Network Diagram

Work Stations, Servers, Computers

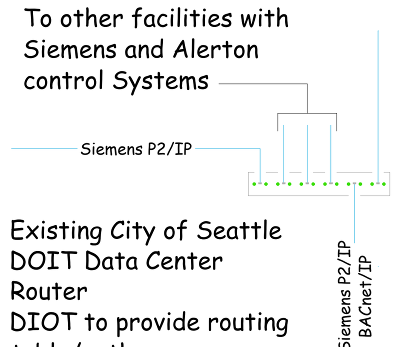
Operator Work Station (OWS)
Functions and details as noted

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
archival data storage for LEED M&V

To other facilities with
Siemens and Alerton
control Systems



Existing City of Seattle
DOIT Data Center
Router
DIOT to provide routing
table/path

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

Contractor to verify conductor and conduit size for each application per the requirements of National Electric Code and other applicable standards and vendor requirements

Service	##
4#14, 1/2"C, 2S	

Line voltage conduit and wire providing interlock and line voltage control functions

Service = Unit or function served by the run

= Conduit identifier

4#14, 1/2"C = Number of conductors followed by their AWG size followed by the conduit size followed by the number of spares included

Panel P-2
Ckt 1

Home run to the power source; 20 amp capacity with an independent ground conductor. Panel space and circuit breaker to be provided by Division 26, conduit and wire from the control panel location to the power source provided by the Mechanical Instrumentation contractor.

Service	##
4#14, 1/2"C, 2S	

NEC Article 725 Low voltage Input/Output Cable or Networking Cable. Segregate Class 1 from Class 2 circuits. Provide conduit where runs are exposed and at all locations above 8'0" above finished floor.

= Conduit identifier

4#14, 1/2"C = Number of conductors followed by their AWG size followed by the conduit size followed by the number of spares included

TSP = Twisted shielded pair

Per Vendor = Per the vendor requirements for the item served

Per SEAIT = Per City of Seattle IT Requirements

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). Remote = wired connection, Network - wired network connected, Wireless = wireless network connection.

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

Field Devices (Continued)

Pipe temperature transmitter with well and a second calibration well

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

Outdoor air temperature and relative humidity transmitter

External shades motor

Irradiance sensor

Wind speed sensor

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

Miscellaneous

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

12 — Point number reference; see the number specified in the list of sheet specific points.

88 — MEP equipment tag number; reference the number in the list of equipment included on the sheet.

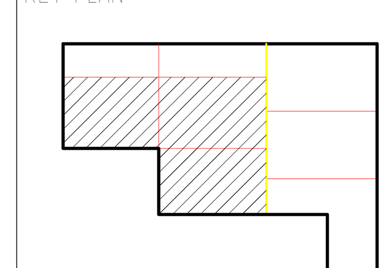
Lines cross each other at different elevations

AHU1 — Line broken for presentation purposes to show something that is below it more clearly

Facility Dynamics
ENGINEERING
6760 Alexander Bell Drive, Suite 200
Columbia, MD 21046
Phone: (410) 290-0900

DAVID A. SELLERS
STATE OF WASHINGTON
52374
REGISTERED PROFESSIONAL ENGINEER
2018-10-04

KEY PLAN



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SHEET TITLE
Symbols and Abbreviations

SHEET NUMBER
MI.0.01

Control System Object Name Structure General Conventions

The table below is used to set up the general structure for object names.   Once these conventions are set, they will be the same for each system in the project and are referenced by the next table, which will be specific to each system on the project.

Jump to the System Specific Object Name Structure (the working point list)

Number of segments for a complete point name	4	◄ Note 2					
Maximum number of characters	30	30	◄ Note 3, 11				
Segment functions		Location Segment	System Segment	Subsystem/Component Segment	Device Descriptor Segment		
Target character count for the segment, including the seperator character(s)		11	7	6	6	◄ Note 2, 11, 13, 14	
Acceptable characters		LETTER, Number, Seperator	LETTER, Number, Seperator	LETTER, Number, Seperator	LETTER, Number, Seperator		
Segment functions		This segment is intended to designate the location of a control system object. For the SPU projects, this segment has two sub-segments, one to designate the facility and one to designate the location in the facility (roof, first floor, etc.).	This segment is intended to designate the system containing the object associated with the name. For example, a building might have a chilled water system, an air handling system, a hot water system, an electrical system, etc.	This segment specifies the subsystem or component associated with the object. For instance, a hot water system might have pumps, heat exchantgers, control valves, boilers, etc.	This segment designates the specific device associated with the object. For instance, the pump serving a hot water system might have a start/stop point, a proof of operation point, a speed command point, and a speed feedback point, etc.		
Applicable notes		4, 8, 9, 10, 12, 13,14	8, 9, 10, 12, 13,14	5, 6, 8, 9, 10, 12, 13,14	6, 7, 8, 9, 10, 12, 13,14		

Example	SPUSOC_BAR_DOAS1_CMP-1_SUCPR	**Translation =** Seattle Public Utilities South Operations Center Building A Roof Dedicated Outdoor Air System-1 Compressor -1 Suction Pressure
Location segment	SPUSOC_BAR_	
System Segment	DOAS1_	
Subsystem Segment	CMP-1_	
Device Descriptor Segment	SUCPR	

Notes:

1. Not used.
2. If you want to have a different number of segments, in the current version of the tool, you would need to edit the spreadsheet to create them. Similarly, if you wanted to be able to use more than two descriptors to build the location segment, more than two descriptors to a build the subsystem/component segment, or more than four descriptors and a letter o number to build the descriptor segment, then you would need to edit the spreadsheet to create them.
3. The desired maximum character count is manually entered in the white cell with the red boarder and is referenced by the various formulas in the spreadsheet that count characters in a given point name. The number in the adjacent cell reflects the total for target charac entered below.   The color will change from green to orange as the total approaches the character limit you enter. It will turn to red if the target counts you have entered exceed the limit.
4. This segment can include two location descriptors strung together as needed to fully describe the object with-in the constraints of the maximum character count allowed. Each descriptor needs to be followed by a seperator character.
5. This segment can include two location descriptors and a letter or number strung together as needed to fully describe the object with-in the constraints of the maximum character count allowed. Each descriptor needs to be followed by a seperator character.
6. The letter/number field provide some flexibility in terms of making a custom descriptor using something that is not included in the standard dropdown selections.
7. This segment can include four location descriptors and a letter or number strung together as needed to fully describe the object with-in the constraints of the maximum character count allowed. Each descriptor other than the last one needs to be followed by a seperator
8. Avoid using upper case "O" (the letter O) to avoid confusion with "0" (the number zero).
9. Avoid using upper case "I" (the letter I) to avoid confusion with 1 (the number one).
10. Use leading zeros for numbered items with similar prefixes to ensure they sort in numerical order. No leading zero is required if you only anticipate 10 or fewer objects with a similar prefix. If you anticpate fewer than 100 objects with a similar prefix use one leading zer fewer than 1,000 objects with a similar prefix, use two leading zeros. For example in a facility with 12 air handling units use AHU01, AHU02, ... AHU10, AHU11, AHU12 instead of AHU1, AHU2, ... AHU 10, AHU11, AHU12.
11. Names may use less than the maximum number of allowable characters for a given segment. In addition the number of characters in a segment can exceed the target for the segment as long as the total character count is less than the maximum allowable character count.
12. Use an apostrophe ahead of any numeric values so they are interpreted as text and allow the other formulas to work; i.e. enter'01 vs. 01
13. The formulas that build the point names place a seperator after each descriptor. That means that for segments built from two or more descriptors, there will be two or more seperators included in the character count. Note that the final descriptor in the Device Descrip a seperator after it. This should be reflected in the target character count for that segment.
14. This naming convention has been modified from the convention used in the DD and early CD documents based on the structure and abbreviations provided by Siemens from their other SPU work and is included after the seperator tab named "◄ This Job - Siemens Original differences are that Siemens included a building level descriptor in their location string. And they use different system and subsystem abbreviations for controllers on terminal equipment vs. field panels controlling other systems and equipment.   The selections avaialble f version of the tool have been edited to reflect the Siemens convention and then augmented for the systems and equipment on this project if there was not an existing Siemens abbreviation for the item.   Each drop down list tab has a column labled "Not In Siemens 2013-C abbreviations have a cell with an "X" in it and yellow highlighting.

Facility Dynamics ENGINEERING
6760 Alexander Bell Drive, Suite 200
Columbia, MD 21046
Phone: (410) 290-0900

DAVID A. SELLERS — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER — 2018-10-04

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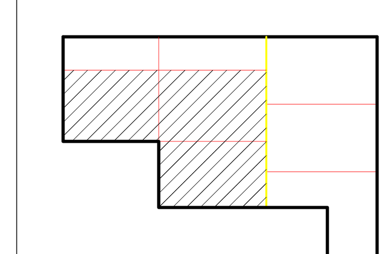

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SHEET TITLE
Point Naming Convention

SHEET NUMBER
MI.0.02

South Operations Center Variable Flow Refrigeration System (Location and system point name segments = SPUSOC.VRF.; See note 6)

Point Name (Note 6)	Description and Service	Sensor Type	Reference Spec Paragraph	Accuracy	Features: Alarms Limit Hi	Alarms Limit Lo	Alarms Warning Hi	Alarms Warning Lo	Trending Samples[1]	Commissioning[5] Time[2]	Commissioning[5] Local[3]	Commissioning[5] Archive[4]	Operating[5] Time[2]	Operating[5] Local[3]	Operating[5] Archive[4]	Notes
Analog Inputs																
ODU-1.CMP.SUCTMP-1	VRF Outdoor Unit -1 Compressor Suction Temperature -1	Surface mounted 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				360	5 sec	X	X	1 min	X	X	Note 7
ODU-1.CMP.DISTMP-1	VRF Outdoor Unit -1 Compressor Discharge Temperature -1	Surface mounted 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				360	5 sec	X	X	1 min	X	X	Note 7
ODU-1.CMP.SUCTMP-2	VRF Outdoor Unit -1 Compressor Suction Temperature -2	Surface mounted 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				360	5 sec	X	X	1 min	X	X	Note 7
ODU-1.CMP.DISTMP-2	VRF Outdoor Unit -1 Compressor Discharge Temperature -2	Surface mounted 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				360	5 sec	X	X	1 min	X	X	Note 7
ODU-2.CMP.SUCTMP-1	VRF Outdoor Unit -2 Compressor Suction Temperature -1	Surface mounted 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				360	5 sec	X	X	1 min	X	X	Note 7
ODU-2.CMP.DISTMP-1	VRF Outdoor Unit -2 Compressor Discharge Temperature -1	Surface mounted 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				360	5 sec	X	X	1 min	X	X	Note 7
ODU-2.CMP.SUCTMP-2	VRF Outdoor Unit -2 Compressor Suction Temperature -2	Surface mounted 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				360	5 sec	X	X	1 min	X	X	Note 7
ODU-2.CMP.DISTMP-2	VRF Outdoor Unit -2 Compressor Discharge Temperature -2	Surface mounted 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				360	5 sec	X	X	1 min	X	X	Note 7
IDU-X.CO2	VRF Indoor Unit -X Carbon Dioxide	CO2 sensor, 4-20 ma output	25 35 00	+/- 50 ppm	Note 8				12	5 min	X	X	15 min	X	X	Note 42
ODU-1.CDF.DISTMP-1	VRF Outdoor Unit -1 Condenser Fan Discharge Temperature -1	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				60	1 min	X	X	5 min	X	X	Note 9
ODU-1.CDF.DISTMP-2	VRF Outdoor Unit -1 Condenser Fan Discharge Temperature -2	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				60	1 min	X	X	5 min	X	X	Note 9
ODU-1.CDF.DISTMP-3	VRF Outdoor Unit -1 Condenser Fan Discharge Temperature -3	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				60	1 min	X	X	5 min	X	X	Note 9
ODU-1.CDF.DISTMP-4	VRF Outdoor Unit -1 Condenser Fan Discharge Temperature -4	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				60	1 min	X	X	5 min	X	X	Note 9
ODU-1.CMP.CUR-1	VRF Outdoor Unit -1 Compressor Current -1	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-1.CMP.CUR-2	VRF Outdoor Unit -1 Compressor Current -2	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-1.CDF.CUR-1	VRF Outdoor Unit -1 Condenser Fan Current -1	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-1.CDF.CUR-2	VRF Outdoor Unit -1 Condenser Fan Current -2	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-1.CDF.CUR-3	VRF Outdoor Unit -1 Condenser Fan Current -3	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-1.CDF.CUR-4	VRF Outdoor Unit -1 Condenser Fan Current -4	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-1.CCHT.CUR	VRF Outdoor Unit -1 Crankcase Heater Current	Current Transformer	25 35 00	+/-2% full scale	Note 11				10	COV	X	X	COV	X	X	
ODU-2.CDF.DISTMP-1	VRF Outdoor Unit -2 Condenser Fan Discharge Temperature -1	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				60	1 min	X	X	5 min	X	X	Note 9
ODU-2.CDF.DISTMP-2	VRF Outdoor Unit -2 Condenser Fan Discharge Temperature -2	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				60	1 min	X	X	5 min	X	X	Note 9
ODU-2.CDF.DISTMP-3	VRF Outdoor Unit -2 Condenser Fan Discharge Temperature -3	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				60	1 min	X	X	5 min	X	X	Note 9
ODU-2.CDF.DISTMP-4	VRF Outdoor Unit -2 Condenser Fan Discharge Temperature -4	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				60	1 min	X	X	5 min	X	X	Note 9
ODU-2.CMP.CUR-1	VRF Outdoor Unit -2 Compressor Current -1	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-2.CMP.CUR-2	VRF Outdoor Unit -2 Compressor Current -2	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-2.CDF.CUR-1	VRF Outdoor Unit -2 Condenser Fan Current -1	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-2.CDF.CUR-2	VRF Outdoor Unit -2 Condenser Fan Current -2	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-2.CDF.CUR-3	VRF Outdoor Unit -2 Condenser Fan Current -3	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-2.CDF.CUR-4	VRF Outdoor Unit -2 Condenser Fan Current -4	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
ODU-2.CCHT.CUR	VRF Outdoor Unit -2 Crankcase Heater Current	Current Transformer	25 35 00	+/-2% full scale	Note 11				10	COV	X	X	COV	X	X	Note 12
IDU-X.XX.DISTMP	VRF Indoor Unit -X.XX Discharge Temperature	Rigid averaging 1,000 Ω Pt RTD with close coupled transmitter	25 35 00	0.75% of span for sensor + transmitter	Note 8				60	1 min	X	X	1 min	X	X	Note 12
IDU-X.XX.CUR	VRF Indoor Unit -X.XX Current	Current Transformer	25 35 00	+/-2% full scale	Note 8				60	1 min	X	X	1 min	X	X	Note 10
IDU-X.XX.FLT.DIFPR	VRF Indoor Unit -X.XX Filter Differential Pressure	0-2 in.w.c. input, 4-20 ma output transmitter, Dwyer MS-121	25 35 00	+/-1% full scale	Note 13				60	1 min	X	X	1 day	X	X	Note 45
Hard wired and Safety Interlocks (Safety interlocks are hardwired to shut down or 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)																
IDU-X.XX.HWCNT	VRF Indoor Unit -X.XX Hard Wired Controller	Mitsubishi PAR-U01MEDU remote controller	25 35 00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 41
IDU-X.XX.CND.HLVSW	VRF Indoor Unit -X.XX Condensate High Level Switch	Mitsubishi DPLS2 Drain Pan Level Sensor	25 35 00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 44
Virtual Points																
ODU-1.CMP.SUCPR-1	VRF Outdoor Unit -1 Compressor Suction Pressure -1	Calculated Point	25 35 00	N/A	Note 8											Note 14
ODU-1.CMP.DISPR-1	VRF Outdoor Unit -1 Compressor Discharge Pressure -1	Calculated Point	25 35 00	N/A	Note 8											Note 14
ODU-1.CMP.SUCPR-2	VRF Outdoor Unit -1 Compressor Suction Pressure -2	Calculated Point	25 35 00	N/A	Note 8											Note 14
ODU-1.CMP.DISPR-2	VRF Outdoor Unit -1 Compressor Discharge Pressure -2	Calculated Point	25 35 00	N/A	Note 8											Note 14
ODU-2.CMP.SUCPR-1	VRF Outdoor Unit -2 Compressor Suction Pressure -1	Calculated Point	25 35 00	N/A	Note 8											Note 14
ODU-2.CMP.DISPR-1	VRF Outdoor Unit -2 Compressor Discharge Pressure -1	Calculated Point	25 35 00	N/A	Note 8											Note 14
ODU-2.CMP.SUCPR-2	VRF Outdoor Unit -2 Compressor Suction Pressure -2	Calculated Point	25 35 00	N/A	Note 8											Note 14
ODU-2.CMP.DISPR-2	VRF Outdoor Unit -2 Compressor Discharge Pressure -2	Calculated Point	25 35 00	N/A	Note 8											Note 14
ODU-1.CMP.PRF-1	VRF Outdoor Unit -1 Compressor Proof of Operation -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CMP.KW-1	VRF Outdoor Unit -1 Compressor kW -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CMP.RUNTM-1	VRF Outdoor Unit -1 Compressor Run Time -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CMP.KWH-1	VRF Outdoor Unit -1 Compressor kWh -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CMP.PRF-2	VRF Outdoor Unit -1 Compressor Proof of Operation -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CMP.KW-2	VRF Outdoor Unit -1 Compressor kW -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CMP.RUNTM-2	VRF Outdoor Unit -1 Compressor Run Time -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CMP.KWH-2	VRF Outdoor Unit -1 Compressor kWh -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CDF.PRF-1	VRF Outdoor Unit -1 Condenser Fan Proof of Operation -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CDF.KW-1	VRF Outdoor Unit -1 Condenser Fan kW -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CDF.RUNTM-1	VRF Outdoor Unit -1 Condenser Fan Run Time -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CDF.KWH-1	VRF Outdoor Unit -1 Condenser Fan kWh -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CDF.PRF-2	VRF Outdoor Unit -1 Condenser Fan Proof of Operation -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CDF.KW-2	VRF Outdoor Unit -1 Condenser Fan kW -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CDF.RUNTM-2	VRF Outdoor Unit -1 Condenser Fan Run Time -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-1.CDF.KWH-2	VRF Outdoor Unit -1 Condenser Fan kWh -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-2.CMP.PRF-1	VRF Outdoor Unit -2 Compressor Proof of Operation -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-2.CMP.KW-1	VRF Outdoor Unit -2 Compressor kW -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-2.CMP.RUNTM-1	VRF Outdoor Unit -2 Compressor Run Time -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-2.CMP.KWH-1	VRF Outdoor Unit -2 Compressor kWh -1	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-2.CMP.PRF-2	VRF Outdoor Unit -2 Compressor Proof of Operation -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-2.CMP.KW-2	VRF Outdoor Unit -2 Compressor kW -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-2.CMP.RUNTM-2	VRF Outdoor Unit -2 Compressor Run Time -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-2.CMP.KWH-2	VRF Outdoor Unit -2 Compressor kWh -2	Calculated Point	25 35 00	N/A	Note 8											Note 10
ODU-2.CDF.PRF-1	VRF Outdoor Unit -2 Condenser Fan Proof of Operation -1	Calculated Point	25 35 00	N/A	Note 8											Note 10

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6760 Alexander Bell Drive, Suite 200
Columbia, MD 21046
Phone: (410) 290-0900

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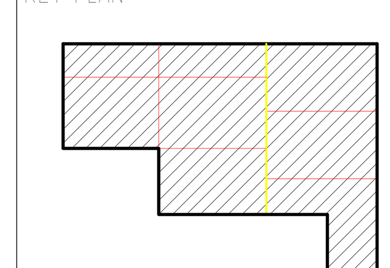

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REVISIONS	DATE
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SHEET TITLE
VRF System Point List - Part 1

SHEET NUMBER
MI.6.03-1

South Operations Center Variable Flow Refrigeration System (Location and system point name segments = SPUSOC.VRF.; See note 6)

Point Name (Note 6)	Description and Service	Sensor: Type	Sensor: Reference Spec Paragraph	Sensor: Accuracy	Features (Alarms: Limit Hi / Lo, Warning Hi / Lo; Trending: Samples[1], Commissioning[5] Time[2] / Local[3] / Archive[4], Operating[5] Time[2] / Local[3] / Archive[4])	Notes
ODU-2.CDF.KW-1	VRF Outdoor Unit -2 Condenser Fan kW -1	Calculated Point	25 35 00	N/A	Note 8	Note 10
ODU-2.CDF.RUNTM-1	VRF Outdoor Unit -2 Condenser Fan Run Time -1	Calculated Point	25 35 00	N/A	Note 8	Note 10
ODU-2.CDF.KWH-1	VRF Outdoor Unit -2 Condenser Fan kWh -1	Calculated Point	25 35 00	N/A	Note 8	Note 10
ODU-2.CDF.PRF-2	VRF Outdoor Unit -2 Condenser Fan Proof of Operation -2	Calculated Point	25 35 00	N/A	Note 8	Note 10
ODU-2.CDF.KW-2	VRF Outdoor Unit -2 Condenser Fan kW -2	Calculated Point	25 35 00	N/A	Note 8	Note 10
ODU-2.CDF.RUNTM-2	VRF Outdoor Unit -2 Condenser Fan Run Time -2	Calculated Point	25 35 00	N/A	Note 8	Note 10
ODU-2.CDF.KWH-2	VRF Outdoor Unit -2 Condenser Fan kWh -2	Calculated Point	25 35 00	N/A	Note 8	Note 10
IDU-X.XX.PRF	VRF Indoor Unit -X.XX Proof of Operation	Calculated Point	25 35 00	N/A	Note 8	Note 10
IDU-X.XX.KW	VRF Indoor Unit -X.XX kW	Calculated Point	25 35 00	N/A	Note 8	Note 10
IDU-X.XX.RUNTM	VRF Indoor Unit -X.XX Run Time	Calculated Point	25 35 00	N/A	Note 8	Note 10
IDU-X.XX.KWH	VRF Indoor Unit -X.XX kWh	Calculated Point	25 35 00	N/A	Note 8	Note 10
Network Points						
IDU-X.XX.BN.S/SSET	VRF Indoor Unit -X.XX BACnet Indoor Unit Start/Stop	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 16
IDU-X.XX.BN.S/SFBK	VRF Indoor Unit -X.XX BACnet Indoor Unit Operating State	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 17
IDU-X.XX.BN.ALARM	VRF Indoor Unit -X.XX BACnet General Alarm	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 18
IDU-X.XX.BN.ERRCD	VRF Indoor Unit -X.XX BACnet General Error	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 19
IDU-X.XX.BN.OPMDSET	VRF Indoor Unit -X.XX BACnet Operating Mode Setting	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 20
IDU-X.XX.BN.OMDSTA	VRF Indoor Unit -X.XX BACnet Operating Mode Feedback	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 21
IDU-X.XX.BN.FNSPSET	VRF Indoor Unit -X.XX BACnet Set Fan Speed	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 22
IDU-X.XX.BN.FNSPFBK	VRF Indoor Unit -X.XX BACnet Fan Speed Feedback	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 23
IDU-X.XX.BN.RMTMP	VRF Indoor Unit -X.XX BACnet Space Temperature Indication	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 24
IDU-X.XX.BN.STRMTMP	VRF Indoor Unit -X.XX BACnet Set Space Temperature Set Point	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 25
IDU-X.XX.BN.FTRSGN	VRF Indoor Unit -X.XX BACnet Change Filter Indication	VRF Network Integration Panel	25 35 13	N/A	Note 8	Nt. 15, 26, 46
IDU-X.XX.BN.FTRRSET	VRF Indoor Unit -X.XX BACnet Change Filter Indication Reset	VRF Network Integration Panel	25 35 13	N/A	Note 8	Nt. 15, 27, 46
IDU-X.XX.BN.PRONOF	VRF Indoor Unit -X.XX BACnet Prohibit Remote On-Off Override	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 28
IDU-X.XX.BN.PRMODE	VRF Indoor Unit -X.XX BACnet Prohibit Rmt. Operating Mode Ovrd.	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 29
IDU-X.XX.BN.PRFLTRS	VRF Indoor Unit -X.XX BACnet Prohibit Rmt. Filter Chng. Ind. Reset	VRF Network Integration Panel	25 35 13	N/A	Note 8	Nt. 15, 30, 46
IDU-X.XX.BN.PRSTTMP	VRF Indoor Unit -X.XX BACnet Prohibit Remote Set Point Adj.	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 31
IDU-X.XX.BN.MNETST	VRF Indoor Unit -X.XX BACnet MNet Error Indication	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 32
IDU-X.XX.BN.FRCOFF	VRF Indoor Unit -X.XX BACnet Force Indoor Unit Off	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 33
IDU-X.XX.BN.AIRDSET	VRF Indoor Unit -X.XX BACnet Set Airflow Direction	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 34
IDU-X.XX.BN.AIRDFBK	VRF Indoor Unit -X.XX BACnet Airflow Direction Feedback	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 35
IDU-X.XX.BN.STCOOL	VRF Indoor Unit -X.XX BACnet Set Cooling Set Point	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 36
IDU-X.XX.BN.STHEAT	VRF Indoor Unit -X.XX BACnet Set Heating Set Point	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 37
IDU-X.XX.BN.STAUTO	VRF Indoor Unit -X.XX BACnet Set Auto Mode Set Point	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 38
IDU-X.XX.BN.STBKHLM	VRF Indoor Unit -X.XX BACnet Set Unocc. Cycle Hi Lmt Set Point	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 39
IDU-X.XX.BN.STBKLLM	VRF Indoor Unit -X.XX BACnet Set Unocc. Cycle Lo Lmt Set Point	VRF Network Integration Panel	25 35 13	N/A	Note 8	Note 15, 40

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. Point names are based on the Owner's point naming convention which is included in the specification. The location and system segments of the point name shown at the top of the point list will be included with the subsystem and descriptor segments in this column to create the complete point name in the point data base. Point names will be verified during the submittal process in the control system integration and coordination meeting.
7. Use temperature as a proxy for pressure. Epoxy the sensor to the appropriate pipe near the associated pressure test port (i.e. suction temperature near the suction pressure port on the VRF unit, etc.). Insulate over the sensor and for 1 inch on either side to minimize the influence of ambient temperature. Vapor seal the insulation to the pipe and sensor leads.
8. Coordinate alarm values if desired with the Owner and commissioning provider during the submittal process. Document final alarm settings in the mark-ups of the As Built point list.
9. Select sensor length to match the fan diameter. Mount the sensor across the outlet of the fan to the fan guard. This sensor is used along with outdoor temperature to determine the operating state of the ODU (heat pump, cooling, balanced, etc.) based on the temperature change across the condenser.
10. Monitor amps to provide a proof of operation input and create virtual meters to track run time as well as energy use using voltage and power factor constants determined during commissioning. Accumulate and display current demand level, kWh and hours for the day, and kWh and hours 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. Generate an alarm if the compressors are off and there is no current being drawn by the crankcase heater.
12. For ducted select the sensor so that it spans the duct and mount it in the discharge duct. For ceiling cassette units, coordinate with the Mitsubishi installing technician for length and mounting location as needed to pick up the temperature on the discharge side of the cooling coil in.
13. Coordinate during commissioning to trigger at the pressure drop associated with best life cycle cost operation for the filters that are installed. Document the final settings in the mark-ups of the As Built point list. This point is only provided for the ducted IDUs with filter boxes. Otherwise the standard Mitsubishi filter timer flag is used.
14. Use the maintenance tool pressure data to create a look-up table that calibrates the measured proxy temperature with a pressure.
15. See Mitsubishi manual WT07919X01 - Centralized Controller BACnet Instruction Book for additional information.
16. BACnet Binary Output Object used to set the VRF IDU operating state. Values are Stop or Run.
17. BACnet Binary Input Object used to indicate the VRF IDU operating state. Values are Stop or Run.
18. BACnet Binary Input Object used to indicate a general error with the VRF system. Values are Normal or Error.
19. BACnet Multi-state Input object used to flag a number of different issues in the VRF system. Values are 01 = Normal, 02 - Other Errors, 03 = Refrigeration System Fault, 04 = Water System Error (not applicable for this project), 05 = Air System Error, 06 = Electronic System Error, 07 = Sensor Fault, 08 = Communication Error, and 09 = System Error.
20. BACnet Multistate Output object used to set up the VRF IDU operating mode. Values can be 01 = Cool, 02 = Heat, 03 = Fan, 04 = Auto, 05 = Dry, and 06 = Setback.
21. BACnet Multistate Input object used to display the VRF IDU operating state setting. Values can be 01 = Cool, 02 = Heat, 03 = Fan, 04 = Auto, 05 = Dry, and 06 = Setback.
22. BACnet Multistate Output object used to set up the VRF IDU fan speed. Values can be 01 = Low, 02 = High, 03 = Mid 2, 04 = Mid 1, and 05 = Auto.
23. BACnet Multistate Output object used to indicate the VRF IDU fan speed setting. Values can be 01 = Low, 02 = High, 03 = Mid 2, 04 = Mid 1, and 05 = Auto.
24. BACnet Analog Input object used to indicate the current room temperature.
25. BACnet Analog Value object used to set the room temperature.
26. BACnet Binary Input object used to indicate if the filter needs to be changed. Values are On or Off. It is not a pressure drop measurement; rather it is a timer that sets the output on after so many hours in operation. For this project, the is not used for the ducted VRF IDUs because they have higher performance filters in them for LEED purposes and it will be more cost effective to change them based on pressure drop instead of time in service.
27. BACnet Binary Value object used to reset the filter change flag once the filters have been changed. See not 26.
28. BACnet Binary Value object used to prevent the room occupants from changing the On/Off state of the IDU once it has been set by the Siemens system. See the sequence of operation for additional information on prohibit points as well as Mitsubishi Application Note 3001, 3003, and 3007.
29. BACnet Binary Value object used to prevent the room occupants from changing the operating mode of the IDU once it has been set by the Siemens system. See the sequence of operation for additional information on prohibit points as well as Mitsubishi Application Note 3001, 3003, and 3007.
30. BACnet Binary Value object used to prevent the room occupants from resetting the filter alarm so that only someone servicing the filters can reset it. See Note 26 for additional information on the filter status points and the sequence of operation for additional information on prohibit points.
31. BACnet Binary Value object used to prevent the room occupants from changing the set point of the IDU once it has been set by the Siemens system. See the sequence of operation for additional information on prohibit points as well as Mitsubishi Application Note 3001, 3003, and 3007.

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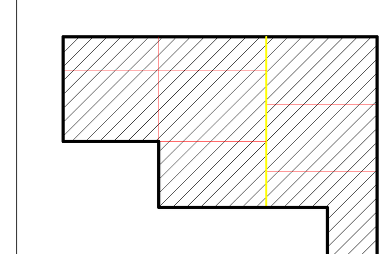

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SHEET TITLE
VRF System Point List - Part 2

SHEET NUMBER
MI.6.03-2

South Operations Center Variable Flow Refrigeration System (Location and system point name segments = SPUSOC.VRF.; See note 6)

Point		Sensor			Features											Notes
Name (Note 6)	Description and Service	Type	Reference Spec Paragraph	Accuracy	Alarms				Trending							
					Limit		Warning		Samples[1]	Commissioning[5]			Operating[5]			
					Hi	Lo	Hi	Lo		Time[2]	Local[3]	Archive[4]	Time[2]	Local[3]	Archive[4]	

32. BACnet Binary Input object used to flag a problem on the Mitsubishi proprietary control network (M-NET).
33. BACnet Binary Value object used to collectively or individually reset or and deactivate IDUs from the Siemens system.
34. BACnet Multistate Output object used to set the position the air directing vanes. Not all IDUs have this feature (ducted units for instance). Possible values will vary with the type of unit but will typically include "auto", and number of different fixed positions, and a swing position that causes the vanes to continuously modulate.
35. BACnet Multistate Input object used to report the position the air directing vanes. Not all IDUs have this feature (ducted units for instance). Possible values will vary with the type of unit but will typically include "auto", and number of different fixed positions, and a swing position that causes the vanes to continuously modulate.
36. BACnet Analog Value object used in conjunction with the prohibit points to allow the building automation system to perform over-ride local control and/or perform night set-back and set-up functions. This object sets the cooling set point for units that support dual set points; i.e. an independent cooling set point and heating set point with a deadband in-between. When the Auto mode is enabled for these units, they will automatically heat or cool depending on the space temperature relative to these two set points. Not all controllers will support this function.
37. BACnet Analog Value object used in conjunction with the prohibit points to allow the building automation system to perform over-ride local control and/or perform night set-back and set-up functions. This object sets the heating set point for units that support dual set points; i.e. an independent cooling set point and heating set point with a deadband in-between. When the Auto mode is enabled for these units, they will automatically heat or cool depending on the space temperature relative to these two set points. Not all controllers will support this function.
38. BACnet Analog Value object used in conjunction with the prohibit points to allow the building automation system to perform over-ride local control and/or perform night set-back and set-up functions. This object sets the set point for units that do not support dual set points; i.e. there is only one set point with no dead band between heating and cooling. When the Auto mode is enabled for these units, they will automatically heat or cool depending on the space temperature relative to this one set point. Not all controllers will support this function.
39. BACnet Analog Value object used in conjunction with the prohibit points to allow the building automation system to perform over-ride local control and/or perform night set-back and set-up functions by setting a high temperature limit set point. Not all controllers will support this function.
40. BACnet Analog Value object used in conjunction with the prohibit points to allow the building automation system to perform over-ride local control and/or perform night set-back and set-up functions by setting a low temperature limit set point. Not all controllers will support this function.
41. Vendor furnished for installation by the Mechanical Control Instrumentation contractor.
42. Provide one calibration kit specific to the make and model of sensor that is provided and turn it over to the Owner at the completion of construction to support on-giong operation and maintenance of the sensors.
43. Required for the following rooms, 100, 101, 124, 141, 142, 143, 144, 210, 212, 230, 231, 241, and 244. For monitoring purposes and LEED compliance purposes only.
44. Hardwire the drain pain overflow sensor to the Mitsubishi VRF IDU using the wiring harness provided and verify operation.
45. Applies to IDU-1.2, IDU-1.3, IDU-1.4, IDU-1.5, IDU-1.6, IDU-1.14, IDU-2.1, IDU-2.2, IDU-2.3, IDU-2.7, and IDU-2.9.
46. Not required for IDU-1.2, IDU-1.3, IDU-1.4, IDU-1.5, IDU-1.6, IDU-1.14, IDU-2.1, IDU-2.2, IDU-2.3, IDU-2.7, and IDU-2.9.

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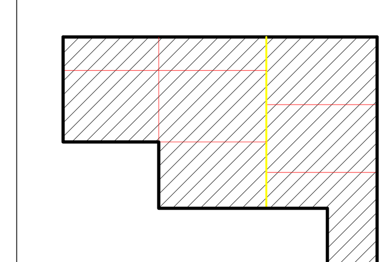

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VPI-NO	790-641

SHEET TITLE
VRF System Point List - Part 3

SHEET NUMBER
MI.6.03-3

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 is served by:

- Two OutDoor Units (ODU) that can serve as conventional condensers to reject heat to the ambient environment or near-conventional heat pumps to extract heat from the ambient environment, and
- Three Branch Controllers (BC) to manage and direct the flow of refrigerant between
- Twenty-five InDoor Units (IDUs) with contain coils that function as evaporators for a cooling cycle and condensers for a heating cycle.

Note that the ODUs are two different sizes and that each ODU contains two compressors. The ODUs are "twinned" which generally means they are piped in parallel and will operate as a unit with the Mitsubishi controllers using one as the master unit and the other as the slave unit, staging the compressors based on the operating mode and requirements of the system to optimize performance and efficiency.

This system configuration will allow:

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

The system diagrams/operating diagrams used in the following section can be viewed as a narrated animation by downloading the Mitsubishi City Multi Refrigerant Flow Animation Application at www.mylinkdrive.com.

Full Cooling

This operating mode is virtually identical to a conventional direct expansion/vapor compression refrigeration process and is illustrated in Figure 1.

In this mode, refrigerant is evaporated in the coils in all zones to cool them. The heat is then rejected in the coils at the ODU which causes the refrigerant to condense.

In this operating mode the air leaving the ODU fan will be warmer than the ambient temperature. This condition is used by the control system as an indication that the ODU is in the cooling mode.

Full Heating

This operating mode is virtually identical to a conventional direct expansion/vapor compression process applied in a heat pump and is illustrated in Figure 2, although the coils in the condenser can see a liquid vapor mix entering them whereas heat pumps often receive only liquid refrigerant and the outdoor coil.

In this mode, refrigerant is condensed in the coils in all zones to heat them. Then, the refrigerant is evaporated in the coils at the ODU, which causes it to pick up heat from the ambient environment for use in heating the indoor zones.

In this operating mode the air leaving the ODU fan will be cooler than the ambient temperature. This condition is used by the control system as an indication that the ODU is in the heating mode.

Heat Recovery

There are three general operating states associated with the VRF system performing heat recovery.

Balanced System

This operating mode is illustrated in Figure 3.

In this operating mode, energy is transferred from the zones that require cooling to the zones that require heating with no heat being rejected or picked up at the coils in the ODU. This is the lowest energy state for the system because no ODU fan operation is require and because the refrigerant moving through the system does double duty by first passing through the coils where cooling is required and picking up energy and then moving to the coils where heating is required and giving that energy back up.

In this operating mode, the compressor operates but the ODU fan does not operate. The control system uses this as an indication that the system is in a balanced state.

More Zones in Heating than Cooling

This operating mode is illustrated in Figure 4.

This operating mode allows the VRF system to concurrently provide heating and cooling with the energy extracted from the zones needing cooling providing energy to the zones that need heat. But because more heat is required than is being recovered from the zones with a cooling load, the ODU coils are configured to recover heat from the ambient environment and the ODU operates as a heat pump.

As was the case for the full heating mode, the ODU coil receives a mix of liquid and gaseous refrigerant, and the air leaving the ODU fan is cooler than the ambient air. The control system uses the cooler air leaving the ODU fan in combination with a mixed operating state of the VRF InDoor Unit (IDU) zones (some in heating and some in cooling) as an indication that the system is in this operating state.

More Zones in Cooling than Heating

This operating mode is illustrated in Figure 5.

This operating mode is similar to the operating mode discussed in the preceding paragraph in that it allows the VRF system to concurrently provide heating and cooling with the energy extracted from the zones needing cooling providing energy to the zones that need heat. But because the heat that needs to be rejected by the zones in cooling exceeds the amount of heat required by the zones in heating, the ODU coils receive hot gas and the ODF fan operates to .

As was the case for the full heating mode, the ODU coil receives a mix of liquid and gaseous refrigerant, and the air leaving the ODU fan is cooler than the ambient air. The control system uses the cooler air leaving the ODU fan in combination with a mixed operating state of the VRF InDoor Unit (IDU) zones (some in heating and some in cooling) as an indication that the system is in this operating state.

Proprietary Digital Control System

The various elements in the VRF system are managed by a stand-alone proprietary digital control system that is capable of providing all of the functionality necessary to operate the system, perform diagnostics, schedule equipment, and track energy consumption including providing web-based access to these features from a central location. However, since the City of Seattle is a sole source Siemens site, the Mitsubishi control system will be integrated with the Siemens control system using BACnet as well as dedicated physical points that are hardwired into the Siemens control system.

The two primary control elements of the Mitsubishi Control network are the Network Manager and the IDU Remote Controllers.

Network Manager

The Mitsubishi AE-200 controller functions as the network manager for the Mitsubishi control system. It shall be furnished and programmed by the Mitsubishi installing contractor and will be mounted by the Mechanical Instrumentation contractor in an enclosure furnished by the Mechanical Instrumentation contractor.

The Mechanical Instrumentation contractor shall also furnish and install all wiring, raceways and accessories require for a complete wiring system and shall make final terminations to the Mitsubishi equipment in coordination with the Mitsubishi Installing Contractor.

Commissioning shall be performed in conjunction with the Commissioning Provider, the Mitsubishi installing contractor and the Mechanical Instrumentation contractor with support from the design and construction team as required by the contract documents.

The AE-200 provides the following functions for this project.

- Master control functions for the network
- Operation and monitoring of the VRF equipment in the facility
- BACnet functions as required to integrate with the Siemens system
- Web browser access to allow a user with proper credentials to access the system via a web browser for monitoring, operation, energy management, and maintenance functions.

(Continued on sheet MI.8.03-2)

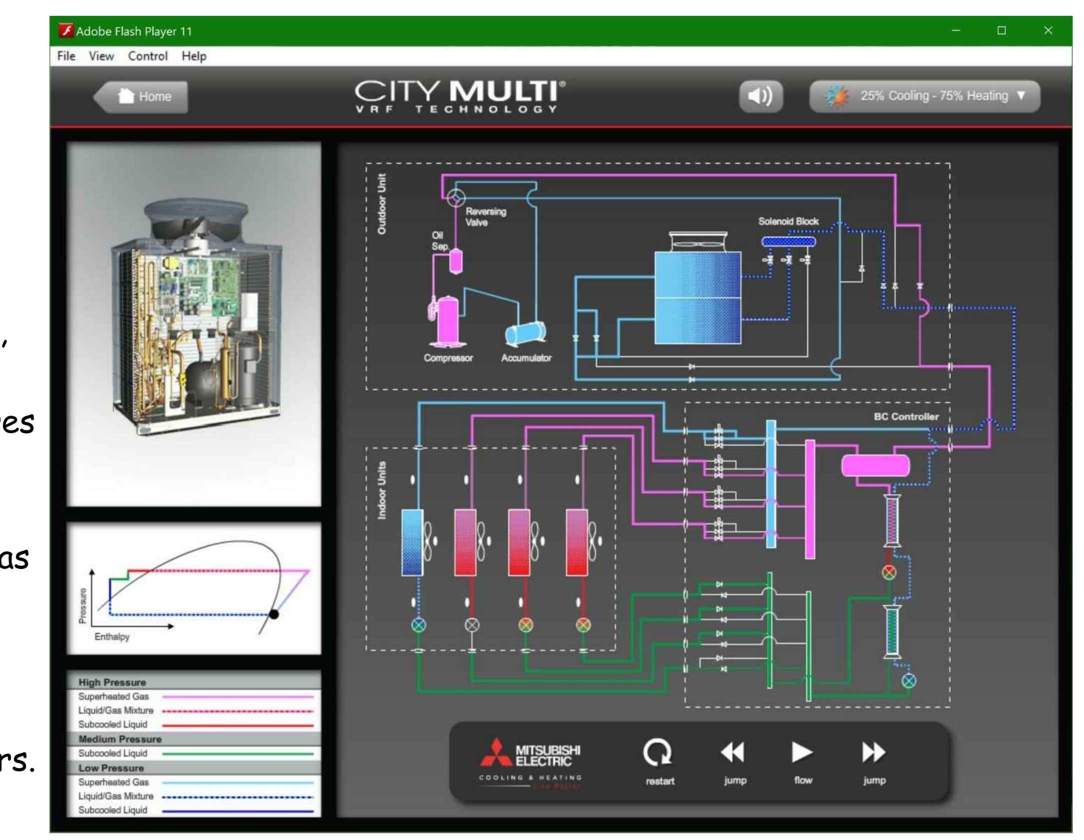


Figure 4 - A VRF System with a Net Heating Requirement on the System

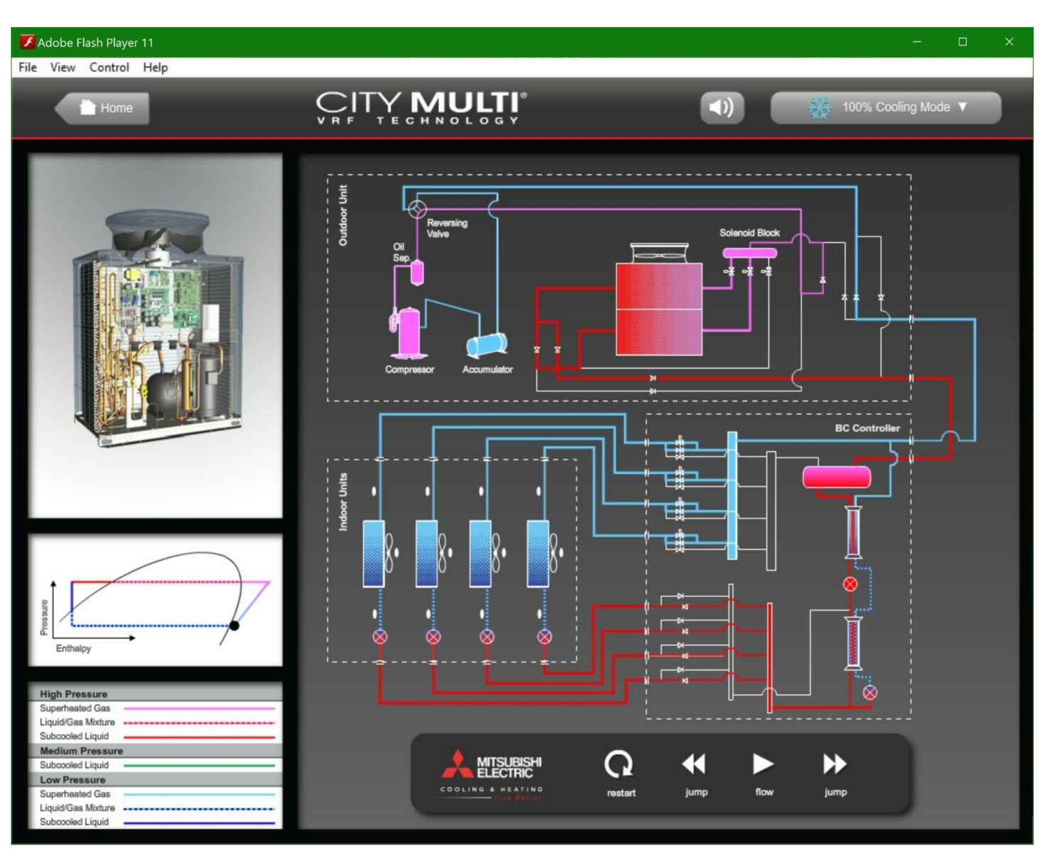


Figure 1 - A VRF System Operating in the Full Cooling Mode

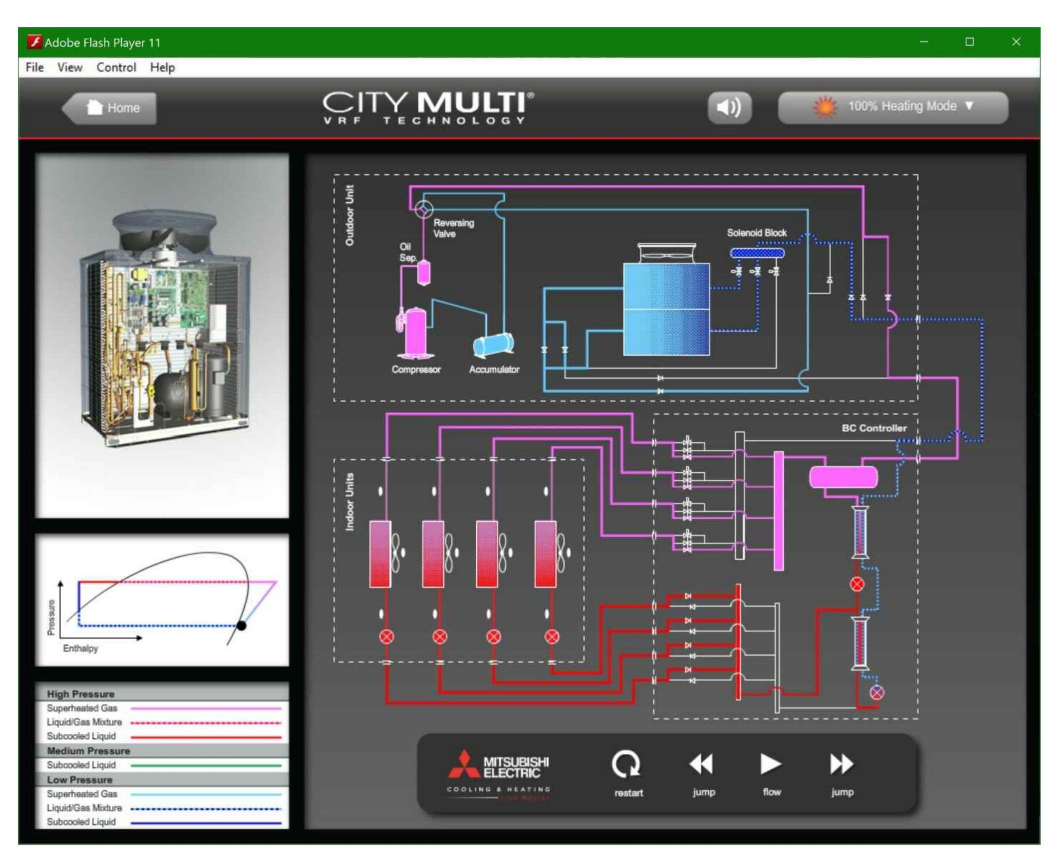


Figure 2 - A VRF System Operating in Full Heating Mode

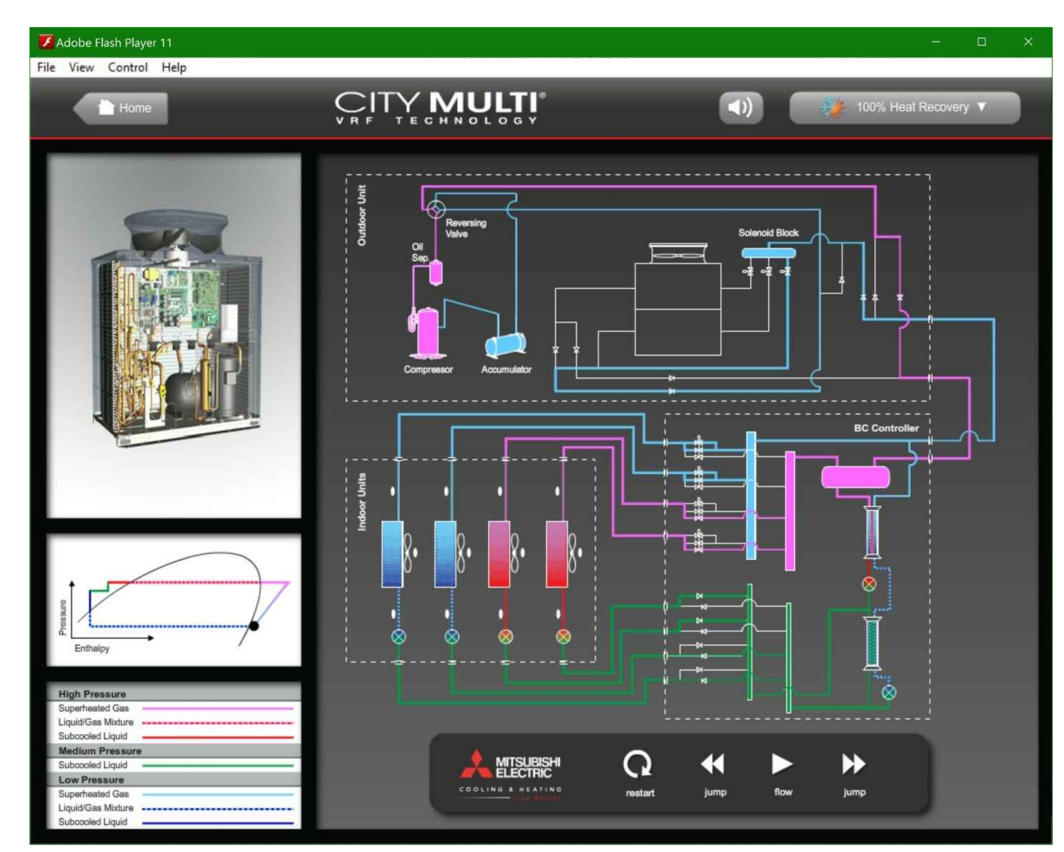


Figure 3 - A VRF System Operating in a Balanced State

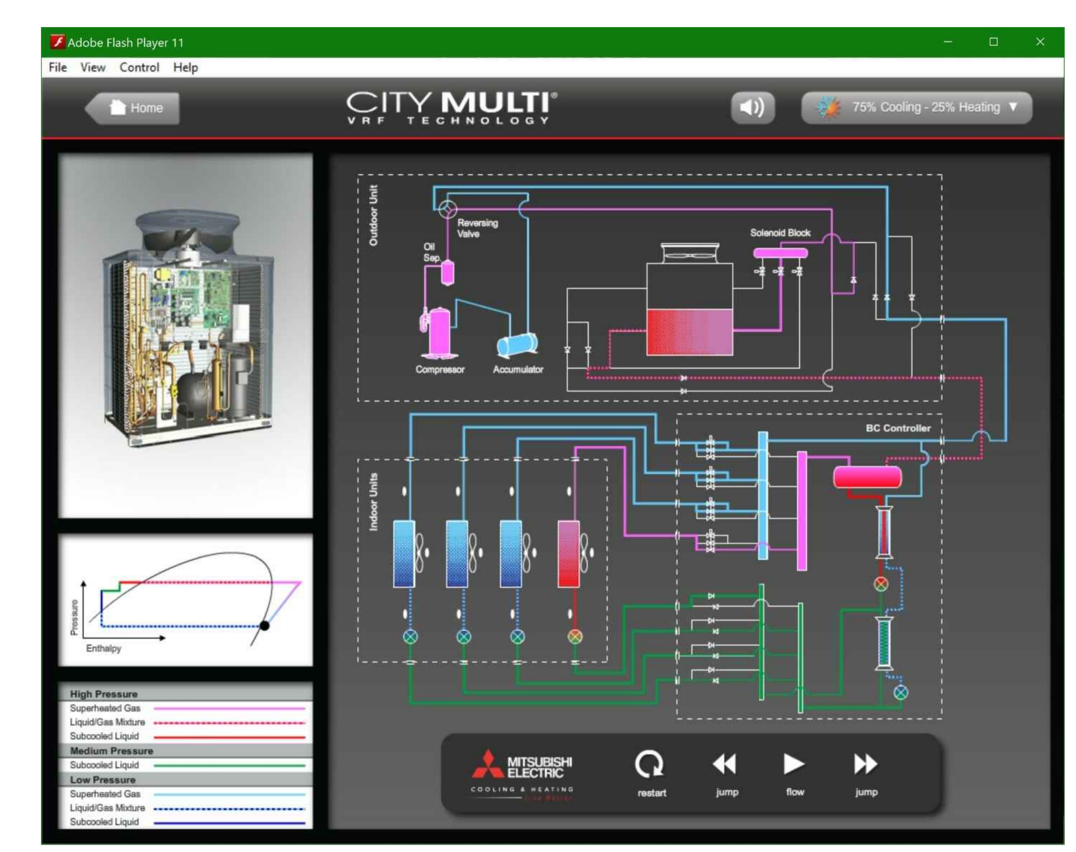
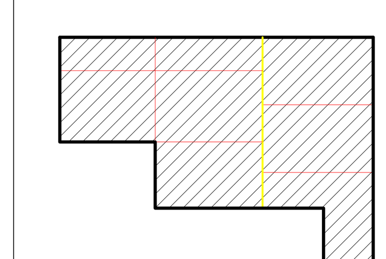


Figure 5 - A VRF System with a Net Cooling Requirement on the System

Facility Dynamics Engineering
6760 Alexander Bell Drive, Suite 200
Columbia, MD 21046
Phone: (410) 290-0900

KEY PLAN



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CITY OF SEATTLE

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Capital Development & Construction Management

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PROJECT-NO	FAS 2016-054
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CHECKED BY	CBM
DATE	10/04/18
REVISIONS	DATE
△	
△	
△	
△	
△	
VPI-NO	790-641

SHEET TITLE
VRF System Sequence of Operation Part 1

SHEET NUMBER
MI.8.03-1

IDU Remote Controller Features and Settings

User Menu Settings; X = Selected Option, L= Locked, U= Unlocked, N/A Not Applicable, D = Disabled, E = Enabled, Sie - Managed by Siemens, AE = Managed by the AE-200 Central Controller, En = English, Sh = Show, Hi = Hide, Dft = Default, AR = As Reqired, NU = Not Used, H = Hide, S = Show, SI = Single, DU - Dual, , N## = See note referenced by the number, Lit = Light, Drk = Dark, Cx = Set During Commissioning, CSB = Color Selection by Architect (Note 15)

Service Menu Settings; Abbrevations are the same as for the User Menu

HVAC System	Area Served	VRF Zone Type (see Sequence)	Function Settings (Nt. 18): Use Remote Controller Temperature Sensor – Use Remote Sensor	Use Internal Sensor	Power Failure Recovery Mode – Automatically Restart	Do not restart (Note 16)	External Static Pressure Setting, in.w.c. (Note 17)
DOAS 1							
IDU-1.2	Room 101 - Dispatch B	8	X			X	
IDU-1.3	Room 100 - Dispatch A	8	X			X	
DOAS 2							
IDU-1.14	Room 124 – Break-out	2	X			X	
IDU-1.15	Room 130 – CCTV Workroom	6	X			X	
IDU-2.1	Room 211 – Open Office	1	X			X	
IDU-2.2	Room 222 – Office	3	X			X	
IDU-2.3	Room 212 – Breakout	1	X			X	
IDU-2.4A	Room 230 - Conference	5	X			X	
IDU-2.4B	Room 230 - Conference	5	X			X	
IDU-2.5	Room 231 – Conference	4	X			X	
IDU-2.6	Room 210 - Breakout	4	X			X	
DOAS 3							
IDU-1.4	Room 111 - Lobby	1	X			X	
IDU-1.5	Room 140 – ERC	3	X			X	
IDU-1.6	Room 144 – Lunch Room	4	X			X	
IDU-1.7	Room 145 – Shared Support	1	X			X	
IDU-2.6	Room 210 - Breakout	4	X			X	
IDU-2.7	Room 242 – Office	3	X			X	
IDU-2.8	IDU Number Not Used	N/A	X			X	
IDU-2.9	Room 213 – Open Office	1	X			X	
DOAS 4							
IDU-1.8	Room 150 – Women's Locker	1	X			X	
IDU-1.9	Room 152 – Women's Drying Room	10	X			X	
IDU-1.10	Room 151 – Men's Locker Room	1	X			X	
IDU-1.11	Room 153 – Men's Drying Room	10	X			X	
HRV-1							
IDU-1.12	Room 161 – Warehouse Office	7	X			X	
HRV-2							
IDU-1.13	Room 164 – Tool Office	7	X			X	
HRV-3							
IDU-1.1	Room 105 – Source Control Work Room	9	X			X	

Mitsubishi PAR-U01MEDU Remote Controller Feature

HVAC System	User Password (Note 8)	Service Password (Note 8)	Basic Operation Settings: On/Off	Operating Mode	Set Temperature	Override (Note 10)	Fan Speed	Air Direction	Louver Swing	LOSSNAY Fan Speed	Hold	Set Humidity	Date and Time	Date/Time Format	Daylight Savings Time	Schedule
Password Protected ▶		▶	X	X	X		X	X	X	N/A		N/A				N10
BACnet Access ▶	▶	▶								N/A		N/A	X	X	X	X
DOAS 1																
IDU-1.2	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-1.3	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
DOAS 2																
IDU-1.14	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-1.15	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.1	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.2	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.3	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.4A	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.4B	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.5	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.6	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
DOAS 3																
IDU-1.4	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-1.5	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-1.6	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-1.7	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.6	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.7	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.8	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-2.9	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
DOAS 4																
IDU-1.8	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-1.9	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-1.10	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
IDU-1.11	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
HRV-1																
IDU-1.12	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
HRV-2																
IDU-1.13	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE
HRV-3																
IDU-1.1	AR	AR	N12	N12	N12	L	N12	N/A	N/A	N/A	L	N/A	AE	AE	AE	SIE

HVAC System	Timer: On-Off	Auto-Off	Display Format: Language	Temperature Unit	Show/hide Room Temp.	Backlight Timeout	Sound/Contrast: Sound	Contrast	Energy Savings Assistant – Mode Settings, Select 1 (Note 11): Non-Use	Thermo-off	Temp. Offset	Fan Spd. Down	On/Off	Operating Mode	Note 13: Offset Value	Auto-Away Time	Detection Level	Invalidate Item Setting: Date and Time	Light Sensor: Enable/Disable	Condition
BACnet Access	X		X				X		X											
DOAS 1																				
IDU-1.2	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-1.3	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
DOAS 2																				
IDU-1.14	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-1.15	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.1	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.2	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.3	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.4A	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.4B	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.5	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.6	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
DOAS 3																				
IDU-1.4	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR
IDU-1.5	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR
IDU-1.6	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR
IDU-1.7	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.6	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.7	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.8	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
IDU-2.9	D	D	En	°F	Sh	Dft	Dft	Dft						X	NU	NU	NU	NU	NU	AR
DOAS 4																				
IDU-1.8	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR
IDU-1.9	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR
IDU-1.10	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR
IDU-1.11	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR
HRV-1																				
IDU-1.12	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR
HRV-2																				
IDU-1.13	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR
HRV-3																				
IDU-1.1	D	D	En	°F	Sh	Dft	Dft	Dft	X						NU	NU	NU	NU	NU	AR

HVAC System	LED Indicator – Basic Display Mode – Function, Select One: Non-use	Mode	Room Temp.	Mode Color Settings: Cooling	Heating	Fan	Auto	Dry	Setback	Room Temp. Settings, Note 14: Normal, Low	Normal, High	Temp. Bands: Below Normal	Normal	Above Normal	Bright-ness: High	Low	Color During Energy Savings	Occupancy Detection Indication	Switch LED Brightness via Space Brightness: Enable/Disable	Light Detected	Dark Detected	Touch Panel Calibration
BACnet Access	X																					X
DOAS 1																						
IDU-1.2		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-1.3		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
DOAS 2																						
IDU-1.14		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-1.15		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.1		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.2		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.3		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.4A		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.4B		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.5		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.6		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
DOAS 3																						
IDU-1.4		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-1.5		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-1.6		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-1.7		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.6		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.7		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.8		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-2.9		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
DOAS 4																						
IDU-1.8		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-1.9		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-1.10		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
IDU-1.11		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
HRV-1																						
IDU-1.12		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
HRV-2																						
IDU-1.13		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR
HRV-3																						
IDU-1.1		X		CBA	CBA	CBA	CBA	CBA	CBA	NU	NU	NU	NU	NU	AR	AR	CBA	E	AR	AR	AR	AR

HVAC System	Lockable Remote Controller Functions Lock State: On/Off	Operating Mode	Set Temp.	Fan Speed	Air Direction	Lover Swing	LOSSNAY Speed	Hold	Sensor Threshold: Occupancy	Brightness Sensor: Light Threshold	Dark Threshold	Temperature Range Limit: Auto Upper	Auto Lower	Cooling Upper	Cooling Lower	Heating Upper	Heating Lower	Auto Return: Enable/Disable	Cool - Return After Time	Cool - Temp. to Return To	Heat - Return After Time	Heat - Temp. to Return To
BACnet Access	X								X			X						X				
DOAS 1																						
IDU-1.2	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-1.3	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
DOAS 2																						
IDU-1.14	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-1.15	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.1	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.2	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.3	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.4A	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.4B	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.5	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.6	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
DOAS 3																						
IDU-1.4	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-1.5	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-1.6	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-1.7	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.6	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.7	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.8	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-2.9	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
DOAS 4																						
IDU-1.8	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-1.9	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-1.10	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
IDU-1.11	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
HRV-1																						
IDU-1.12	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
HRV-2																						
IDU-1.13	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU
HRV-3																						
IDU-1.1	L	L	U	L	N/A	N/A	N/A	L	AR	NU	NU	77	68	77	73	72	68	D	NU	NU	NU	NU

HVAC System	Screen Cleaning	Filter Information	Group Settings	Interlocked LOSSNAY	Cool-Heat Display: Auto Mode	Setback Mode	Override Control: Enable/Disable	Operating Time	Temp. Sensor Offset	Humidity Sensor Offset	Auto Mode (Select 1): Single Setpoint	Dual Setpoint	Room Name	Telephone Number	LED Colors	Extra Occupancy Sensor, Note 1	Notes
BACnet Access	X	X	X	X	X	X		X	X	X	X		X	X	X		
DOAS 1																	
IDU-1.2	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-1.3	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
DOAS 2																	
IDU-1.14	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	2
IDU-1.15	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-2.1	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-2.2	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	3	5
IDU-2.3	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	4
IDU-2.4A	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	7
IDU-2.4B	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	7
IDU-2.5	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-2.6	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
DOAS 3																	
IDU-1.4	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-1.5	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	3
IDU-1.6	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-1.7	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	3	
IDU-2.6	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-2.7	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	6
IDU-2.8	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-2.9	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
DOAS 4																	
IDU-1.8	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-1.9	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-1.10	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
IDU-1.11	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
HRV-1																	
IDU-1.12	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
HRV-2																	
IDU-1.13	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	
HRV-3																	
IDU-1.1	AR	NU	AR	N/A	H	H	D	NU	AR	AR	X		AR	NU	Dft	0	

Notes

1. This is the number of supplemental occupancy sensors provided and wired to the Siemens system to suppport IDUs that serve multiple zones.
2. This is the IDU controller location. The unit also serves Room 120 – Hallway, Room 127 – Recovery Room, Room 128 – Restroom, Room 129 - Janitor's Closet, and Room 131 – Waste/Recycle
3. This is the IDU controller location. The IDU also serves Room 141 - Break-out, Room 142 - Breakout and Room 143 - Conference.
4. This is the IDU controller location. The IDU also serves Room 200 – Hallway,
5. This is the IDU controller location. The IDU also serves Room 221 – Office, Room 223 – Office, and Room 221 – Office
6. This is the IDU controller location. The IDU also serves Room 241 – Breakout, Room 243 – Office, and Room 244 – Breakout.
7. There are two IDUs serving this space controlled together by one Mutsubishi controller.
8. Replace the default password with a new password that is as requested and approved by the Owner.
9. Disabled from the service menu (vs. the user menu).
10. Even thought there is not BACnet access to the Schedule feature of the remote controller, the Siemens system can use the other BACnet points to manage the schedule of the IDUs. See the Seauence of Operation for more information.
11. Only one of the options can be selected. "X" = the option that should be selected for the indicated unit.
12. If locked, the setting can not be adjusted from the remote controller by it still can be adjusted via the BACnet object associated with it. If it is unlocked, it can be adjusted from the remote controller as well as by the associated BACnet object and the "last command wins" (see the sequence of operation).
13. These settings only apply if the Temperature Offset mode is selected.
14. If the schedule feature is used, it is possible to set up to 8 operating patterns for each day of a week. Each operating pattern allows you to set the on and off time, mode, and temperature setpoint(s).
15. LED color options are Blue, Light blue, Purple, Red, Pink, Orange, Yellow, Green, Lime, and White. The mode selection and colors are initial suggestions. Final mode selection to drive the LEDs shall be as required by the Owner, with color selections by the Architect and Owner.
16. The design intent is for Siemens to manage the restart after a power failure to allow it to be coordinated with the other equipment on the project.
17. The indicated values are based on the design documents. Coordinate the final setting with the testing and balaincing contractor based on their test results.

IDU Remote Controller Features and Settings

VRF System Sequence of Operation (Continued from MI.8.03-1)

IDU Remote Controller

The Mitsubishi PAR-U01MEDU remote controller provides local, stand-alone control functions for the VRF IDUs on the project. The AE-200 controller shall be configured to access the remote controller to change set points, monitor the state of the IDU, and generally manage the IDU from a central location and via a web browser for personnel with appropriate log-in credentials.

The BACnet feature of the AE-200 shall also allow the Siemens system to access key data and manage key operating set points to provide scheduling functions, night set back and set up functions, and monitoring of basic parameters as indicated below under BACnet Points.

Some of the features provided by the Mitsubishi PAR-U01MEDU remote controller shall also be activated to support how the units respond during unoccupied hours when people are present. The *IDU Remote Controller Features and Settings* table indicates the anticipated settings required for each of the zone controllers at the time of design.

This table should be field coordinated and verified and submitted for approval as a part of the control system submittal package.

Siemens System Integration with the Mitsubishi Control 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, set back and set up, diagnostics or tenant support. All schedules, set backs and set ups shall reside in the Siemens system.
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.
3. Monitoring for LEED Measurement and Verification and Energy Code compliance purposes.

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 proprietary service and maintenance tool associated with the proprietary VRF system network will be used for deep diagnostics. Access to the service and maintenance tool and other proprietary Mitsubishi features will be via a web browser interface to the Mitsubishi network controller.

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

4. Going to the www.mylinkdrive.com web site and then,
5. Selecting the United States portion of the site and then,
6. Selecting the "R2 Series", "Controls", or "Software" options from the list under the page header and then,
7. 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.

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 descriptions provided in the following sections of the BACnet points and their possible values are states are taken from Mitsubishi Application Note 3003 - BACnet point list.

Last Command "Wins"

The Mitsubishi 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 Mitsubishi *AE-200 Technical Manual.*

Scheduling and Operating Mode Points

The following point are provided to facilitated scheduled operation based on occupancy, time of day or similar triggering mechanisms and to manage the operating state of the IDU.

- On/Off Set-up; BACnet Binary Output Object used to set the VRF IDU operating state. The value can Stop or Run.

(Continued on MI.8.03-3)

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6760 Alexander Bell Drive, Suite 200
Columbia, MD 21046
Phone: (410) 290-0900

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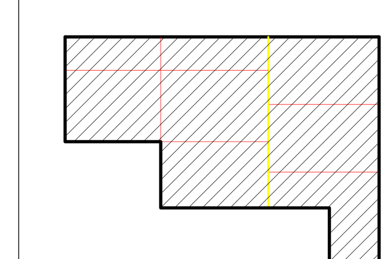

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SHEET TITLE
VRF System Sequence of Operation Part 2

SHEET NUMBER
MI.8.03-2

VRF System Sequence of Operation (Continued from MI.8.03-2)

IDU Remote Controller

The Mitsubishi PAR-U01MEDU remote controller provides local, stand-alone control functions for the VRF IDUs on the project. The AE-200 controller shall be configured to access the remote controller to change set points, monitor the state of the IDU, and generally manage the IDU from a central location and via a web browser for personnel with appropriate log-in credentials.

The BACnet feature of the AE-200 shall also allow the Siemens system to access key data and manage key operating set points to provide scheduling functions, night set back and set up functions, and monitoring of basic parameters as indicated below under BACnet Points.

Some of the features provided by the Mitsubishi PAR-U01MEDU remote controller shall also be activated to support how the units respond during unoccupied hours when people are present. The *IDU Remote Controller Features and Settings* table indicates the anticipated settings required for each of the zone controllers at the time of design.

This table should be field coordinated and verified and submitted for approval as a part of the control system submittal package.

Siemens System Integration with the Mitsubishi Control System

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1. Supervisory management to command units on and off as required for scheduling, set back and set up, diagnostics or tenant support. All schedules, set backs and set ups shall reside in the Siemens system.
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.
3. Monitoring for LEED Measurement and Verification and Energy Code compliance purposes.

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 proprietary service and maintenance tool associated with the proprietary VRF system network will be used for deep diagnostics. Access to the service and maintenance tool and other proprietary Mitsubishi features will be via a web browser interface to the Mitsubishi network controller.

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

4. Going to the www.mylinkdrive.com web site and then,
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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 descriptions provided in the following sections of the BACnet points and their possible values are states are taken from Mitsubishi Application Note 3003 - BACnet point list.

Last Command "Wins"

The Mitsubishi 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 Mitsubishi *AE-200 Technical Manual*.

Scheduling and Operating Mode Points

The following point are provided to facilitated scheduled operation based on occupancy, time of day or similar triggering mechanisms and to manage the operating state of the IDU.

- On/Off Set-up; BACnet Binary Output Object used to set the VRF IDU operating state. The value can Stop or Run.
- Operational Mode Set-up; BACnet Multistate Output Object used to set up the VRF IDU operating mode. The values can be 01 = Cooling, 02 = Heating, 03 = Fan, 04 = Auto, 05 = Dry, and 06 = Setback. Note that some IDUs will not provide all of these functions.
- Fan Speed Set-up; BACnet Multistate Output Object used to set up the VRF IDU fan speed. Values can be 01 = Low, 02 = High, 03 = Mid 2, 04 = Mid 1, and 05 = Auto. Note that different IDU types can have a different number of speed options; i.e. not all IDUs have 4 speed fans.
- Air Direction Setup; BACnet Multistate Output that can be used to set up the air flow direction controls in the IDU. Possible values are Horizontal, Down-blow 60°, Down-blow 80°, Down-blow 100°, and swing. Note that not all IDUs provide this feature. For instance, ducted IDUs do not have an air flow direction control capability.
- System Force Off; BACnet Binary Value Object that can be used to collectively or individually reset or and deactivate IDUs via a command from the Siemens system. Possible values are Reset and Execute. Air Direction Setup

Setpoint Adjustment Points

The following points are provided to adjust set points in the VRF unit controller.

- Set Temp; BACnet Analog Value Object used to adjust the room temperature setpoint in °F or °C.
- Set Temp Cool; BACnet Analog Value Object used to adjust the cooling set point in °F or °C for units with a cooling set point, a heating set point, and a dead band in between. These units, when in Auto, will cool of the space temperature is above the cooling set point, will heat if the temperature is below the heating set point, and will not do heating or cooling if the temperature is in-between the two set points.
- Set Temp Heat; BACnet Analog Value Object used to adjust the heating set point in °F or °C for units with a cooling set point, a heating set point, and a dead band in between. These units, when in Auto, will cool of the space temperature is above the cooling set point, will heat if the temperature is below the heating set point, and will not do heating or cooling if the temperature is in-between the two set points.
- Set Temp Auto; BACnet Analog Value Object used to adjust the heating set point in °F or °C for units that can heat and cool but which have only a single set point and no dead band in between. These units, when in Auto, will cool of the space temperature is above the set point, will heat if the temperature is below the set point.
- Set High Limit Setback Temp; BACnet Analog Value Object used to adjust the cooling night set up set point in °F or °C; i.e. how warm will the space be allowed to get during the unoccupied cycle.
- Set Low Limit Setback Temp; BACnet Analog Value Object used to adjust the heating night set back set point in °F or °C; i.e. how cool will the space be allowed to get during the unoccupied cycle.

State Points

The BACnet state points provide feedback regarding the state of various operating parameters associated with the IDUs.

- Room Temperature; BACnet Analog Value Object used to report the current room temperature control setpoint in °F or °C.
- On/Off State; BACnet Binary Input Object used to report the current operating state of the IDU. Values can be Stop or Run.
- Op Mode State; BACnet Multistate Input Object used to report the operating mode of the IDU. Values can be 01 = Cooling, 02 = Heating, 03 = Fan, 04 = Auto, 05 = Dry, and 06 = Setback. Note that some IDUs do not accommodate all of these modes.
- Air Direction State; BACnet Multistate Input Object used to report the air flow direction setting of the IDU. Possible values are Horizontal, Down-blow 60°, Down-blow 80°, Down-blow 100°, and swing. Note that not all IDUs provide this feature. For instance, ducted IDUs do not have an air flow direction control capability.
- Fan Speed State; BACnet Multistate Input Object used to report the VRF IDU fan speed. Values can be 01 = Low, 02 = High, 03 = Mid 2, 04 = Mid 1, and 05 = Auto. Note that different IDU types can have a different number of speed options; i.e. not all IDUs have 4 speed fans.

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.

- Alarm Signal - BACNet Binary Input Object used to report that an error has been detected in the system and a error specific 4 digit error code has been transmitted to the AE-200. Values can be Normal and Error. The error code is not visible through the BACnet interface.
- Error Code - BACNet Multistate Input Object used to report a number of general alarm conditions. Values can be 01 = Normal, 02 = Other Errors, 03 = Refrigeration System Fault, 04 = Water System Error (not applicable for this project), 05 = Air System Error, 06 = Electronic System Error, 07 = Sensor Fault, 08 = Communication Error, and 09 = System Error.
- MNet Com State; BACnet Binary Input Object used to report the operating state of the proprietary Mitsubishi communications network. Values can be Normal and Error.

Filter Status Points - General

Mitsubishi provides a time-based filter status alarm that shall be mapped across the BACnet interface unless otherwise indicated. The point shall be used to notify the operators of the need to change the filters. This point is intended to be manually reset after the filters are changed to initiate a new timed filter change cycle.

- Filter Sign; BACnet Binary Input Object used to report the state of the filter change timer. Values can be On or Off.
- Filter Sign Reset; BACnet Binary Value object used to reset the filter change timer. Possible values are Reset and Void.

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

Note that some of the IDUs are provided with filter boxes and will not require that this point be used. See the point list and Filter Status Points- Ducted Fan Coil IDUs below for additional information.

Prohibit Points

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

- Prohibit Remote On-Off Override; BACnet Binary Value object used to prevent the IDU On-Off state from being changed from the remote controller. Possible values are Permit and Prohibit.
- Prohibit Remote Operating Mode Override; BACnet Binary Value object used to prevent the IDU Operating Mode from being changed from the remote controller. Possible values are Permit and Prohibit.
- Prohibit Remote Filter Change Indication Reset; BACnet Binary Value object used to prevent the change filter indication from being reset from the remote controller. Possible values are Permit and Prohibit.
- Prohibit Remote Set Point Adjustment; BACnet Binary Value object used to prevent the set point from being adjusted from the remote controller. Possible values are Permit and Prohibit.

Sending a Prohibit command makes the associated feature unavailable for adjustment from the remote controller. Sending "Permit" commands makes the features available again.

When implemented in the "last command wins" environment, these points and commands allow the Siemens system to place the IDUs in different operating modes and manage whether an occupant can control of features like starting and stopping the equipment, changing its operating mode, or changing the temperature set point.

This capability, along with the other BACnet object provide the capability for to implement schedules, night set back, and night set up.

ODU Integration with IDU Operation

Integration of the operation of the ODUs with the IDUs is handled by the Mitsubishi proprietary control system along with the operation of the BCs as needed to support the IDUs. The ODUs will operate if any IDU is in operation and the compressors will be staged to optimize efficiency and performance based on the current system operating requirements by the Mitsubishi controllers.

(Continued on MI.8.03-4)

Facility Dynamics ENGINEERING
6760 Alexander Bell Drive, Suite 200
Columbia, MD 21046
Phone: (410) 290-0900

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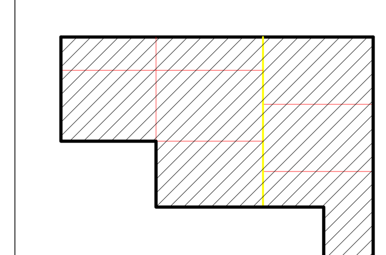

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SHEET TITLE
VRF System Sequence of Operation Part 3

SHEET NUMBER

VRF System Sequence of Operation (Continued from MI.8.03-3)

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.

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.

LEED Measurement and Verification Requirements

The IDUs and ODUs are provided with current transmitters that provide proof of operation, allow the operating state of the system to be determined, and support metering functions needed for measurement and verification purposes. See the metering sequence of operation and point list for additional information.

Run Time Accumulation

The proof of operation points also supports run time accumulation for each motor in the system. Run time shall be accumulated and archived. The graphic for each individual unit shall display the run time for that unit for the current day, the previous day, the month to date, and the year to date.

Typical IDU Zone Sequences of Operation

DOAS Units Associated with IDUs

The IDU's associated with each of the four DOAS systems are as follows:

DOAS-1	***DOAS-2***	***DOAS-3***	***DOAS-4***
IDU-1.2	IDU-1.14	IDU-1.4	IDU-1.8
IDU-1.3	IDU-1.15	IDU-1.5	IDU-1.9
	IDU-2.1	IDU-1.6	IDU-1.10
	IDU-2.2	IDU-1.7	IDU-1.11
	IDU-2.3	IDU-2.6	
	IDU-2.4A	IDU-2.7	
	IDU-2.4B	IDU-2.9	
	IDU-2.5		

IDU-2.6 In addition, there are three IDUs that are associated with Heat Recovery Ventilators (HRV) as follows:

- IDU-1.1 - Room 105 - Source Control Work Room is associated with HRV-3
- IDU-1.12 - Room 161 - Warehouse Office is associated with HRV-1
- IDU-1.13 - Room 164 - Tool Office is associated with HRV-2

Note that there is no IDU-2.8.

The association between an IDU and a DOAS unit or HRV unit is created by the physical arrangement of the ductwork. In other words, the IDUs associated with a given DOAS or HRV unit have outdoor air delivered to the zone(s) they serve by a connection from the supply duct of their associated DOAS or HRV unit.

Similarly, exhaust air is returned from the IDU zone to the DOAS or HRV unit to allow energy to be recovered when appropriate, based on the current climate conditions, building operating state, and utility rate structure.

The DOAS/HRV unit's function is to deliver the ventilation air required by the zone when it is occupied. Thus, the DOAS and HRV systems will not run during a warm-up or cool down cycle. They will also not run during set back or set up cycles if the IDU(s) are only running to maintain the space temperature with-in the set back or set up limits and there are no occupants in the zone served by the IDU.

See the DOAS and HRV sequence of operation for additional information regarding the DOAS and HRV system control.

IDU Zone Types

There are several different zone configurations associated with the IDUs as follows:

- Zone type 1 - Single zone ducted fan coil unit
- Zone type 2 - Multiple zone ducted fan coil unit
- Zone type 3 - Multiple zone VAV ducted fan coil unit
- Zone type 4 - Single zone ceiling cassette fan coil unit
- Zone type 5 - Single zone multiple ceiling cassette fan coil units
- Zone type 6 - Single zone wall mounted fan coil unit
- Zone Type 7 - Single space, single zone wall mounted IDU with a heat recovery ventilator
- Zone Type 8 - Single space, single zone ducted IDU with destratification fans
- Zone Type 9 - Single space, single zone, ceiling cassette IDU with a dedicated exhaust fan and hood and a dedicated make-up air system
- Zone Type 10 - Single space, single zone ducted IDU with dedicated exhaust

Many of the zones have common sequence requirements as described in the following section.

Operating Requirements Common to All Zone Types

Indoor Unit Function Switch Setting Coordination

Coordinate with the Mitsubishi start-up technician for the following indoor unit function settings.

1. Set the IDU to not restart automatically after a power failure to allow the Siemens power failure recovery sequence to manage the restart.
2. For ducted units, set the external static switch for the appropriate external duct static pressure requirement. An initial setting can be made based on the design documents but the final setting should be coordinated with the testing and balancing results during the commissioning process.
3. Unless otherwise noted, set the IDUs up to use the remote controller sensor for space temperature control.

- External static pressure setting matches the requirements for the unit

Occupied Setpoints

The following setpoints shall be used for occupied hours:

- Cooling - nominal setpoint of 75°F with an occupant adjustment range of +/-2°F around the nominal setpoint.
- Heating - nominal set point of 70°F with an occupant adjustment range of +/-2°F around the nominal setpoint.

The occupant range of adjustment shall be restricted to the bands indicated above via the programmable settings of the Mitsubishi PAR-U01MEDU remote controller. See the *IDU Remote Controller Features and Settings* table for additional information.

Unoccupied Setpoints

The following initial setpoints shall be used for unoccupied hours:

- Cooling - nominal setpoint of 85°F with no occupant adjustment capability.
- Heating - nominal setpoint of 60°F with no occupant adjustment capability.

Once a space has achieved steady state operating conditions at the desired operating temperature, an investment has been made in storing energy in the thermal mass represented by the space and its contents at the steady-state condition. Setback and setup cycles are a balancing act between the cost of replacing the stored energy that will be lost if the space temperature is allowed to drift and the parasitic energy and time it takes to replace that lost energy and recover the space from the setback/setup condition to the desired condition.

The unoccupied set points shall be fine-tuned via the commissioning process during the first year of operation to balance the recovery time required to return the space to the nominal occupied set point against the amount of operating time required to unoccupied hours to maintain the set-back temperature.

Recovery from Power Failure

The VRF equipment shall be included in the power failure recovery sequence provided for the facility. Each VRF IDU shall have a start order set point and a time delay set point. See the Power Failure Recovery Sequence of Operation for additional details.

Note that starting the first VRF IDU will also enable the operation of the ODUs, which are significant loads.

Fire alarm shut down

A hardwired point from the fire alarm system provides an input to the DDC systems. The DDC system shall use this input to perform a courtesy shutdown of all of the HVAC equipment if there is a fire alarm. This is not a code requirement but is being provided as an added measure of protection against the spread of smoke in the event of a fire.

Specifically, when a fire alarm is detected, all of the VRF IDUs shall be commanded to the off state and restart from the local controller shall be prohibited. After the fire alarm is cleared, the VRF IDUs shall be allowed to resume normal operation based on the current operating condition. The unit starts shall be staggered and shall use the logic associated with the Power Failure Recovery sequence for order of start and timing.

Drain Pan Alarm

Furnish and install the optional Mitsubishi DPLS2 drain pan level sensor and connect the wiring harnesses to shut down the VRF unit if the drain pan is about to overflow per the manufacturer's instructions. The level switch is powered by an internal 20-year life cycle battery.

For each IDU graphic, provide an indicator showing the remaining years of service available using a countdown timer that is started and begins counting down based on the date of installation. Include the installation date below the countdown timer.

Operating Requirements Common to Multiple Zone Types but Not All Zone Types

These features apply to multiple zone types as indicated, but not to all zone types.

Time Driven Schedules

Unless otherwise indicated, the IDUs shall be controlled via an optimized start-stop schedule with warm-up and cool-down cycles.

Each IDU shall be capable of having its own schedule with the hours of operation fully adjustable by the operators. The initial schedule settings for each zone shall be as indicated below and shall be fine-tuned to the Owner's specific requirements during the control system submittal review process.

Occupancy Driven Schedules

The following zones are to be provided with occupancy driven schedules based on the occupancy sensors that are incorporated in the Mitsubishi PAR-U01MEDU controller.

- • Breakout 210
- Conference 230
- Conference 231

Occupied Cycle Temperature Control

When the occupancy sensor serving these zones detects motion the IDU(s) serving the area shall be enabled and allowed to operate to actively control the space temperature at the occupied heating and cooling set points (70°F and 75°F respectively, both adjustable +/-2°F). 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.

Unoccupied Cycle Temperature Control During Normal Hours

These zones shall have two different unoccupied cycle set back/set up temperature set. If the zone is unoccupied and all of the other zones associated with the DOAS unit serving it are occupied, then the set back/set up temperature set points shall be set to allow the unit to shut down but also to minimize the drift from the normal occupied set points so that the zone can recover quickly if a zone level occupancy cycle is triggered.

At the end of an occupied cycle, the IDU(s) serving the area are turned off and the temperature in the area is allowed to drift between the unoccupied heating and cooling set points. Each zone shall have:

- A zone-specific unoccupied set-up set point that will be set to 1°F (adjustable) above the current occupied cooling set point, and
- A zone-specific unoccupied set-back set point that will be set to 1°F (adjustable) below the current occupied heating set point.

If the zone temperature is between the unoccupied set points, no active cooling or heating shall be provided. But, if the temperature drifts outside the set-back temperature range, the unit associated with the space shall be placed in occupied mode and operated until the space temperature is driven back inside the set back/set up range at which time the unit shall return to the unoccupied mode.

Ventilation air will be provided to the zones by the DOAS units serving them any time the DOAS runs and will continue to be provided even if the zone is unoccupied. Continuing to supply ventilation air, along with a fairly narrow set-back/set-up range (1°F above the maximum set point and 1°F below the minimum set point) is intended to minimize the pull-down time required when a zone goes occupied based on an occupancy sensor driven trigger.

Functional testing technique shall be used to fine tune the 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.

Figure 6 (see sheet sheet MI.8.03-4) illustrates how the zones associated with DOAS-2 would operate over the course of a typical day, including the interaction of the zones and DOAS-2 and reflects the design intent for the integration of zones with time driven schedules, occupancy driven schedules and the DOAS system supporting them.

(Continued on sheet MI.8.03-4)

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6760 Alexander Bell Drive, Suite 200
Columbia, MD 21046
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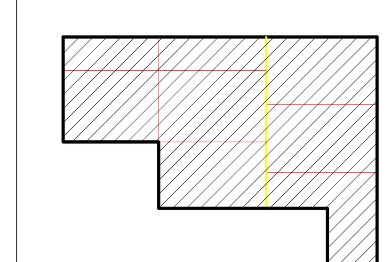

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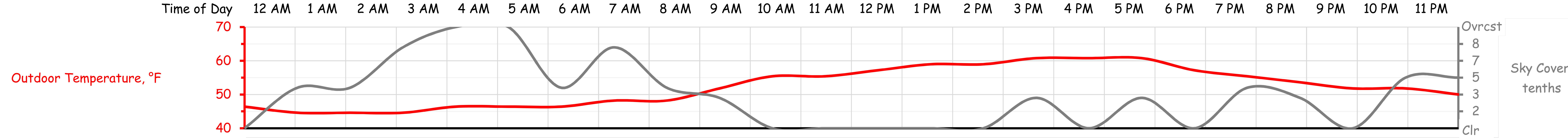
VRF System Sequence of Operation Part 4

SHEET NUMBER
MI.8.03-4

DOAS-2 Scheduled Operation Example



Unit Number	Area Served	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM
Hour of Day		0	1	2	3	4	5	6	7	8	9	10	11
Time of Day		12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM
Scheduled Hours of Occupancy (Siemens System)		U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}
IDU-1.14	Room 120 - Hallway, Room 124 - Break-out	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}
IDU-1.15	Room 130 - CCTV Workroom	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}
IDU-2.1	Room 211 - Open Office	U_{Sh}	N_{Sb}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	W/C	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}
IDU-2.2	Room 222 - Office	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}
IDU-2.3	Room 212 - Breakout	U_{Sh}	U_{Sh}	N_{Sb}	U_{Sh}	U_{Sh}	U_{Sh}	W/C	U_{Os}	U_{Os}	O_{Os}	U_{Os}	U_{Os}
IDU-2.4A	Room 230 - Conference	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	O_{OS}	O_{OS}	O_{OS}	O_{OS}	O_{OS}	O_{OS}
IDU-2.4B	Room 230 - Conference	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	O_{OS}	O_{OS}	O_{OS}	O_{OS}	O_{OS}	O_{OS}
IDU-2.5	Room 231 - Conference	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	W/C	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}
IDU-2.6	Room 210 - Breakout	U_{Sh}	N_{Sb}	U_{Sh}	U_{Sh}	U_{Sh}	W/C	W/C	U_{OS}	U_{OS}	U_{OS}	U_{OS}	O_{OS}
DOAS-2	All IDUs Listed Above	U_{IDU}	U_{IDU}	U_{IDU}	U_{IDU}	U_{IDU}	U_{IDU}	O_{IDU}	O_{IDU}	O_{IDU}	O_{IDU}	O_{IDU}	O_{IDU}

Unit Number	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Notes
Hour of Day	12	13	14	15	16	17	18	19	20	21	22	23	
Time of Day	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	
Scheduled Hours of Occupancy (Siemens System)	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	
IDU-1.14	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	1
IDU-1.15	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	2
IDU-2.1	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	U_{Sh}	O_{OS}	O_{OS}	U_{Sh}	U_{Sh}	3
IDU-2.2	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	O_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	2
IDU-2.3	U_{Os}	U_{Os}	U_{Os}	U_{Os}	D_{Sb}	U_{Os}	U_{Os}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	4, 5
IDU-2.4A	O_{OS}	O_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	4, 6
IDU-2.4B	O_{OS}	O_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	4, 6
IDU-2.5	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	4,7
IDU-2.6	O_{OS}	O_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{OS}	U_{Sh}	U_{Sh}	U_{Sh}	U_{Sh}	N_{Sb}	4, 8
DOAS-2	O_{IDU}	O_{IDU}	O_{IDU}	O_{IDU}	O_{IDU}	O_{IDU}	O_{IDU}	U_{IDU}	O_{IDU}	O_{IDU}	U_{IDU}	U_{IDU}	9

Operating Status Codes

U_{Sh} = Unoccupied and Off based on schedule
U_{OS} = Unoccupied and Off based on the zone occupancy sensor
O_{Sh} = Occupied and On based on schedule
O_{OS} = Occupied and On based on zone the occupancy sensor
U_{IDU} = Unoccupied and Off based on the IDUs served
O_{IDU} = Occupied and On based on the IDUs served
N_{SB} = On due to night set back
D_{SB} = On due to day set back
W/C = On due to warm up or cool down cycle

Notes:

1. This IDU serves multiple spaces including the Hallway the Break-out room. Areas like the Hallway require conditioning during all occupied hours so even though the break-out area will see random occupancy, the IDU runs for all occupied hours. Since the thermostat for the zone is located in the break-out room, its occupancy sensor is used to trigger after-hours operation if someone comes in and uses the break-out room during unscheduled hours.
2. These zones operate per the scheduled hours because they are operated on a time based schedule and there were no special events that occurred outside of the scheduled hours of operation, like someone coming in early, staying late, or working after hours.
3. IDU-2.1 is controlled by a schedule during normal hours and as a result, operates for all of those hours. This zone has an exterior wall with glass and is much more influenced by the outdoor conditions than the interior zones. Since the day in question was a cool, but not cold day, overnight, the temperature in this zone drifted down to the point where operation under night setback was triggered (1 AM). In addition, the optimized start/stop schedule for the zone brought the unit on in advance of the scheduled occupancy hours to warm up the space (6 AM start vs. 7 AM start). During unoccupied hours, the space temperature is allowed to drift to the night setback/setup temperatures unless the occupancy sensor on the thermostat detects an occupant, which is what happens from 8 PM to 10 PM.
4. These zones have a random occupancy pattern and do not operate on a schedule. Instead, during normal hours of operation, their occupancy sensors are used to trigger operation. And their set-back temperature band is narrowed down to be 1 degree above the cooling set point and one degree below the heating set point (both adjustable by the operators). The design intent is that the units will only operate when the room is in use, but also that the temperature in the space will not be allowed to drift much so that the space can recover quickly when an occupant arrives. During unscheduled hours, the zones are allowed to set back/set up to the same level as the other zones. As a result, when the time driven schedule shifts from unoccupied to occupied, these zones may come on in a warm up or cool down cycle to bring the zone temperature up or down from the night set back temperature to the day set back temperature.
5. This zone has some exterior glass and wall surface and as a result of the losses that occur on this cool day, it comes on at 2 AM due to night set back and performs a warm up cycle at 6 AM to bring it up from the night set back temperature to the day set back temperature. Since the window glass faces south-west, the solar gain causes the IDU to come on at 4 PM to keep the zone temperature within the day time set back temperature band.
6. This IDU comes on at 6 AM because someone came into the conference room to set up for a early morning meeting and the zone thermostat occupancy sensor picked them up and started the IDU. The IDUs associated with the route they used to enter the building did not start because IDUs serving common areas are not set up to trigger from their occupancy sensor.
7. This room is never used on the day of the example and as a result the only time it runs is to warm the zone up from the temperature it drifted to overnight to the daytime unoccupied set back temperature. The room only has a small roof area exposure and it is not enough area to cause sufficient losses and trigger a night set back cycle. During more extreme weather, the zone may also come on for night set back/set up due to the roof load.
8. Losses through the north-east facing wall and glass and the roof on this zone cause it to come on for several night set back cycles. Since it is a smaller unit, it also requires a longer warm-up cycle in the morning, which is why it started at 5 AM when the other zones started at 6 AM for their warm-up cycles.
9. This example assumes that DOAS-2 has been set to run any time that an of the IDU's it serves run due to occupancy as determined either by the occupancy sensor for zones with that feature enabled or by the scheduled hours of occupancy. Via the graphic for the system, the operators have the option to select *No DOAS Operation During Scheduled Unoccupied Hours*. If this option had been selected for the time period illustrated in this example, when IDUs start during the unoccupied cycle due to their occupancy sensor picking up an occupant (for example, IDU-2.1 from 8 PM to 10 PM), then DOAS-2 would not have started. See the sequence of operation for additional information regarding this option. The DOAS system did not run for any of the night set-back events nor did it start during the warm up cycle for IDU-2.6 at 5AM because there were no occupants in the spaces during those hours and ventilation air was not required. It starts ahead of the normal scheduled hours of occupancy (6 AM instead of 7 AM) because of the occupancy sensor for IDU-2.5 and IDU-2.4B being triggered; see Note 6.

VRF System Sequence of Operation (Continued from MI.8.03-4)

Filter Status Points- Ducted Fan Coil IDUs

The following ducted fan coil type IDUs are being provided with separate filter boxes designed to accommodate MERV 13 filters in support of LEED Indoor Air Quality (IAQ) requirements.

- IDU 1.2
- IDU 1.3
- IDU 1.4
- IDU 1.5
- IDU 1.6
- IDU 1.14
- IDU 2.1

- IDU 2.2
- IDU 2.3
- IDU 2.7
- IDU 2.9

Under the Mechanical Instrumentation work, as indicated in the point list, these filter boxes will be provided with stand-alone filter differential pressure sensors that are wired directly to the Siemens system. For these units, the BACnet filter points shall be disabled and shall not be mapped across the BACnet interface.

The design intent behind this decision is for the filters to be changed based on pressure drop, which approaches changing them based on best life cycle cost. The higher performance filters have a higher first cost and thus, maximizing their service life by not changing them until the pressure drop warrants it was deemed desirable. Monitoring pressure drop also provides more positive proof that the filters are in place and functional and that the intended IAQ benefit is being realized.

The filter change set points shall be coordinated during the start-up and commissioning process to match the capabilities of the IDU fans in terms of ensuring they deliver the required air flows at a minimum with dirty filters.

Carbon Dioxide Monitoring

The following zones are provided with CO2 monitors for the purposes of compliance with LEED Indoor Air Quality credits.

- Dispatch A (Room 100),
- Dispatch B (Room 101),
- Break Out (Room 124),
- Break Out (Room 141),
- Break Out (Room 142),
- Conference (Room 143),
- Lunch Room (Room 144),
- Break Out (Room 210),
- Break Out (Room 212),
- Conference (Room 230),

(Continued on MI.0.03-6)

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Columbia, MD 21046
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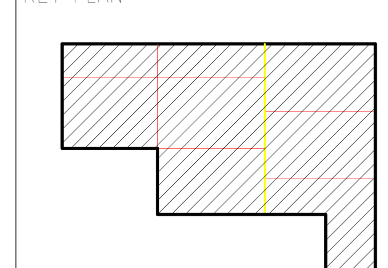

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VRF System Sequence of Operation (Continued from MI.8.03-5)

- Conference (Room 231),
- Break Out (Room 241), and
- Break Out (Room 244).

The manufacturer's recommended calibration kit for the make(s) and model(s) of CO2 sensors furnished for the project shall be provided as part of the turn-over package and the Facility Operations staff who will be servicing the facility shall be trained regarding its use as part of the training package.

Zone Specific Features and Operating Requirements

The following paragraphs describe the different zone types and zone type specific sequence requirements.

Zone Type 1 - Single Space, Single Zone or Open Space, Ducted IDU

This zone configuration applies to the following IUDs.

1. IDU-1.4 - Room 111 - Lobby
2. IDU-1.7 - Room 145 - Shared Support
3. IDU-1.8 - Room 150 - Women's Locker
4. IDU-1.10 - Room 151 - Men's Locker Room
5. IDU-2.1 - Room 211 - Open Office
6. IDU-2.3 - Room 200 - Hallway, Room 212 - Breakout
7. IDU-2.9 - Room 213 - Open Office

The Mitsubishi controller for these zones provides direct contr

For these zones, the zone temperature shall be controlled by a wired, multifunction controller mounted as shown on the floor plans. When an occupancy sensor in these areas detects motion the IDU(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 75°F respectively, both adjustable +/-2°F). 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.

At the end of an occupied cycle, the IDU(s) serving the area are turned off and the temperature in the area is allowed to drift between the unoccupied heating and cooling set points. Each zone shall have:

- A zone-specific unoccupied set-up set point that will be set to 1°F (adjustable) above the current occupied cooling set point, and
- A zone-specific unoccupied set-back set point that will be set to 1°F (adjustable) below the current occupied heating set point.

If the zone temperature is between the unoccupied set points, no active cooling or heating shall be provided. But, if the temperature drifts outside the set-back temperature range, the unit associated with the space shall be placed in occupied mode and operated until the space temperature is driven back inside the set back/set up range at which time the unit shall return to the unoccupied mode.

Ventilation air will be provided to the zones by the DOAS units serving them any time the DOAS runs and will continue to be provided even if the zone is unoccupied. Continuing to supply ventilation air, along with a fairly narrow set-back/set-up range (1°F above the maximum set point and 1°F below the minimum set point) is intended to minimize the pull-down time required when a zone goes occupied based on an occupancy sensor driven trigger.

Functional testing technique shall be used to fine tune the 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.

Zone Type 2 - Multiple Space, Single Zone Ducted IDU

This zone configuration applies to the following IUDs.

1. IDU-1.14 - Room 120 - Hallway, Room 124 - Break-out, Room 127 - Recovery Room, Room 128 - Restroom, Room 129 - Janitor's Closet, and Room 131 - Waste/Recycle

Zone Type 3 - Multiple Space, Multiple Zone Variable Air Volume (VAV) Ducted IDU

This zone configuration applies to the following IUDs.

1. IDU-1.5 - Room 140 - ERC, Room 141 - Break-out, Room 142 - Breakout and Room 143 - Conference
2. IDU-2.2 - Room 221 - Office, Room 222 - Office, Room 223 - Office, and Room 221 - Office
3. IDU-2.7 - Room 241 - Breakout, Room 242 - Office, Room 243 - Office, and Room 244 - Breakout

Zone Type 4 - Single Space, Single Zone Ceiling Cassette IDU

This zone configuration applies to the following IUDs.

1. IDU-1.6 - Room 144 - Lunch Room
2. IDU-2.5 - Room 231 - Conference
3. IDU-2.6 - Room 210 - Breakout

Zone Type 5 - Single Space, Single Zone, Multiple Ceiling Cassette IDUs

This zone configuration applies to the following IUDs.

1. IDU-2.4A - Room 230 - Conference
2. IDU-2.4B - Room 230 - Conference

Zone Type 6 - Single Space, Single Zone Wall Mounted IDU with Dedicated Exhaust

This zone configuration applies to the following IUDs.

1. IDU-1.15 - Room 130 - CCTV Workroom

Zone Type 7 - Single Space, Single Zone Wall Mounted IDU with a Heat Recovery Ventilator

This zone configuration applies to the following IUDs.

1. IDU-1.12 - Room 161 - Warehouse Office
2. IDU-1.13 - Room 164 - Tool Office

Zone Type 8 - Single Space, Single Zone Ducted IDU with Destratification Fans

This zone configuration applies to the following IUDs.

1. IDU-1.2 - Room 101 - Dispatch B
2. IDU-1.3 - Room 100 - Dispatch A

This

Zone Type 9 - Single Space, Single Zone, Ceiling Cassette IDU with a Dedicated Exhaust Fan and Hood and a Dedicated Make-up Air System, with Ventilation Air from a Heat Recovery Ventilator

This zone configuration applies to the following IUDs.

1. IDU-1.1 - Room 108 - Source Control Work Room

Zone Type 10 - Single Space, Single Zone Ducted IDU with Dedicated Exhaust

This zone configuration applies to the following IUDs.

1. IDU-1.9 - Room 152 - Women's Drying Room
2. IDU-1.11 - Room 153 - Men's Drying Room

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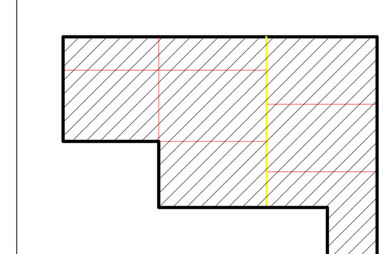

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SHEET TITLE
VRF System Sequence of Operation Part 6

SHEET NUMBER
MI.8.03-6