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.

S

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 conductor and conduit size with the requirements of the branch circuit associated with the function based on the requirements of the National Electric Code and 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
TC2.11	Basement Floor Plan
TC2.21	First Floor Plan
TC2.31	Second Floor Plan
TC2.41	Roof Plan
TC5.11	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
TC6.19	HRV-2 and 3Sequence of Operation
TC6.20	Variable Flow Refrigeration System Diagram and Sequence
TC6.21	Variable Flow Refrigeration Sequence Continued

Miscellaneous

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

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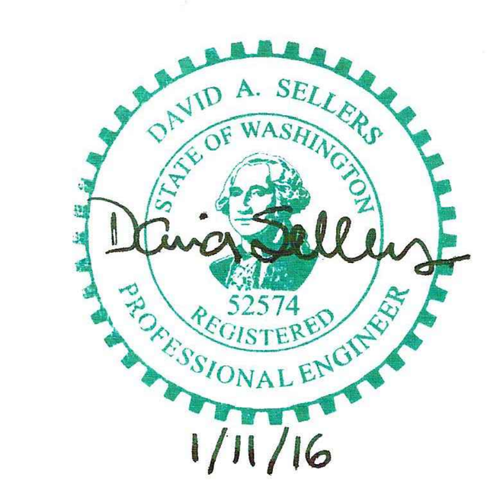

PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE

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	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																
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 deterimine the appropriate set point.

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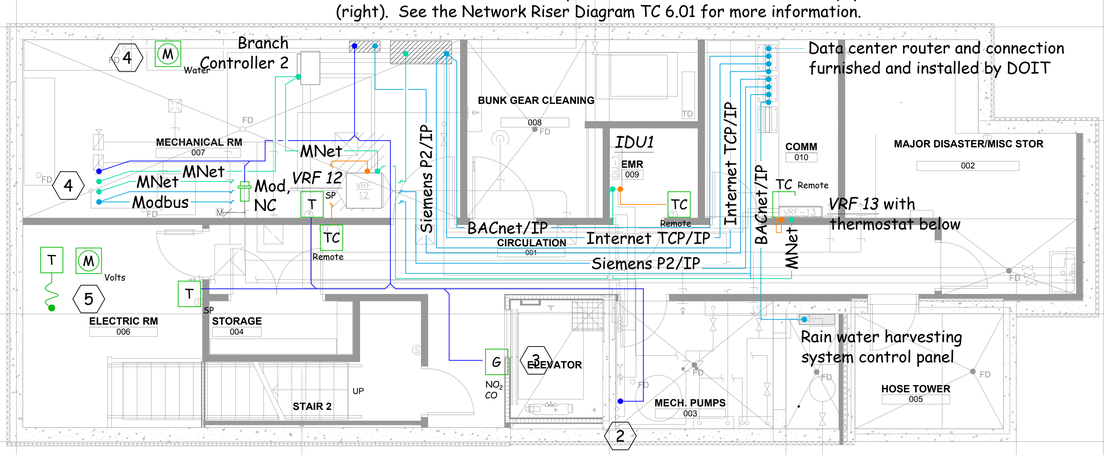
PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE

SHEET TITLE
HRV-1 Point List

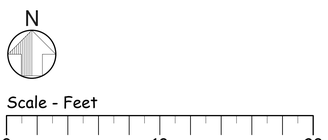
SHEET NUMBER
TC 0.10

Siemens Building Controller BC-1 (left) and locked, ventilated Hoffman Enclosure for the Mitsubishi Operator Work Station and related equipment (right). See the Network Riser Diagram TC 6.01 for more information.



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. ?? #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 via the control conduit provided under Division 26.



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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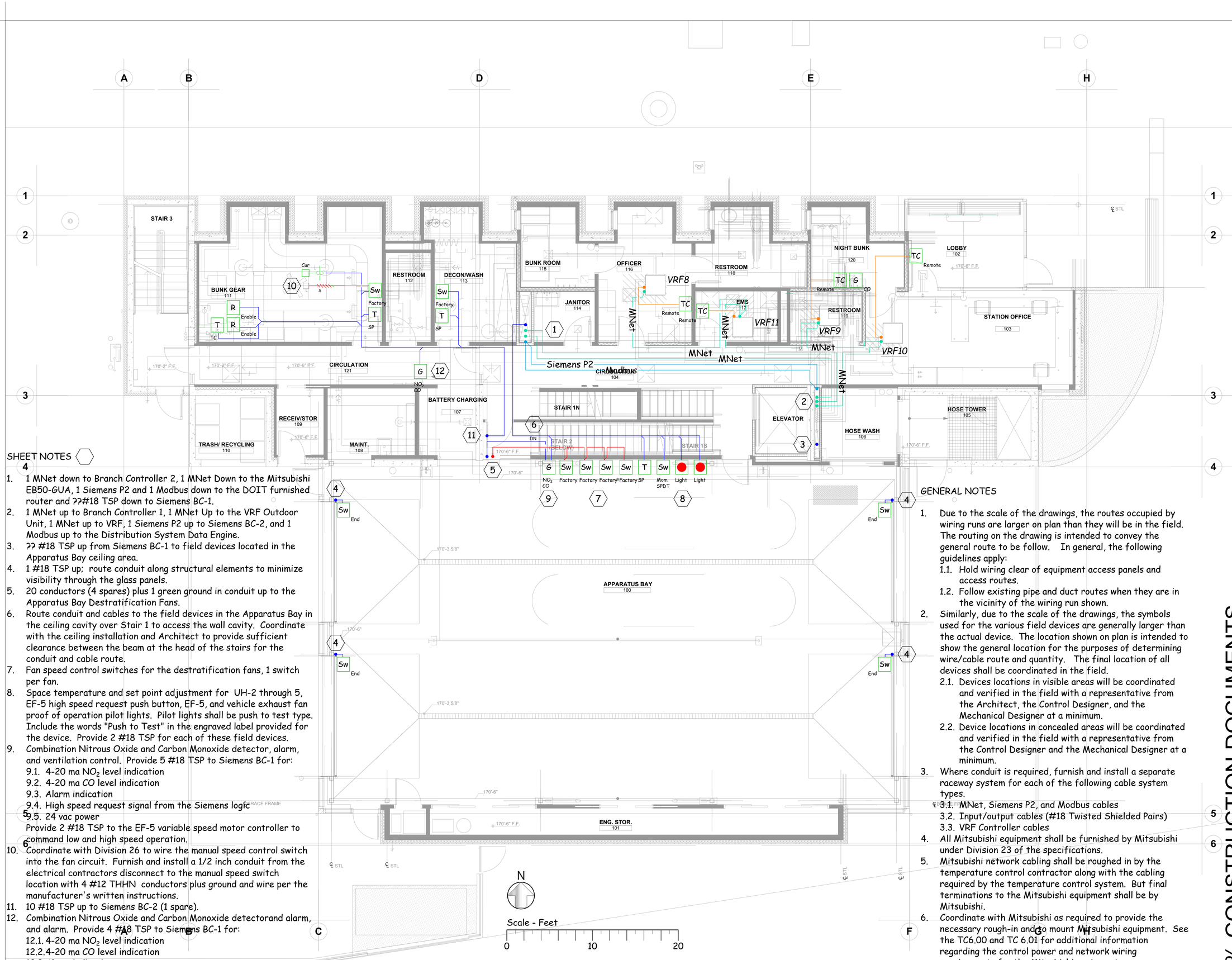
SHEET TITLE
Basement Floor Plan

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. ?? #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. 20 conductors (4 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 switch per fan.
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. 10 #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

N

Scale - Feet

0 10 20

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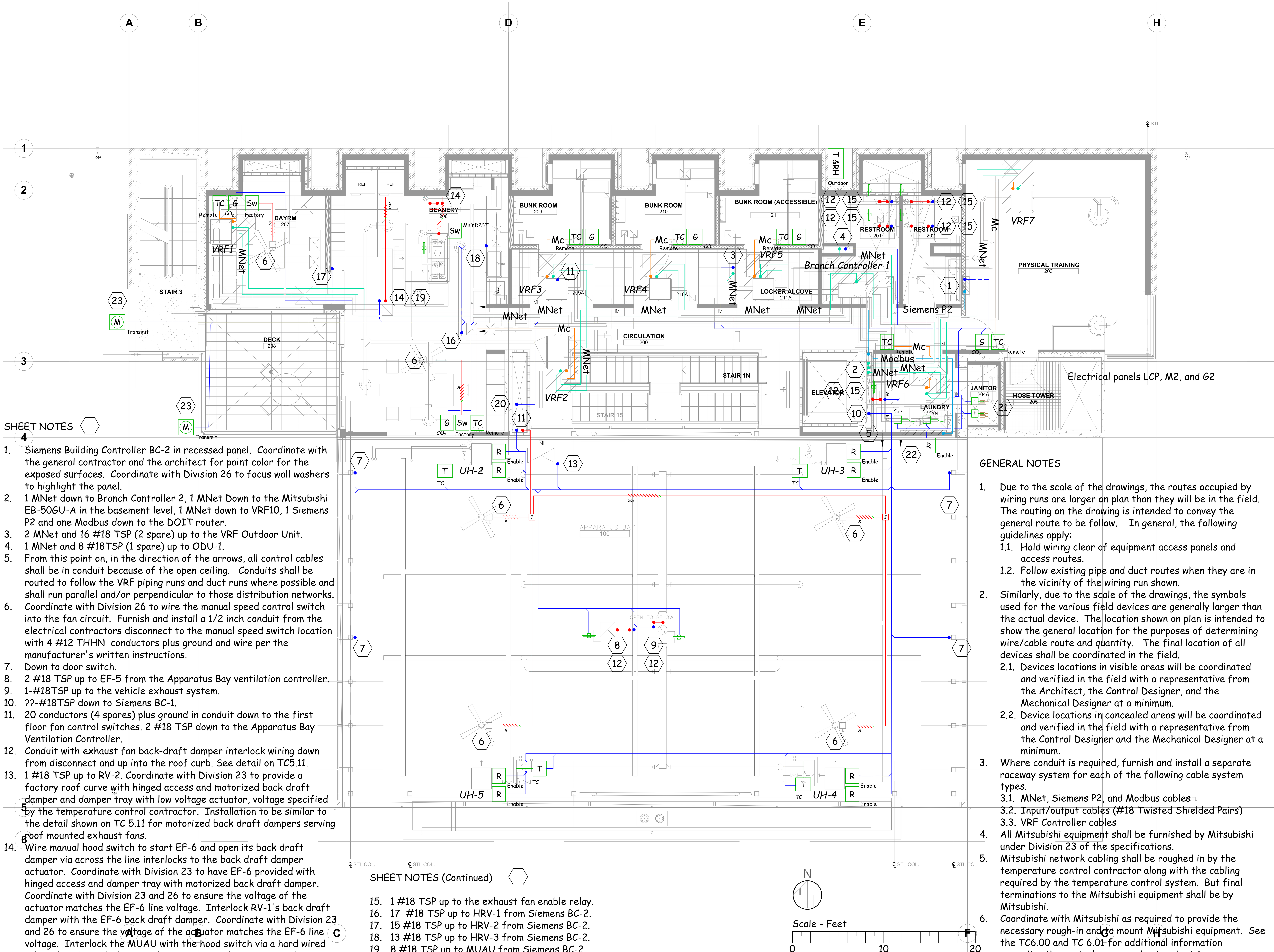
PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	1/11/16
REVISIONS	DATE

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 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.
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. ??-#18TSP down to Siemens BC-1.
11. 20 conductors (4 spares) 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)

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.
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.

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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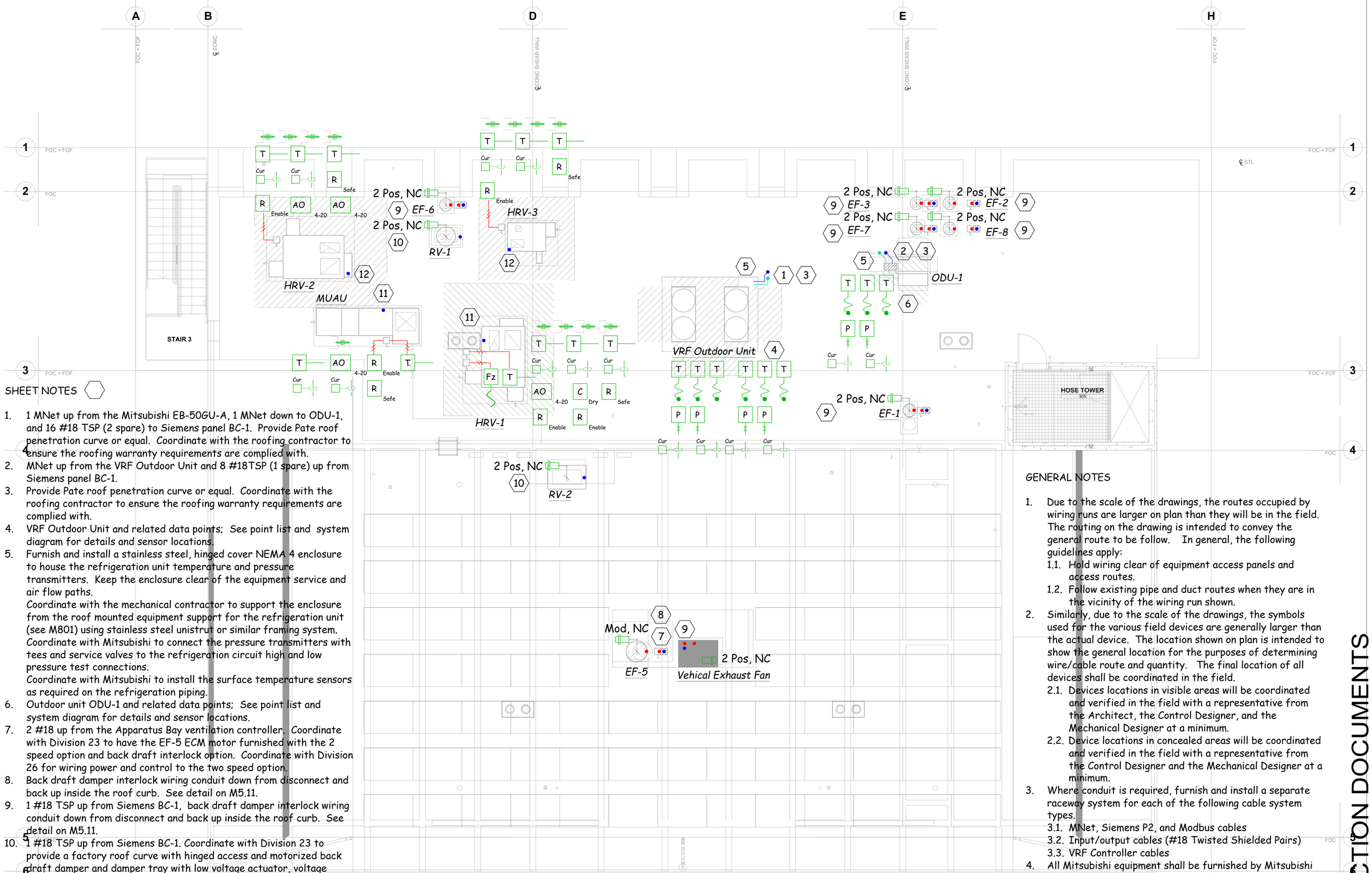
SHEET TITLE

Second Floor Plan

SHEET NUMBER

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.
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   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.
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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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DRAWN	DAS
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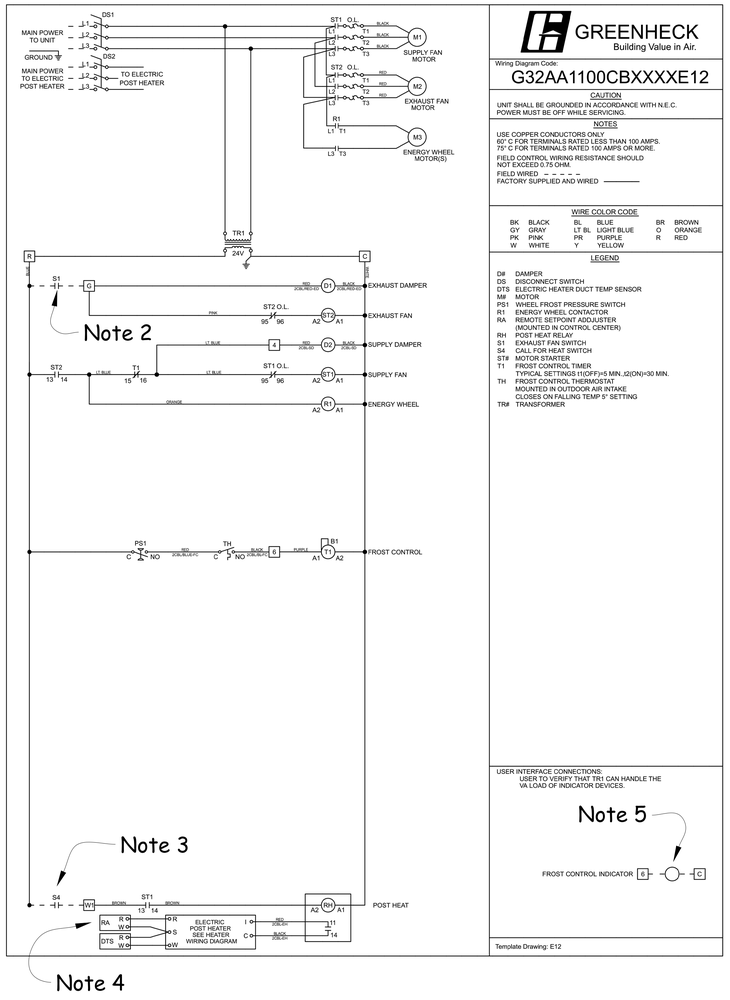
DATE	1/11/16
REVISIONS	DATE

SHEET TITLE
Roof Plan

SHEET NUMBER
TC 2.41

ERCH-20-15L
WIRING DIAGRAM



GREENHECK
Building Value in Air.

Wiring Diagram Code:

G32AA1100CBXXXXE12

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	BL	BLUE	BR	BROWN
GY	GRAY	LT BL	LIGHT BLUE	O	ORANGE
PK	PINK	PR	PURPLE	R	RED
W	WHITE	Y	YELLOW		

LEGEND

D# DAMPER
DS DISCONNECT SWITCH
DTS ELECTRIC HEATER DUCT TEMP SENSOR
M# MOTOR
PS1 WHEEL FROST PRESSURE SWITCH
R1 ENERGY WHEEL CONTACTOR
RA REMOTE SETPOINT ADDJUSTER (MOUNTED IN CONTROL CENTER)
RH POST HEAT RELAY
S1 EXHAUST FAN SWITCH
S4 CALL FOR HEAT SWITCH
ST# MOTOR STARTER
T1 FROST CONTROL TIMER
TYPICAL SETTINGS t1(OFF)=5 MIN.,t2(ON)=30 MIN.
TH FROST CONTROL THERMOSTAT MOUNTED IN OUTDOOR AIR INTAKE CLOSES ON FALLING TEMP 5° SETTING
TR# TRANSFORMER

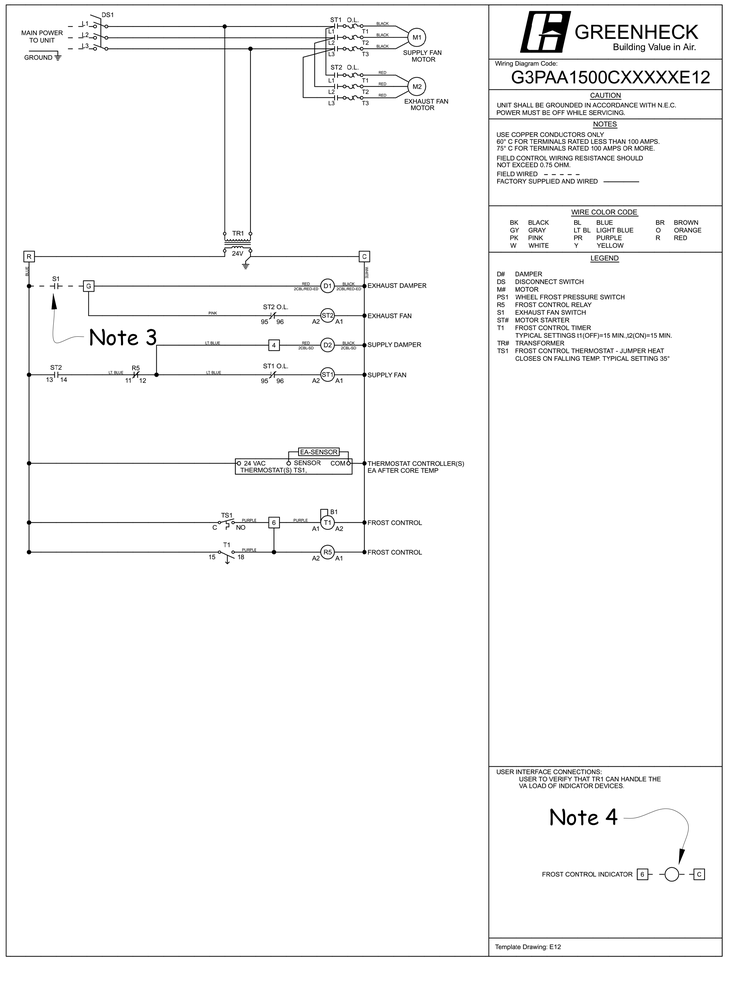
USER INTERFACE CONNECTIONS:
USER TO VERIFY THAT TR1 CAN HANDLE THE VA LOAD OF INDICATOR DEVICES.

Note 5

FROST CONTROL INDICATOR

Template Drawing: E12

PVe-20-SC
WIRING DIAGRAM



GREENHECK
Building Value in Air.

Wiring Diagram Code:

G3PAA1500CXXXXXE12

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	BL	BLUE	BR	BROWN
GY	GRAY	LT BL	LIGHT BLUE	O	ORANGE
PK	PINK	PR	PURPLE	R	RED
W	WHITE	Y	YELLOW		

LEGEND

D# DAMPER
DS DISCONNECT SWITCH
M# MOTOR
PS1 WHEEL FROST PRESSURE SWITCH
R5 FROST CONTROL RELAY
S1 EXHAUST FAN SWITCH
ST# MOTOR STARTER
T1 FROST CONTROL TIMER
TYPICAL SETTINGS t1(OFF)=15 MIN.,t2(ON)=15 MIN.
TR# TRANSFORMER
TS1 FROST CONTROL THERMOSTAT - JUMPER HEAT CLOSES ON FALLING TEMP. TYPICAL SETTING 35°

USER INTERFACE CONNECTIONS:
USER TO VERIFY THAT TR1 CAN HANDLE THE VA LOAD OF INDICATOR DEVICES.

Note 4

FROST CONTROL INDICATOR

Template Drawing: E12

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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1/11/16

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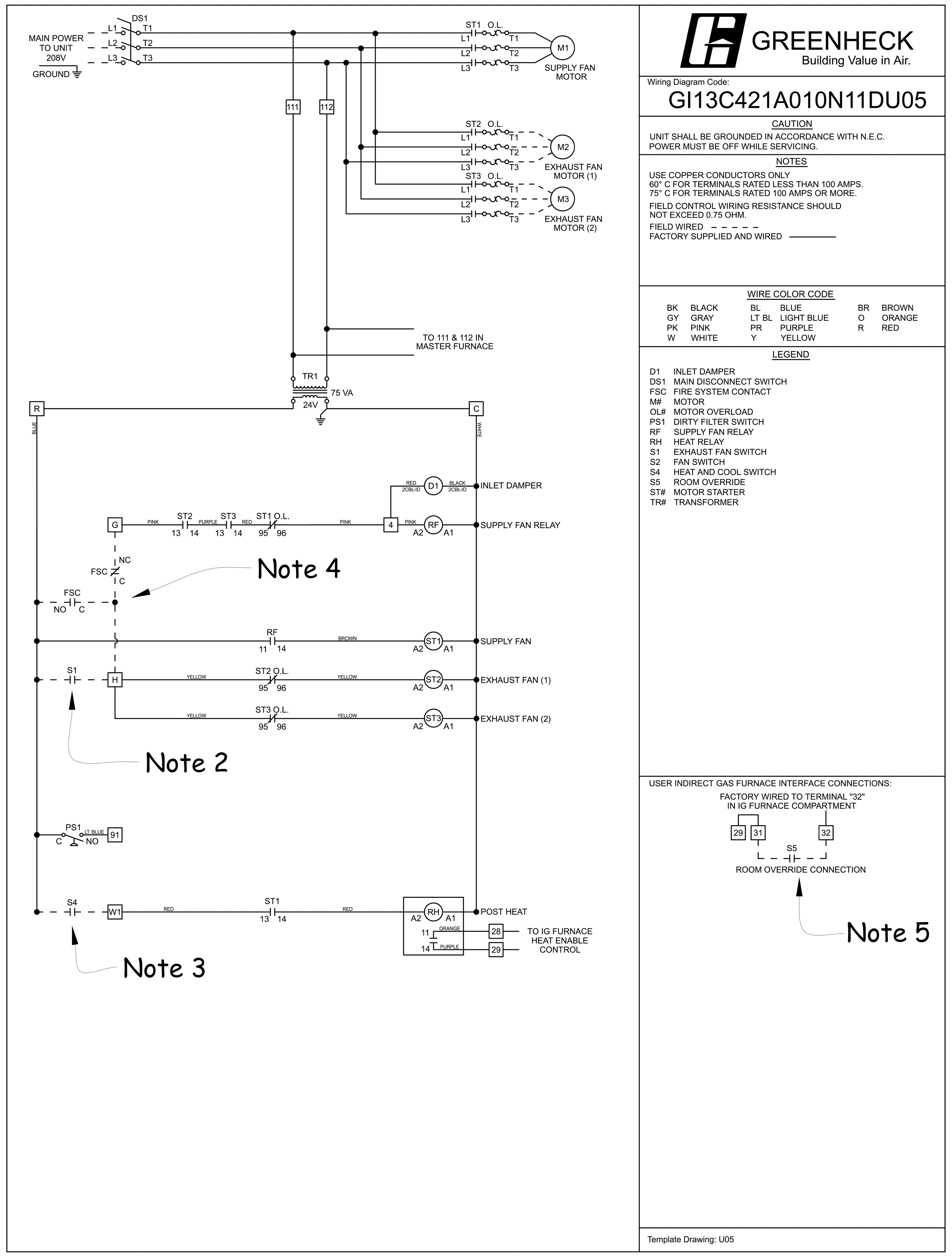
PROJECT-NO	13004
DRAWN	DAS
CHECKED BY	CBM
DATE	2/19/16
REVISIONS	DATE
1 Revision 1 - Addendum 5 - 2016-02-19	

SHEET TITLE

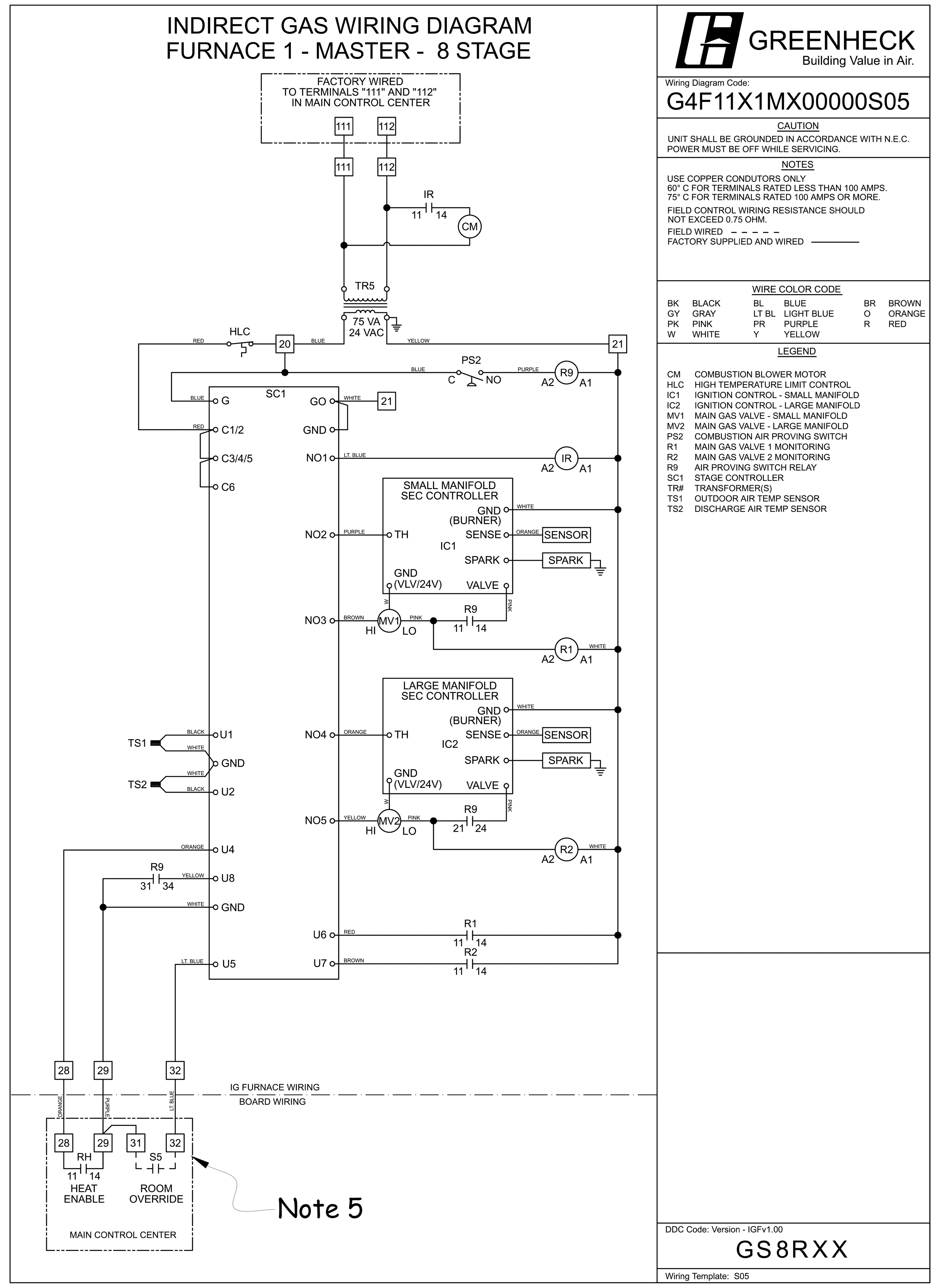
Wiring Details

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, BL BLUE, BR BROWN
GY GRAY, LT BL LIGHT BLUE, O ORANGE
PK PINK, PR PURPLE, R RED
W WHITE, Y YELLOW
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
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
BK BLACK, BL BLUE, BR BROWN
GY GRAY, LT BL LIGHT BLUE, O ORANGE
PK PINK, PR PURPLE, R RED
W WHITE, Y YELLOW
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
SMALL MANIFOLD SEC CONTROLLER
LARGE MANIFOLD SEC CONTROLLER
IG FURNACE WIRING
BOARD WIRING
HEAT ENABLE
ROOM OVERRIDE
MAIN CONTROL CENTER
Note 5
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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DATE	2/19/16
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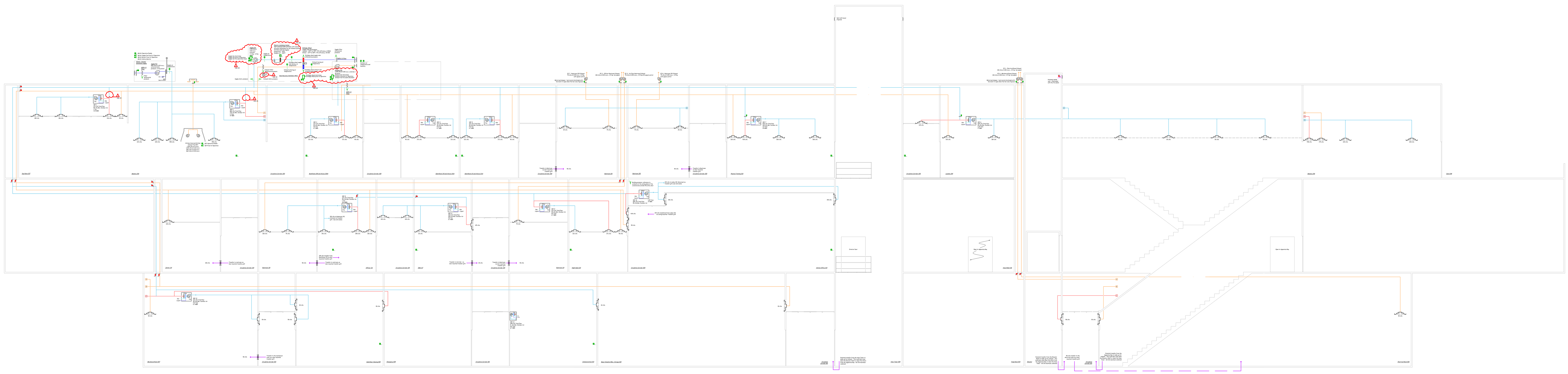
1 Revision 1 - Addendum 5 - 2016-02-19	

SHEET TITLE

Wiring Details

SHEET NUMBER

TC 5.22



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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1/11/16

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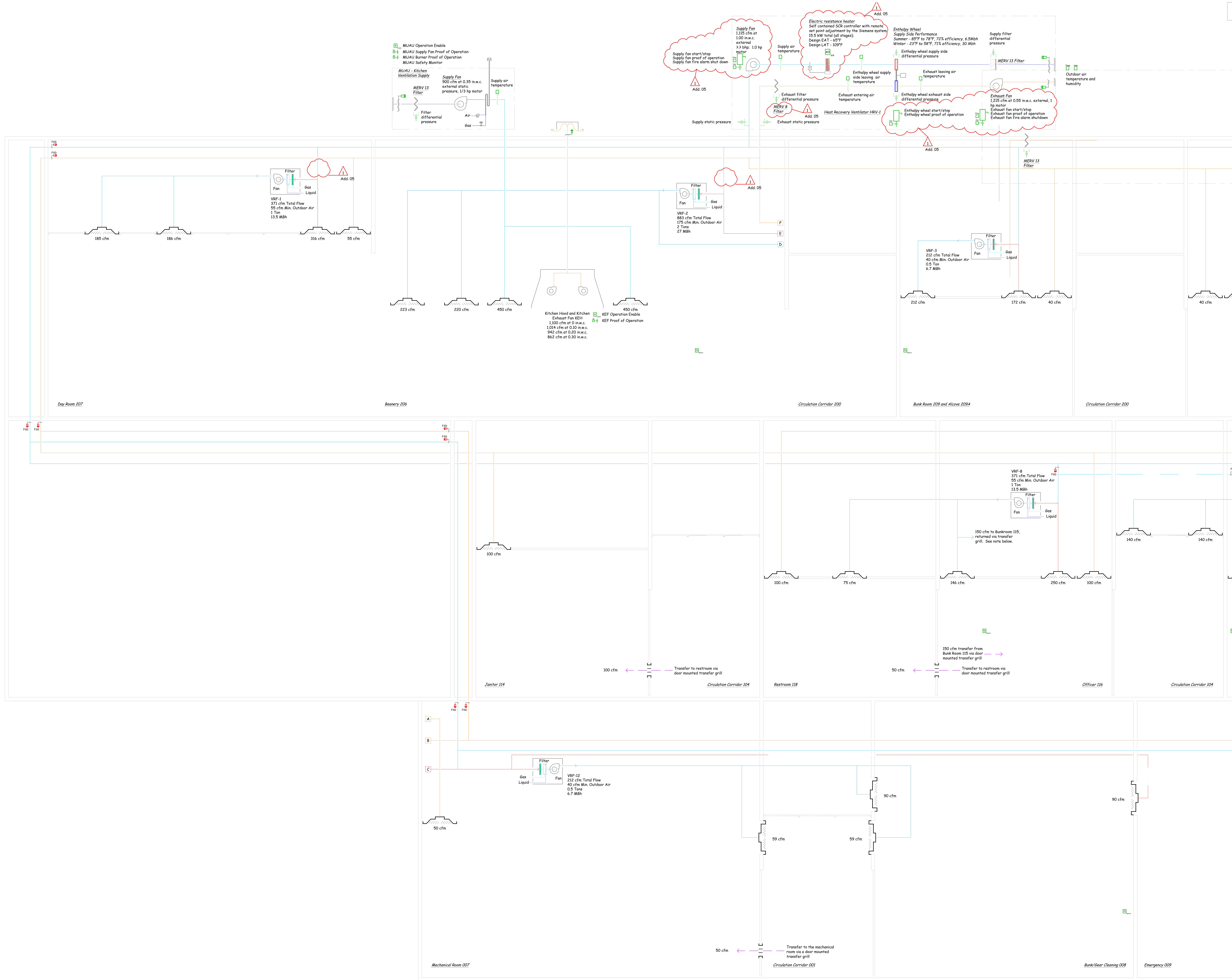
SHEET TITLE
HRV1 and MUAU System Diagram

SHEET NUMBER
TC 6.10



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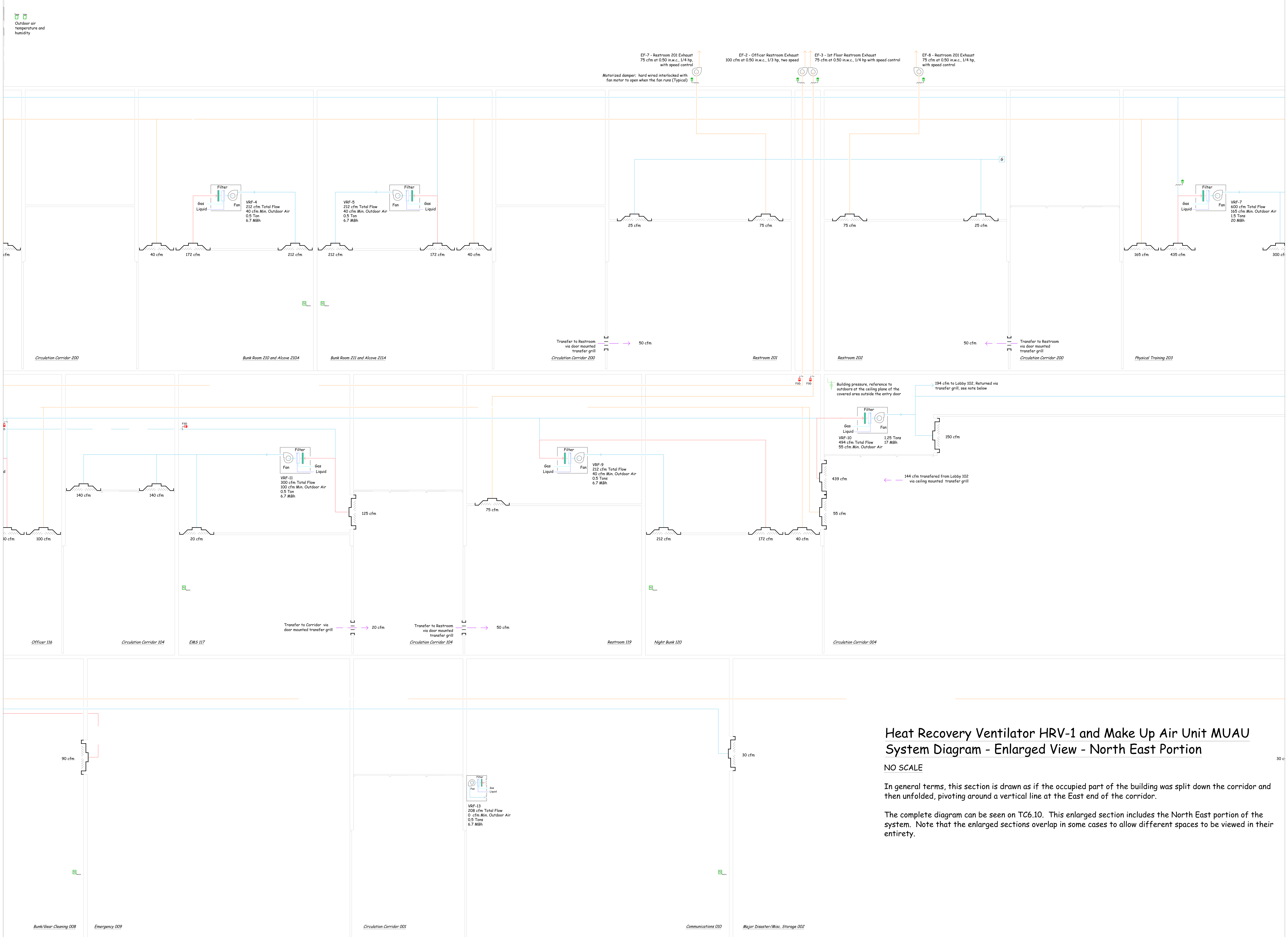
SHEET TITLE
HRV1 and MUAU System Diagram -NW Detail

SHEET NUMBER
TC 6.11

A B

For Continuation, See TC6.11



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.

A B

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HRV1 and MUAU System Diagram NE Detail

SHEET NUMBER
TC 6.12

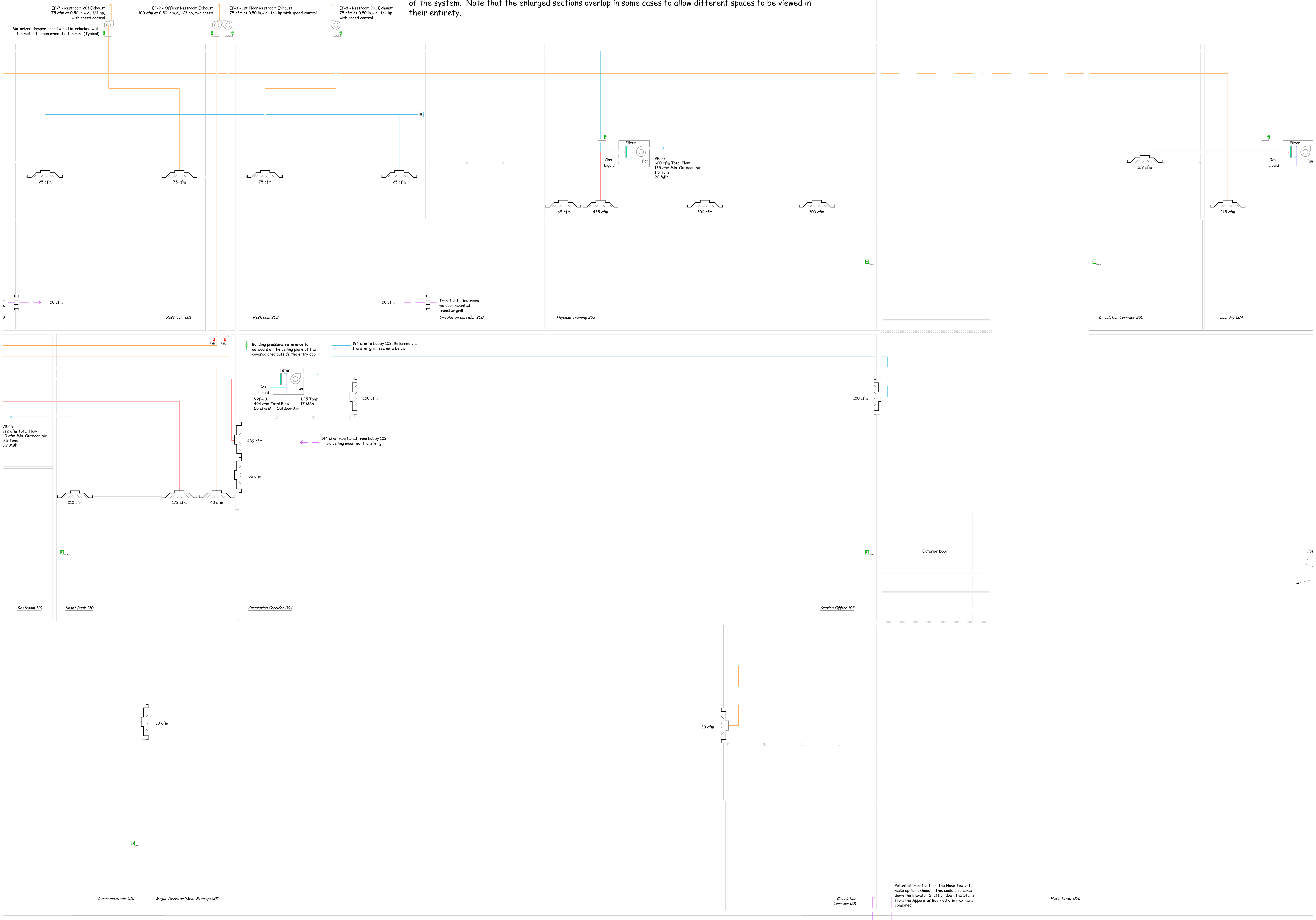
Heat Recovery Ventilator HRV-1 and Make Up Air Unit MUAU System Diagram - Enlarged View - North and South East Portion

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.

For Continuation, See TC6.12



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HRV1 and MUAU System Diagram NE and SE Detail

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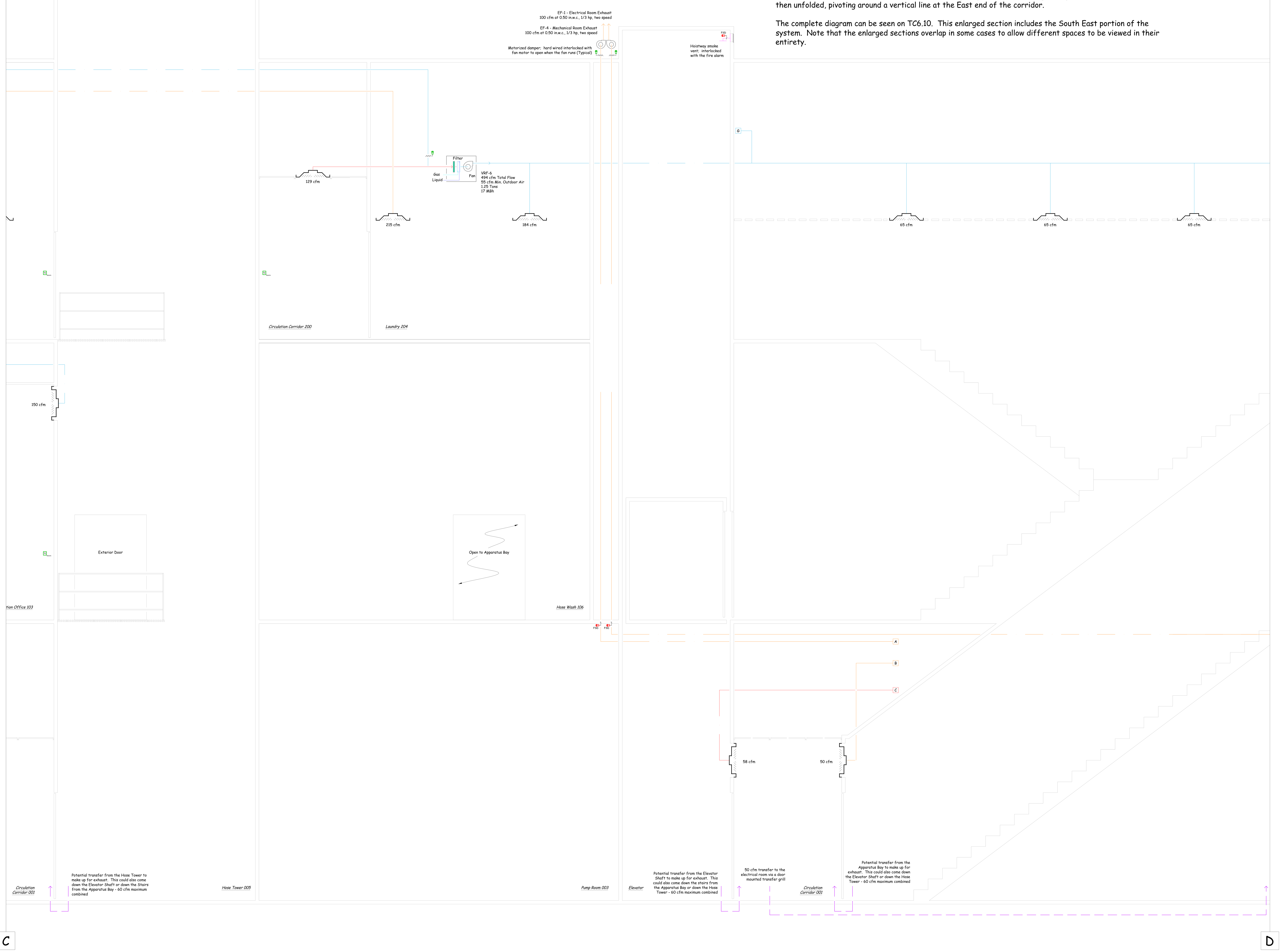
Heat Recovery Ventilator HRV-1 and Make Up Air Unit MUAU System Diagram - Enlarged View - South East Portion

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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HRV1 and MUAU System Diagram SE Detail

SHEET NUMBER
TC 6.14

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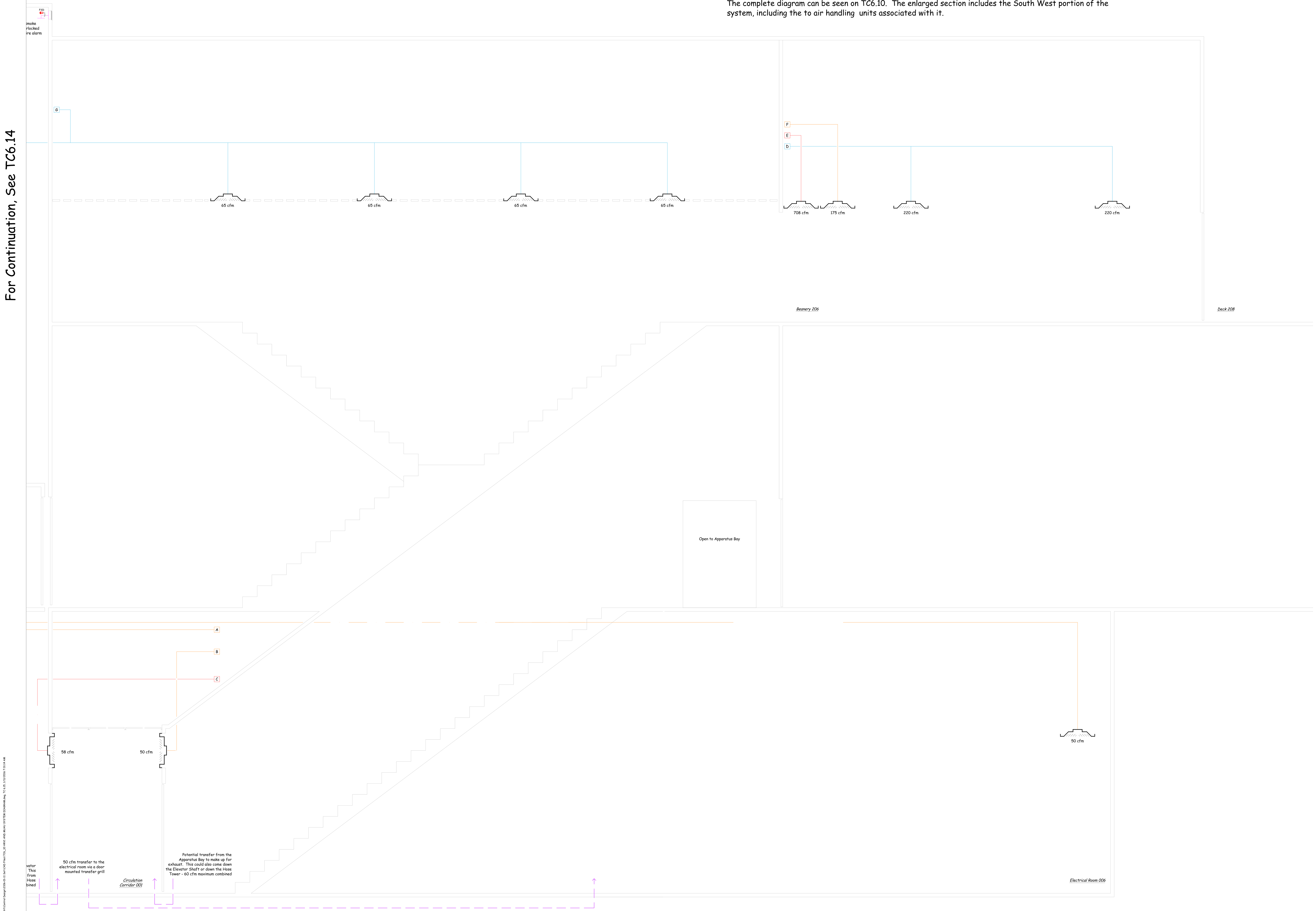
Heat Recovery Ventilator HRV-1 and Make Up Air Unit MUAU System Diagram - Enlarged View - South West Portion

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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HRV1 and MUAU System Diagram SW Detail

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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.

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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SHEET TITLE
HRV-1 and MUAU Sequence of Operation

SHEET NUMBER
TC 6.16

1
Add. 05

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.

1 Add. 05

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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