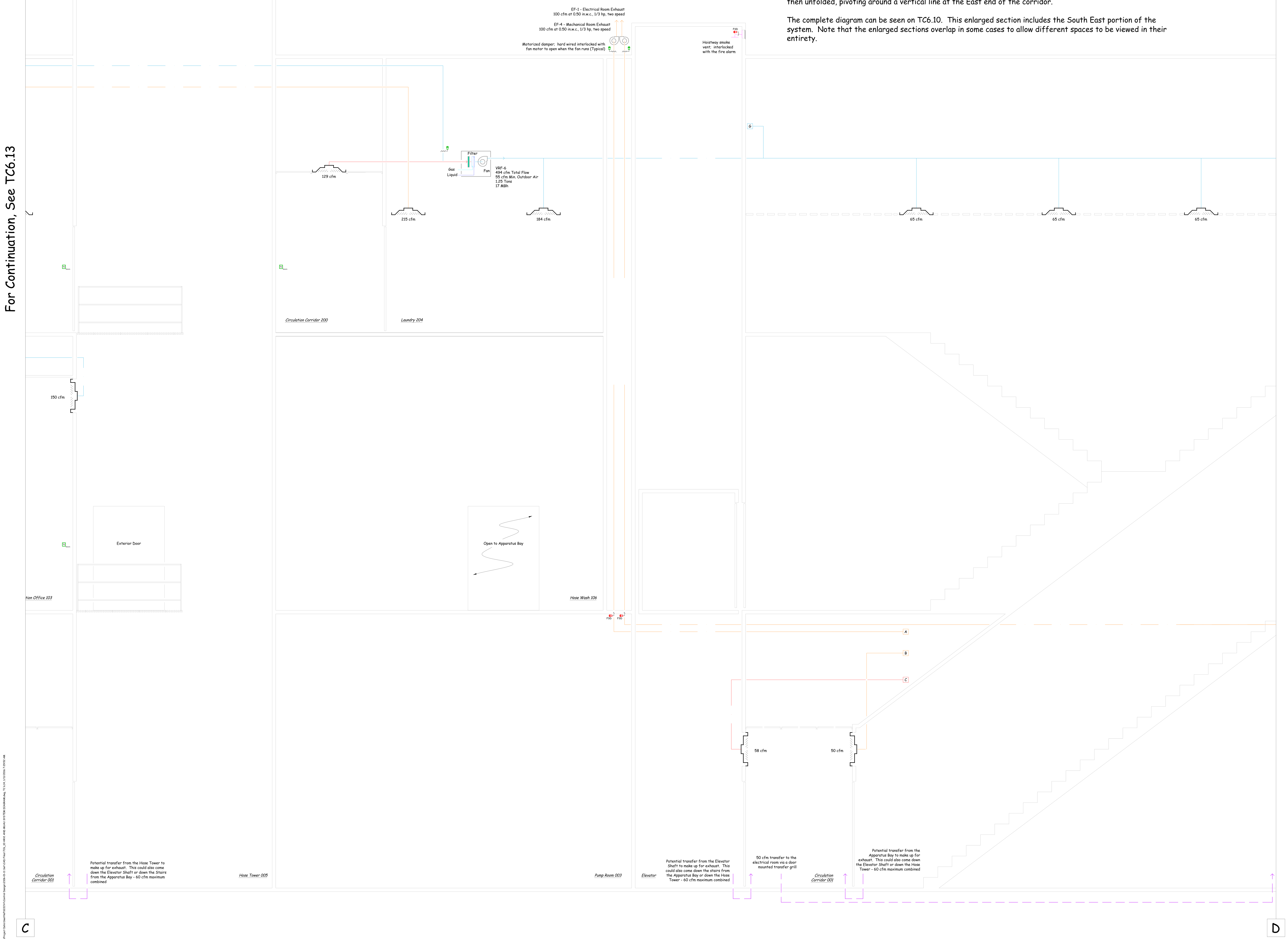
Heat Recovery Ventilator HRV-1 and Make Up Air Unit MUAU System Diagram - Enlarged View - South East Portion

NO SCALE

In general terms, this section is drawn as if the occupied part of the building was split down the corridor and then unfolded, pivoting around a vertical line at the East end of the corridor.

The complete diagram can be seen on TC6.10. This enlarged section includes the South East portion of the system. Note that the enlarged sections overlap in some cases to allow different spaces to be viewed in their entirety.

For Continuation, See TC6.13



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SHEET TITLE
HRV1 and MUAU System Diagram SE Detail

SHEET NUMBER
TC 6.14

Heat Recovery Ventilator HRV-1 and Make Up Air Unit MUAU System Diagram - Enlarged View - South West Portion

NO SCALE

In general terms, this section is drawn as if the occupied part of the building was split down the corridor and then unfolded, pivoting around a vertical line at the East end of the corridor.

The complete diagram can be seen on TC6.10. The enlarged section includes the South West portion of the system, including the to air handling units associated with it.

For Continuation, See TC6.14

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SHEET TITLE
HRV1 and MUAU System Diagram SW Detail

SHEET NUMBER
TC 6.15

HRV-1 Sequence of Operation

Overview

The system includes HRV-1 and the related indoor VRF units (VRF-1 through 13) that it provides make-up air for. The Kitchen Make-up Air Unit MUAU is also very interactive with this system so please refer to that sequence of operation for additional information.

The system includes the following components:

- Motorized power open/spring return closed intake dampers
- MERV13 supply air (outdoor air) filters
- A constant speed enthalpy wheel
- A supplemental electric heating coil with a silicon controlled rectifier to allow modulating capacity control
- A constant speed supply fan
- Variable flow refrigeration indoor units which include:
    1. MERV 8 filters
    2. Direct expansion refrigerant coils capable of heating or cooling
    3. Variable speed supply fans
- MERV 8 exhaust filters
- A constant speed exhaust fan
- Motorized power open/spring return closed exhaust dampers

The majority of the indoor units will run continuously but will have scheduling capabilities provided in the software if schedules are desired at some point in the future. Additional information regarding the indoor units can be found in the Variable Flow Refrigeration System (VRF) sequence of operation.

The following three zones will have their indoor units cycled by an occupancy sensor due to the highly variable occupancy.

- Day Room
- Beanery
- Fitness Center

These zones will also have their CO2 levels monitored for LEED purposes. The CO2 sensors will provide no active control function and are for monitoring only. Outdoor air from the HRV will be delivered to these zones even when the indoor unit is shut down.

Damper Interlocks

The AHU supply and exhaust dampers shall be commanded open any time the unit is commanded on via factory interlock wiring.

Start/Stop Control

HRV-1 shall include a scheduling feature to allow scheduled operation to be implemented if so desired. However, the schedule shall be set initially to provide round-the-clock operation.

HRV-1 Sequence of Operation

(Continued)

Power Failure Recovery

In the event of a power failure, the HRV-1 logic shall be arranged to provide for an orderly restart of the system in conjunction with the other systems in the facility, including the utility systems serving it. The details of the specific restart sequence shall be coordinated with the design team and facility operations during submittal review and the start-up and commissioning process.

Start-up Sequencing

An enable command from the Siemens control system to HRV-1, issued for any purpose, shall:

- Immediately start the exhaust fan and open the exhaust damper via the factory interlock wiring.
- Immediately start the enthalpy wheel via an exhaust fan starter auxiliary contact and the factory interlock wiring.
- Immediately start the supply fan and open the supply damper if the frost control cycle is not active via an exhaust fan starter auxiliary contact and the factory interlock wiring. (The frost control cycle is described in the next section.)

On start-up of HRV-1, the operation of the VRF systems associated with the system shall be delayed for 15 minutes (adjustable) to allow the supply system conditions to stabilize.

Shut Down Sequencing

A shut down command to HRV-1, issued for any purpose, shall immediately disable the electric reheat coil and the VRF systems associated with HRV-1. The command shall also trigger a shutdown timer that will disable the HRV-1 system after 5 minutes (adjustable) to ensure that any residual heat in the electric heating coils is dissipated prior to shut down in an effort to prevent nuisance high temperature safety trips at the electric resistance heater. When the disable command is issued by the Siemens system, the factory interlock wiring in HRV-1 shall shut down the exhaust fan, supply fan and enthalpy wheel and return the dampers to the fully closed position.

Discharge Temperature Control

Enthalpy Wheel Control

HRV-1 incorporates an enthalpy wheel to recover energy from the exhaust air stream and move it to the supply air stream. Supplemental cooling is not provided. Supplemental heating is provided and controlled as described below.

The enthalpy wheel is a constant speed wheel with no active control of the leaving air temperature. It is started via the same factory interlock wiring that opens the dampers and starts the fans via the HRV-1 enable command from the Siemens system as described above.

HRV-1 Sequence of Operation

(Continued)

Frost Control Cycle

A factory wired frost control cycle is initiated based on the pressure drop across the supply air side of the enthalpy wheel when the outdoor air temperature at the intake to the unit is below 5°F as sensed by a factory furnished and wired thermostat.

When the pressure drop exceeds the setting of the factory furnished and wired pressure switch, a time delay relay cycles the supply fan off for 5 minutes and then on for 30 minutes (factory set, adjustable). During this period of time, the enthalpy wheel continues to rotate, allowing the heat in the exhaust air stream to defrost the wheel.

When the outdoor temperature rises above 5°F plus the fixed differential of the factory outdoor air temperature sensor, the frost control cycle is disable.

An isolated contact factory furnished contact closes when the frost control cycle is occurring. The DDC system monitors this contact to provide annunciation of the frost control cycle.

Supplemental Heat Control

Supplemental heating is provided by an electric reheat coil which is controlled by a factory furnished and installed Silicon Controlled Rectifier (SCR) with a remote set point adjustment capability from the Siemens system. The Siemens systems independently monitors the leaving air temperature from the electric heating coil (along with other unit parameters, see the point list for details) but the electric resistance coil uses a factory furnished and wired temperature sensor to directly control the electric resistance heater via the factory furnished and installed SCR.

The Siemens system enables the supplemental electric heat when the outdoor temperature drops below the discharge air temperature set point for 30 minutes or more (adjustable). When the outdoor air temperature rises above the enable set point, the supplemental heater is disabled.

Once enabled, the factory furnished SCR modulates the capacity of the electric heater to maintain the desired discharge air temperature ("neutral air" 70°F initial set point, adjustable via the Siemens system). Via the physical configuration of the system, the first stage or heating will be provided by the enthalpy wheel transferring energy from the exhaust stream to the outdoor air stream. This is a passive process with no direct control over the temperature and humidity provided in the supply air stream.

If the supply temperature downstream of the energy recovery wheel deviates below the supply air temperature set point because the recovered energy is insufficient to meet it, then the electric heat is modulated from minimum towards maximum capacity by the SCR. A deviation above set point reverses the sequence.

HRV-1 Sequence of Operation

(Continued)

Factory furnished, hardwired safety interlocks will shut down the electric resistance heater irrespective of any commands from Siemens or the SCR if:

- The supply fan stops operating as sensed by a differential pressure switch monitoring the pressure drop across the electric heating element.
- An automatic reset thermal limit switch senses a temperature in the duct heater that exceeds its set point.
- A manual reset thermal limit switch senses a temperature in the duct heater that exceeds its set point, which is higher than the automatic reset thermal switch

Ventilation Operation

HRV-1 operates at a constant volume. Carbon Dioxide (CO2) sensors monitor CO2 levels in the Day Room, Beanery and the Fitness Center and initiate alarms if the levels exceed safe thresholds for 5 minutes or more (1,000 ppm, adjustable).

Nitrous Oxide and Carbon Monoxide sensors monitor the levels of those gases in the corridors with access to the apparatus bay on the first floor and basement levels and initiate alarms if the hard coded threshold levels in the sensors are exceeded (100 ppm for CO and 5 ppm for NO2).

Indoor Fan Coil Unit Controls

See the narrative sequence of operations for the VRF systems for the details of the sequence of operation associated with the indoor fan coil units. Note that HRV-1 shall continue to supply ventilation air to an indoor fan coil unit even if it is in the unoccupied cycle.

Safety Interlocks

The HRV1 fire alarm interface and supply duct freezestat shall shut down the system, no matter what the position the any starter Hand-Off-Auto switches are in if an unsafe operating condition is detected. Note that the fire alarm shut down is provided via software logic in the DDC system based on one hard wired input from the fire alarm control panel. This feature is not required by code and is being provided as an added measure of safety in the event of an alarm.

Factory furnished and wired motor overloads shall shut down and lock out either fan no matter what position their starter Hand-Off-Auto selector switches are in.

Field Wiring Information

The wiring diagram for the basis of design unit has been included for bidding purposes on sheet TC 5.12.

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HRV-1 and MUAU Sequence of Operation

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MUAU Sequence of Operation

Overview

The system includes the Makeup Air Unit MUAU, Exhaust Fan EF-6, the Kitchen Hood, and the discharge hood RV-1. This system is interactive with system HRV-1 so please refer to that sequence of operation for additional information.

The MUAU includes the following components:

- Factory motorized and wired power open/spring return closed outdoor air dampers
- MERV 14 filters
- Supply fan
- Eight stage gas furnace

EF-6 is integral with the kitchen hood and is actually two exhaust fans that operate as one fan.

Damper Interlocks

The MUAU supply damper shall be commanded open any time the unit is enabled via factory interlock wiring.

Start/Stop Control

The MAUA system operation is manually initiated by the occupants in the Beanery when they want to use the kitchen exhaust hood. A manual switch at the hood is hard wire interlocked to do the following when it is turned on.

1. Open the discharge dampers in RV-1.
2. Enable the operation of exhaust fan EF-6.
3. Enable the operation of the MUAU.

When the switch is turned back off, the system is shut down and the dampers close.

Power Failure Recovery

In the event of a power failure, the MUAU system will need to be manually restarted if it is still needed by the occupants of the space.

Discharge Temperature Control

The MUAU is a 100% outdoor air unit that provides no supplemental cooling. The discharge diffusers are located in close proximity to the hood to minimize the impact of untreated outdoor air on the space conditions on hot or humid days. In addition, the ductwork in the Beanery is insulated to prevent condensation problems if the operation of the system is prolonged and it causes the dew point temperature in the space to drift up. However, the design intent is that the kitchen hood only would be in operation when there is stovetop is in use

Supplemental heating is provided by an 8 stage modulating gas furnace. The DDC system enables the gas furnace any time the outdoor temperature is below 70°F (adjustable) and disables it anytime the outdoor temperature is above 72°F (adjustable). Adjust the set point on the factory controller to 80°F (adjustable in the field) to ensure that the Siemens system has control of enabling and disabling the heating system associated with MUAU.

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MUAU Sequence of Operation

(Continued)

When the gas furnace is enabled, as the supply temperature deviates below set point, the gas burner is modulated from minimum towards maximum capacity by a factory furnished and installed controller in 8 steps. A deviation above set point reverses the sequence.

Safety Interlocks

The MUAU fire alarm interface and supply duct freezestat shall shut down the system, no matter what the position of any Hand-Off-Auto switches are in if an unsafe operating condition is detected. Note that the fire alarm shut down is provided via software logic in the DDC system based on one hard wired input from the fire alarm control panel. This feature is not required by code and is being provided as an added measure of safety in the event of an alarm.

Motor overloads shall shut down and lock out any fan no matter what position their starter Hand-Off-Auto selector switches are in.

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HRV-1 and MUAU Sequence of Operation (Continued)

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HRV-2 Sequence of Operation

Overview

The HRV-2 system serves the Bunker Gear storage area and includes the following pieces of equipment.

- Rooftop heat recovery unit HRV-2, which includes:
  1. Motorized, power open/spring return closed intake dampers
  2. MERV13 supply air (outdoor air) filters
  3. A cross-flow plate style air to air heat exchanger
  4. A two speed, VFD controlled supply fan
  5. A two speed Electrically Commutated Motor (ECM) controlled exhaust fan
  6. Motorized, power open/spring return closed exhaust dampers
- Destratification fan
- Gas fired Unit Heater 1

Combustion Air Provisions

Combustion air for Unit Heater 1 is provided by a concentric intake/flue system. See Detail 5 on sheet M801 for more information.

Damper Interlocks

The HRV-2 supply and exhaust dampers shall be commanded open any time the unit is commanded on via factory wiring.

Start/Stop Control

HRV-2 shall include a scheduling feature to allow scheduled operation to be implemented if so desired. However, the schedule shall be set initially to provide round-the-clock operation on the minimum flow ventilation cycle.

Power Failure Recovery

In the event of a power failure, the HRV-2 logic shall be arranged to provide for an orderly restart of the system in conjunction with the other systems in the facility, including the utility systems serving it. The details of the specific restart sequence shall be coordinated with the design team and facility operations during submittal review and the start-up and commissioning process.

Start-up Sequencing

An enable command from the Siemens control system to HRV-2, issued for any purpose, shall:

- Immediately start the exhaust fan and open the exhaust damper via the
- Immediately start the supply fan and open the supply damper if the frost control cycle is not active via an exhaust fan starter auxiliary contact and the factory interlock wiring. (The frost control cycle is described in a subsequent section.)

HRV-2 Sequence of Operation

(Continued)

Shut Down Sequencing

When the disable command is issued to HRV-2 by the Siemens system, the factory interlock wiring in HRV-2 shall shut down the exhaust fan, and supply fan and return the dampers to the fully closed position.

High Flow/Minimum Flow Ventilation Cycle Control

HRV-2 is equipped with a variable speed drive on both the supply fan and a two speed EMC motor on the exhaust fan. The control system shall command the supply fan VSD and the exhaust fan ECM motor as required to achieve either a high flow ventilation cycle or a minimum flow ventilation cycle. The fan sheaves shall be adjusted so that the high flow ventilation rates/design flow rates and pressure relationships associated with it are achieved with the supply fan VFD and exhaust fan ECM at full speed to maximize drive efficiency.

Minimum Flow Ventilation Cycle

HRV-2 is enabled by the DDC system to run continuously on low speed to provide minimum ventilation for the bunker storage room. The low speed setting for the supply fan variable speed drive shall be operator adjustable via the system graphic with access restricted to a high level operator.

The low speed setting on the ECM motor is made via a set point adjustment on the device. The final setting shall be documented in the system graphic in an editable text object with access restricted to a high level operator.

The VFD and ECM motor low speed settings shall be determined by a coordinated effort between the control contractor, the balancing contractor, and the commissioning provider to identify the required supply and exhaust flows and associated pressure relationships. Note that this determination shall be made after setting up the fans to deliver the design maximum flow with the VFD/ECM at full speed as indicated previously.

A 12 hour, no hold position, spring wound interval timer acting as an input to the DDC system shall trigger a high speed operating cycle. When the interval timer times out, the system shall revert to the normal, low speed ventilation mode.

Frost Control Cycle

A factory wired control circuit shall provide a frost control cycle to protect the plate and frame heat exchanger from frost building up at low ambient temperatures by cycling the supply fan off for a predetermined time.

HRV-2 Sequence of Operation

(Continued)

Specifically, when the exhaust air temperature leaving the plate heat exchanger drops below 35°F (adjustable in the field at the unit in the factory furnished and wired exhaust air thermostat), the thermostat triggers a time delay relay. The time delay relay then cycles the supply fan off for 5 minutes and on for 30 minutes (both adjustable in the field at the factory furnished and wired time delay relay). This cycle repeats until the air temperature leaving the plate heat exchanger rises back above the set point of the exhaust air thermostat.

An isolated factory furnished contact closes when the frost control cycle is occurring. The DDC system monitors this contact to provide annunciation of the frost control cycle.

Space Temperature Control

Bunker unit heater UH-1 shall be controlled based on space temperature. During the low speed operating cycle the space temperature set point shall be 60°F (adjustable via software). During the high speed operating cycle, the space temperature set point shall be 80°F (adjustable via software and via a set point adjustment on the space temperature sensor between 70 and 90°F).

If the space temperature drops below the current set point, UH-1 shall cycle its fan on. If the space temperature continues to drop, UH-1 shall cycle on its gas valve. When the space temperature rises back above the current set point plus 2°F differential (adjustable), UH-1 gas valve shall cycle back off. If the space temperature rises above the current set point plus 4°F differential (adjustable), UH-1 fan shall cycle back off.

Safety Interlocks

The variable speed drive shall be equipped with Hand-Off-Auto switches. In the "Off" position, the fan shall be shut down no matter what the status of the command from the DDC system is.

In the "Hand" position, the fan shall run continuously at a speed set locally at the drive control panel, no matter what the status of the commands from the DDC system are

In the "Auto" position, the fan shall be controlled by the DDC system contacts and speed commands per the operating sequence described here-in.

The HRV-2 supply duct freezestat shall shut down the system, no matter what the position the VFD Hand-Off-Auto Switches are in. Motor overloads shall shut down and lock out either fan no matter what position their starter Hand-Off-Auto selector switches are in.

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HRV-2 Sequence of Operation

(Continued)

Ceiling Fan

The ceiling fan shall be wired to a factory furnished, field installed control switch that allows the occupants to turn the fan on or off and select one of three speeds.

A relay piloted by the DDC system shall enable operation of the fan. The relay shall cycle off for 1 minute (adjustable) every day at 2 am (adjustable) if HRV-2 is in the low speed cycle to sweep the fan off and ensure they are not operating when they are not required. If HRV-2 is in the high speed cycle at the sweep time, the fan shall not be commanded off.

A CT monitoring the total current drawn by the fan provides a proof of operation input to the DDC system.

HRV-3 Sequence of Operation

Overview

The HRV-3 system serves the Decon/Wash area, the First Floor West Circulation Corridor, the Maintenance area, and the Battery Charging area. It also provides supplemental ventilation to the Bunker Gear Storage room.

Damper Interlocks

The HRC-3 supply and exhaust dampers shall be commanded open any time the unit is commanded on via factory interlock wiring.

Start/Stop Control

HRV-3 shall include a scheduling feature to allow scheduled operation to be implemented if so desired. However, the schedule shall be set initially to provide round-the-clock operation.

Power Failure Recovery

In the event of a power failure, the HRV-3 logic shall be arranged to provide for an orderly restart of the system in conjunction with the other systems in the facility, including the utility systems serving it.

Start-up Sequencing

An enable command from the Siemens control system to HRV-2, issued for any purpose, shall:

- Immediately start the exhaust fan and open the exhaust damper via the
- Immediately start the supply fan and open the supply damper if the frost control cycle is not active via an exhaust fan starter auxiliary contact and the factory interlock wiring. (The frost control cycle is described in a subsequent section.)

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HRV- 2 and 3 Sequence

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HRV-3 Sequence of Operation

(Continued)

Safety Interlocks

Shut Down Sequencing

When the disable command is issued to HRV-2 by the Siemens system, the factory interlock wiring in HRV-2 shall shut down the exhaust fan, and supply fan and return the dampers to the fully closed position.

Discharge Temperature Control

HRV-3 incorporates a plate heat exchanger to recover energy from the exhaust air stream and move it to the supply air stream. Supplemental cooling and heating are not provided.

Ventilation Operation

HRV-3 operates at a constant volume. Nitrous Oxide and Carbon Monoxide sensors monitor the levels of those gases in the Circulation Corridor near the door to the apparatus bay on the first floor and initiate alarms if the hard coded threshold levels in the sensors are exceeded (100 ppm for CO and 5 ppm for NO2).

Frost Control Cycle

A factory wired control circuit shall provide a frost control cycle to protect the plate and frame heat exchanger from frost building up at low ambient temperatures by cycling the supply fan off for a predetermined time.

Specifically, when the exhaust air temperature leaving the plate heat exchanger drops below 35°F (adjustable in the field at the unit in the factory furnished and wired exhaust air thermostat), the thermostat triggers a time delay relay. The time delay relay then cycles the supply fan off for 5 minutes and on for 30 minutes (both adjustable in the field at the factory furnished and wired time delay relay). This cycle repeats until the air temperature leaving the plate heat exchanger rises back above the set point of the exhaust air thermostat.

An isolated factory furnished contact closes when the frost control cycle is occurring. The DDC system monitors this contact to provide annunciation of the frost control cycle.

Safety Interlocks

The HRV3 fire alarm interface and supply duct freezestat shall shut down the system, no matter what the position the any starter Hand-Off-Auto switches are in if an unsafe operating condition is detected. Note that the fire alarm shut down is provided via software logic in the DDC system based on one hard wired input from the fire alarm control panel. This feature is not required by code and is being provided as an added measure of safety in the event of an alarm.

Motor overloads shall shut down and lock out either fan no matter what position their starter Hand-Off-Auto selector switches are in..

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HRV- 2 and 3 Sequence

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Variable Flow Refrigeration (VRF) Systems Sequence of Operation (Continued)

State Points

The BACnet state points (i.e. On/off State, Operating State, Fan Speed State, Room Temperature, and Air Direction State) will provide Facility Operations with the current operating state selected by the zone occupants in addition to providing proof of operation feedback for any schedules, set back cycles, etc. they implement in the future.

Occupancy Driven Schedules

The following zones are to be provided with occupancy driven operating hours based on the occupancy sensors that are located in them.

- Fitness Area
- Day Room and Beanery Area
- Bunk Rooms

When an occupancy sensor in these areas detects motion the fan coil unit or unit's serving the area are turned on and allowed to operate to actively control the space temperature at the occupied heating and cooling set points (70°F and 72°F respectively, both adjustable). When a cycle is triggered, the system will remain in the occupied cycle for a minimum of 15 minutes (adjustable) from the last time that motion is detected.

Ventilation air to a zone is provided via HRV-1. Dampers in the ventilation air duct open and close as a function of zone occupancy.

At the end of an occupied cycle, the fan coil unit or units serving the area are turned off and the temperature in the area is allowed to drift between the unoccupied heating and cooling set points (initial settings of 68°F and 78°F respectively). As long as the zone temperature is between the unoccupied set points, no active cooling or heating is provided. But, if the temperature drifts outside the set-back temperature range, the unit is placed in occupied mode and operates until the space temperature is driven back inside the set back/set up range at which time the unit is shut back down again.

Functional testing technique shall be used to determine the appropriate set back and set up temperatures for the zones with occupancy based schedule during the commissioning and warranty period. Test results shall be used to optimize the initial set points provided and tailor them to the thermal mass (stored energy) and HVAC process energy associated with the zone served.

Variable Flow Refrigeration (VRF) Systems Sequence of Operation (Continued)

Error Codes and Alarms

The BACnet error code and alarm point shall trigger logic in the Siemens network designed to facilitate remote diagnostics from the Facility Operations office. In general terms the points will trigger alarms and alarm messages with the text of the message providing additional guidance regarding the actions required to resolve the problem. The error messages shall be presented in the system graphics running at the Siemens Operator Work Station (OWS).

Each error code shall have a specific customized message associated with it. The details contained in the message will be coordinated with Facility Operations at the time of the control submittal review.

Filter Status

The BACnet filter points shall be used to trigger an alarm annunciating the need to change a filter and to allow the operators to reset the filter alarm once the filters have been serviced. The alarm set points shall be coordinated during the start-up and commissioning process to match the capabilities of the HRV fans in terms of ensuring they deliver the required air flows at a minimum with dirty filters.

The BACnet Prohibit Filter Sign Reset point shall be configured to prevent the filter alarm from being reset from the remote controllers located in FS-29.

Diagnostic Points

The VRF technology employs numerous analog sensors monitoring system temperatures, pressures, currents and other physical properties as required to control and optimize the system. Most, if not all of this data is available via the VRF Maintenance Tool Software. However, few if any of the points are made available as BACnet objects for direct access by the Siemens control system.

To improve operability certain key parameters as outlined in the point lists, will be brought into the Siemens network as physical points to allow preliminary diagnostics to be performed via the Siemens OWS. Some of the diagnostics will simply present key data to the operator for their assessment and judgment. However, in some instances control logic will be used to combine information from multiple sensors to generate an alarm.

Variable Flow Refrigeration (VRF) Systems Sequence of Operation (Continued)

Control logic will also be used to imply operating pressures based on measure temperatures in the refrigeration system by assuming it is operating as a saturated system and using look-up table functions and/or calculations to infer one parameter from the other. The details of the logic required for diagnostics will be developed during the submittal process once the specific items of equipment to be provided for the project are established, including make and model.

The current project along with FS18, FS29, and several existing facilities with VRF systems will serve as a pilot projects to allow the City to assess the practical issues associated with this approach as well as the cost benefit.

Minimum Outdoor Air Damper

A two position, normally open minimum outdoor air damper is provided in the outdoor air connection to the VRF indoor unit. This damper shall be commanded open if the VRF unit fan is in operation as indicated by the proof of operation input. If the fan is not in operation for any reason (schedule, fan failure, etc.) then the minimum outdoor air damper shall be closed.

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VRF Sequence of Operation Continued

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HRV-1 Sequence of Operation

Overview

The system includes HRV-1 and the related indoor VRF units (VRF-1 through 13) that it provides make-up air for. The Kitchen Make-up Air Unit MUAU is also very interactive with this system so please refer to that sequence of operation for additional information.

Damper Interlocks

The AHU supply and exhaust dampers shall be commanded open any time the unit is commanded on via factory interlock wiring.

Start/Stop Control

HRV-1 shall include a scheduling feature to allow scheduled operation to be implemented if so desired. However, the schedule shall be set initially to provide round-the-clock operation.

Power Failure Recovery

In the event of a power failure, the HRV-1 logic shall be arranged to provide for an orderly restart of the system in conjunction with the other systems in the facility, including the utility systems serving it.

Start-up Sequencing

A start-up command to HRVE-1, issued for any purpose, shall immediately start the supply and exhaust fans. The operation of the VRF systems associated with the system shall be delayed for 15 minutes (adjustable) to allow the supply system conditions to stabilize.

Shut Down Sequencing

A shut down command to HRV-1, issued for any purpose, shall immediately disable the electric reheat coil and the VRF systems associated with HRV-1. The command shall also trigger a shutdown timer that will shut down the system air flow after 5 minutes (adjustable) to ensure that any residual heat in the electric heating coils is dissipated prior to shut down in an effort to prevent nuisance safety trips.

Discharge Temperature Control

HRV-1 incorporates an enthalpy wheel to recover energy from the exhaust air stream and move it to the supply air stream. Supplemental cooling is not provided. Supplemental heating is provided by an electric reheat coil which is controlled by a PI control process.

As the supply temperature deviates below set point, the electric heat is modulated from minimum towards maximum capacity by an SCR (Silicon Controlled Rectifier). A deviation above set point reverses the sequence.

HRV-1 Sequence of Operation (Continued)

Ventilation Operation

HRV-1 operates at a constant volume. Carbon Dioxide (CO_2) sensors monitor CO_2 levels in the Day Room and the Fitness Center and initiate alarms if the levels exceed safe thresholds for 5 minutes or more (adjustable).

Nitrous Oxide and Carbon Monoxide sensors monitor the levels of those gases in the corridors with access to the apparatus bay on the first floor and basement levels and initiate alarms if the hard coded threshold levels in the sensors are exceeded (100 ppm for CO and 5 ppm for NO_2).

Frost Control

The heat wheel in AHU-1 shall include a factory hard wired frost control cycle that shuts down the supply fan for 10 minutes (adjustable) any time the differential pressure across the heat wheel exceeds 0.20 in.w.c. (adjustable) for 10 minutes or more (adjustable)

Indoor Fan Coil Unit Controls

See the narrative sequence of operations for the VRF systems for the details of the sequence of operation associated with the indoor fan coil units. Note that HRV-1 shall continue to supply ventilation air to an indoor fan coil unit even if it is in the unoccupied cycle.

Safety Interlocks

The HRV1 fire alarm interface and supply duct freezestat shall shut down the system, no matter what the position the any starter Hand-Off-Auto switches are in if an unsafe operating condition is detected. Note that the fire alarm shut down is provided via software logic in the DDC system based on one hard wired input from the fire alarm control panel. This feature is not required by code and is being provided as an added measure of safety in the event of an alarm.

Motor overloads shall shut down and lock out either fan no matter what position their starter Hand-Off-Auto selector switches are in.

MUAU Sequence of Operation

Overview

The system includes the Make Up Air Unit MUAU, Exhaust Fan EF-6, the Kitchen Hood, and the discharge hood RV-1.

Damper Interlocks

The AHU supply and exhaust dampers shall be commanded open any time the unit is commanded on via factory interlock wiring.

Start/Stop Control

The MAUA system operation is manually initiated by the occupants in the Beanery when they want to use the kitchen exhaust hood. A manual switch at the hood is hard wire interlocked to do the following when it is turned on.

1. Open the discharge dampers in RV-1.
2. Enable the operation of exhaust fan EF-6.
3. Enable the operation of the MUAU.

When the switch is turned back off, the system is shut down and the dampers close.

Power Failure Recovery

In the event of a power failure, the MUAU system will need to be manually restarted if it is still needed by the occupants of the space.

Discharge Temperature Control

The MUAU is a 100% outdoor air unit that provides no supplemental cooling. The discharge diffusers are located in close proximity to the hood to minimize the impact of untreated outdoor air on the space conditions on hot or humid days. In addition, the ductwork in the Beanery is insulated to prevent condensation problems if the operation of the system is prolonged and it causes the dew point temperature in the space to drift up. However, the design intent is that the kitchen hood only would be in operation when there is stovetop is in use

Supplemental heating is provided by an electric reheat coil which is controlled by a PI control process.

As the supply temperature deviates below set point, the gas burner is modulated from minimum towards maximum capacity by a factory provided controller. A deviation above set point reverses the sequence.

Ventilation Operation

The MUAU system operates at a constant volume. Carbon Dioxide (CO_2) sensors monitor CO_2 levels in the Day Room and the Fitness Center and initiate alarms if the levels exceed safe thresholds for 5 minutes or more (adjustable).

MUAU Sequence of Operation (Continued)

Safety Interlocks

The MUAU fire alarm interface and supply duct freezestat shall shut down the system, no matter what the position the starter Hand-Off-Auto switches are in if an unsafe operating condition is detected. Note that the fire alarm shut down is provided via software logic in the DDC system based on one hard wired input from the fire alarm control panel. This feature is not required by code and is being provided as an added measure of safety in the event of an alarm.

Motor overloads shall shut down and lock out either fan no matter what position their starter Hand-Off-Auto selector switches are in.

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HRV-1 and MUAU Sequence of Operation

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HRV-2 Sequence of Operation

Overview

The HRV-2 system serves the Bunker Gear storage area and includes the following pieces of equipment.

1. Rooftop heat recovery unit HRV-2

2. Destratification fan

3. Gas fire Unit Heater 1

Combustion Air Provisions

Combustion air for Unit Heater 1 is provided by a concentric intake/flue system. See Detail 5 on sheet M801 for more information.

Damper Interlocks

The HRV-2 supply and exhaust dampers shall be commanded open any time the unit is commanded on via factory wiring.

HRV-2 is equipped with variable speed drives on both the supply and exhaust fans. The control system shall command the drives as required to achieve either a high flow ventilation cycle or a minimum ventilation cycle. The fan sheaves shall be adjusted so that the high flow cycle and the design flow rates and pressure relationships associated with it are achieved with the drives at full speed to maximize drive efficiency.

HRV-2 is enabled by the DDC system to run continuously on low speed to provide ventilation for the bunker storage room. The low speed setting shall be hard coded into the control logic and shall be determined by a coordinated effort between the control contractor, the balancing contractor, and the commissioning provider to identify the required supply and exhaust flows and associated pressure relationships. Note that this determination shall be made after setting up the fan to deliver the design maximum flow with the drive on full speed as indicated previously.

A 12 hour, no hold position, spring wound interval timer acting as an input to the DDC system shall trigger a high speed operating cycle. When the interval timer times out, the system shall revert to the normal, low speed ventilation mode.

Space Temperature Control

Bunker unit heater UH-1 shall be controlled based on space temperature. During the low speed operating cycle the space temperature set point shall be 60°F (adjustable via software). During the high speed operating cycle, the space temperature set point shall be 80°F (adjustable via software and via a set point adjustment on the space temperature sensor between 70 and 90°F). If the space temperature drops below the current set point, UH-1 shall cycle its fan on. If the space temperature continues to drop, UH-1 shall cycle on its gas valve. When the space temperature rises back above the current set point plus 2°F differential (adjustable), UH-2 gas valve shall cycle back off. If the space temperature rises above the current set point plus 4°F differential (adjustable), UH-2 fan shall cycle back off.

HRV-2 Sequence of Operation (Continued)

Safety Interlocks

The variable speed drives shall be equipped with Hand-Off-Auto switches. In the "Off" position, the fans shall be shut down no matter what the status of the command from the DDC system is.

In the "Hand" position, the fans shall run continuously at a speed set locally at the drive control panel, no matter what the status of the commands from the DDC system are

In the "Auto" position, the fans shall be controlled by their respective DDC system contacts and speed commands per the operating sequence described here-in.

The AHU2 supply duct freezestat shall shut down the system, no matter what the position the VFD Hand-Off-Auto Switches are in. Motor overloads shall shut down and lock out either fans no matter what position their starter Hand-Off-Auto selector switches are in.

Ceiling Fan

The ceiling fan shall be wired to a factory furnished, field installed control switch that allows the occupants to turn the fan on or off and select one of three speeds.

A relay piloted by the DDC system shall enable operation of the fan. The relay shall cycle off for 1 minute (adjustable) every day at 2 am (adjustable) if HRV-2 is in the low speed cycle to sweep the fan off and ensure they are not operating when they are not required. If HRV-2 is in the high speed cycle at the sweep time, the fan shall not be commanded off.

A CT monitoring the total current drawn by the fan provides a proof of operation input to the DDC system.

Power Failure Recovery

The DDC controllers shall monitor an internal point as an indication that power is available. If the controller loses power, it shall shut down all of the equipment it controls.

When power is restored, the controller shall go through an orderly restart to return the systems to normal operating status. There shall be a 30 second (adjustable) time delay between the time each system is started. The specific order of start shall be coordinated during submittal review based on discussions with Facility Operations and the requirements of the Fire Fighters.

HRV-3 Sequence of Operation

Overview

The HRV-3 system serves the Decon/Wash area, the First Floor West Circulation Corridor, the Maintenance area, and the Battery Charging area. It also provides supplemental ventilation to the Bunker Gear Storage room.

Damper Interlocks

The HRC-3 supply and exhaust dampers shall be commanded open any time the unit is commanded on via factory interlock wiring.

Start/Stop Control

HRV-3 shall include a scheduling feature to allow scheduled operation to be implemented if so desired. However, the schedule shall be set initially to provide round-the-clock operation.

Power Failure Recovery

In the event of a power failure, the HRV-3 logic shall be arranged to provide for an orderly restart of the system in conjunction with the other systems in the facility, including the utility systems serving it.

Start-up Sequencing

A start-up command to HRV-3, issued for any purpose, shall immediately start the supply and exhaust fans.

Shut Down Sequencing

A shut down command to HRV-1, issued for any purpose, shall immediately shut down the supply and exhaust fans.

Discharge Temperature Control

HRV-1 incorporates an enthalpy wheel to recover energy from the exhaust air stream and move it to the supply air stream. Supplemental cooling and heating are provided.

Ventilation Operation

HRV-3 operates at a constant volume. Nitrous Oxide and Carbon Monoxide sensors monitor the levels of those gases in the Circulation Corridor near the door to the apparatus bay on the first floor and initiate alarms if the hard coded threshold levels in the sensors are exceeded (100 ppm for CO and 5 ppm for NO2).

Frost Control

The heat exchanger in HRV-3 shall include a factory hard wired frost control cycle that shuts down the supply fan for 10 minutes (adjustable) any time the differential pressure across the heat wheel exceeds 0.20 in.w.c. (adjustable) for 10 minutes or more (adjustable)

HRV-3 Sequence of Operation (Continued)

Safety Interlocks

The HRV1 fire alarm interface and supply duct freezestat shall shut down the system, no matter what the position the any starter Hand-Off-Auto switches are in if an unsafe operating condition is detected. Note that the fire alarm shut down is provided via software logic in the DDC system based on one hard wired input from the fire alarm control panel. This feature is not required by code and is being provided as an added measure of safety in the event of an alarm.

Motor overloads shall shut down and lock out either fan no matter what position their starter Hand-Off-Auto selector switches are in.

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HRV-2 and 3 Sequence of Operation

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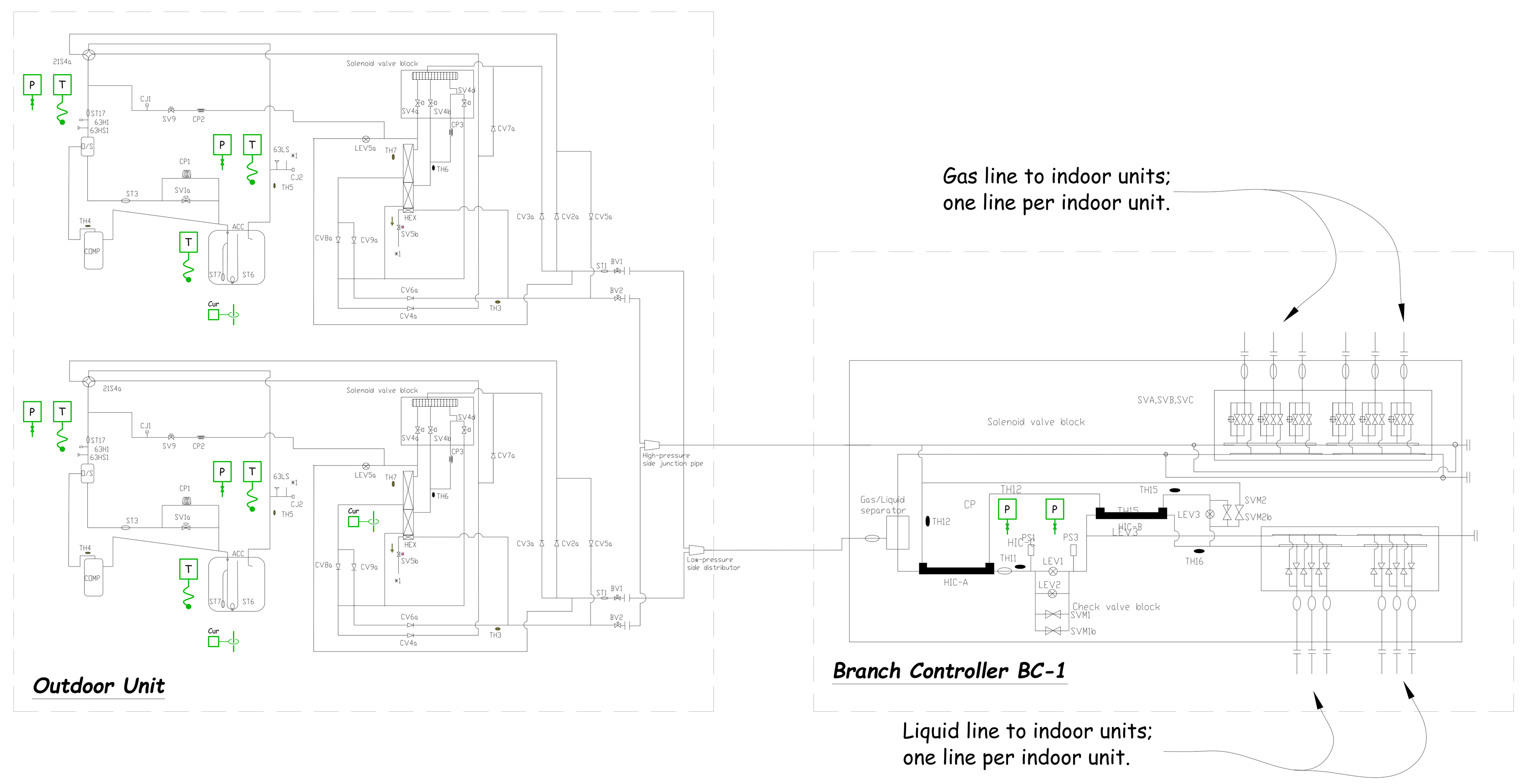

Variable Flow Refrigeration (VRF) Systems Sequence of Operation

Overview

The VRF systems associated with this project operate using a proprietary digital control system that manages the interactions of the indoor units serving the occupied zones with the branch controllers and outdoor units serving the system.

The system served by IDU-1 and ODU-1 is similar to a conventional split systems in that there is a condensing unit dedicated to each evaporator unit.

But the system served by the larger outdoor unit uses a branch controller to manage and direct the flow of refrigerant between multiple evaporators. This will allow:

1. Energy to be redirected from zone to zone for the purposes of heat recover, and/or
2. Refrigerant to be sent to the outdoor unit operating as a conventional condensing unit to reject heat if there is a net cooling requirement on the system, or
3. Refrigerant to be sent to the outdoor unit operating as a heat pump to capture heat from the outdoors if there is a net heating requirement on the system.

The Siemens control network will supplement the proprietary VRF control network to provide the following functions:

1. Supervisory management to command units on and off as required for scheduling, diagnostics or tenant support.
2. Diagnostic information via a combination of BACnet integration with the proprietary VRF control system and physical points wired to Siemens field panels and installed in key locations in the VRF equipment.

Variable Flow Refrigeration (VRF) Systems Sequence of Operation (Continued)

The diagnostic information is intended to provide sufficient information to allow a system manager working at a Siemens Operator Work Station (OWS) to identify emerging problems before they manifest themselves as tenant complaints and/or system failures versus providing deep diagnostic capabilities. Once an issue is identified, the Maintenance Tool Software associated with the proprietary VRF system network will be used for deep diagnostics.

Access to the Maintenance Tool Software will be via a VPN connection to a dedicated PC that is located in FS-22. Once the Mitsubishi network is configured, the PC will be locked down and inaccessible for use by anyone, with the keyboard, monitor, and mouse removed.

Fairly detailed information regarding the operating sequence for the various VRF components can be found by:

1. Going to the www.mylinkdrive.com web site and then,
2. Selecting the United States portion of the site and then,
3. Selecting the "R2 Series", "Controls", or "Software" options from the list under the page header and then,
4. Navigate to the specific piece of equipment of interest based on the model number information on the mechanical drawings.

The most detailed information is generally found in the Technical Service instructions. Branch controller service information is typically found in the manuals for the outdoor units.

Variable Flow Refrigeration (VRF) Systems Sequence of Operation (Continued)

BACnet Points

General

BACnet object are provided for the indoor and outdoor units as indicated in their respective point lists. By the nature of its operation, the Siemens system will auto-discover all of these objects during the start-up and configuration process. The points will be integrated into the Siemens network and graphics to allow the various fan coil units and heat pumps to be monitored and managed remotely from the facility operations office.

To maximize flexibility, from a Mitsubishi M-Net address and BACNet point standpoint, each fan coil will be configured as its own group. Thus, each indoor unit will have all of the BACnet objects identified in the point list associated with it.

Details of the graphic presentation of these points and the logic associated with them will be finalized during the control submittal review process so they are compatible with the City of Seattle control standards that are currently being developed. In general terms, the goal of the standards is to provide consistent representation of the Mitsubishi equipment across all of the facilities that incorporate it and to provide useful diagnostic information to allow the Facility Operations staff to proactively address emerging operational issues before they become occupant issues.

The BACnet points will be complemented by hard-wired physical points tied directly to the Siemens controller to provide diagnostic information and data for LEED Measurement and Verification requirements.

Last Command "Wins"

The Mitubishi command structure uses a "last command wins" approach to control, meaning that the most recent command received from the network or from the controller or remote associated with a unit are the commands that will be in effect. All previous commands will be ignored.

This can have important implications in terms of how schedules are implemented and programmed from the DDC system via the BACnet interface in order to allow set backs and schedules to be effective. An example of this can be found in Mitubishi *Application Note 3001: Third Party Scheduling Strategy*.

Prohibit Points

The BACnet object list includes a number of "Prohibit" points such as:

- Prohibit On/Off
- Prohibit Mode
- Prohibit Set Temperature

Variable Flow Refrigeration (VRF) Systems Sequence of Operation (Continued)

When implemented in the "last command wins" environment, these points allow occupant control of features like starting and stopping the equipment, changing its operating mode, or changing the temperature set point during an unoccupied period. Sending "Permit" commands makes the features available again.

This capability, along with the other BACnet object provide the capability for to implement schedules, night set back, night set up, etc. for the zones on the project that currently have occupancy based control. Having these points and features available will also allow schedules to be applied to the other zones in the facility if the use pattern changes.

Start/Stop Control

Generally speaking, the roof top heat pump operation is driven by the requirements of the fan coil units it serves. For IDU-1/ODU-1, this is a one on one relationship. But for the larger outdoor unit, this occurs via Branch Controllers BC-1 and BC-2. Given that the facility is a 24/7 operation, it is anticipated that all of the refrigeration systems will be enabled and operating round the clock.

The fan coil unit (also referred to as the indoor unit) operating mode, air flow direction control, set point, occupancy status, etc. shall be controlled by the zone occupants via the fan coil unit remote controllers.

Facility operations will have the ability to monitor the status of key parameters via BACnet points or via the hard wired points mentioned previously. They will also have the ability to over-ride a number of functions as described in the following paragraphs.

Scheduling Points

The following point are provided to facilitated scheduled operation based on occupancy time of day or similar triggering mechanisms .

- The BACnet On/Off Set-up point
- The BACnet Operating Mode Set-up point
- The BACnet Speed Set-up point
- The BACnet Set Temperature point
- The BACnet Prohibit On/Off point
- The BACnet Prohibit Mode point
- The BACnet Prohibit Set Temperature point
- The BACnet System Force Off point
- The BACnet Air Direction Set point
- The BACnet Temp Cool point
- The BACnet Temp Heat point
- The BACnet Temp Auto point
- The BACnet High Limit Set Back Temp point
- The BACnet Low Limit Set Back Temp point

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Variable Flow Refrigeration (VRF) Systems Sequence of Operation (Continued)

State Points

The BACnet state points (i.e. On/off State, Operating State, Fan Speed State, Room Temperature, and Air Direction State) will provide Facility Operations with the current operating state selected by the zone occupants in addition to providing proof of operation feedback for any schedules, set back cycles, etc. they implement in the future.

Occupancy Driven Schedules

The following zones are to be provided with occupancy driven operating hours based on the occupancy sensors that are located in them.

- Fitness Area
- Day Room and Beanery Area
- Bunk Rooms

When an occupancy sensor in these areas detects motion the fan coil unit or unit's serving the area are turned on and allowed to operate to actively control the space temperature at the occupied heating and cooling set points (70°F and 72°F respectively, both adjustable). When a cycle is triggered, the system will remain in the occupied cycle for a minimum of 15 minutes (adjustable) from the last time that motion is detected.

Ventilation air to a zone is provided via HRV-1. Dampers in the ventilation air duct open and close as a function of zone occupancy.

At the end of an occupied cycle, the fan coil unit or units serving the area are turned off and the temperature in the area is allowed to drift between the unoccupied heating and cooling set points (initial settings of 68°F and 78°F respectively). As long as the zone temperature is between the unoccupied set points, no active cooling or heating is provided. But, if the temperature drifts outside the set-back temperature range, the unit is placed in occupied mode and operates until the space temperature is driven back inside the set back/set up range at which time the unit is shut back down again.

Functional testing technique shall be used to determine the appropriate set back and set up temperatures for the zones with occupancy based schedule during the commissioning and warranty period. Test results shall be used to optimize the initial set points provided and tailor them to the thermal mass (stored energy) and HVAC process energy associated with the zone served.

Variable Flow Refrigeration (VRF) Systems Sequence of Operation (Continued)

Error Codes and Alarms

The BACnet error code and alarm point shall trigger logic in the Siemens network designed to facilitate remote diagnostics from the Facility Operations office. In general terms the points will trigger alarms and alarm messages with the text of the message providing additional guidance regarding the actions required to resolve the problem. The error messages shall be presented in the system graphics running at the Siemens Operator Work Station (OWS).

Each error code shall have a specific customized message associated with it. The details contained in the message will be coordinated with Facility Operations at the time of the control submittal review.

Filter Status

The BACnet filter points shall be used to trigger an alarm annunciating the need to change a filter and to allow the operators to reset the filter alarm once the filters have been serviced. The alarm set points shall be coordinated during the start-up and commissioning process to match the capabilities of the HRV fans in terms of ensuring they deliver the required air flows at a minimum with dirty filters.

The BACnet Prohibit Filter Sign Reset point shall be configured to prevent the filter alarm from being reset from the remote controllers located in FS-29.

Diagnostic Points

The VRF technology employs numerous analog sensors monitoring system temperatures, pressures, currents and other physical properties as required to control and optimize the system. Most, if not all of this data is available via the VRF Maintenance Tool Software. However, few if any of the points are made available as BACnet objects for direct access by the Siemens control system.

To improve operability certain key parameters as outlined in the point lists, will be brought into the Siemens network as physical points to allow preliminary diagnostics to be performed via the Siemens OWS. Some of the diagnostics will simply present key data to the operator for their assessment and judgment. However, in some instances control logic will be used to combine information from multiple sensors to generate an alarm.

Variable Flow Refrigeration (VRF) Systems Sequence of Operation (Continued)

Control logic will also be used to imply operating pressures based on measure temperatures in the refrigeration system by assuming it is operating as a saturated system and using look-up table functions and/or calculations to infer one parameter from the other. The details of the logic required for diagnostics will be developed during the submittal process once the specific items of equipment to be provided for the project are established, including make and model.

The current project along with FS18, FS29, and several existing facilities with VRF systems will serve as a pilot projects to allow the City to assess the practical issues associated with this approach as well as the cost benefit.

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