

**TERMINAL UNIT (RETURN) SEQUENCE OF OPERATION**

**RUN CONDITIONS**  
THE UNIT SHALL RUN CONTINUOUSLY TO MAINTAIN POSITIVE PRESSURE IN INTENSIVE CARE SUITE.  
**ALARMS SHALL BE PROVIDED AS FOLLOWS:**  
- ROOM PRESSURE: IF THE SPACE PRESSURE IS MORE OR LESS THAN THE SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.)  
**OCCUPIED MODE**  
- UNIT CONTROLLER WILL MODULATE ITS AIR DAMPER TO MAINTAIN OCCUPIED PRESSURE RELATIONSHIP PER DRAWINGS.  
**UNOCCUPIED MODE**  
- UNIT CONTROLLER WILL MODULATE ITS AIR DAMPER TO MAINTAIN UNOCCUPIED PRESSURE RELATIONSHIP PER DRAWINGS.

**BACK-UP CHILLER SYSTEM**

CRITICAL (XAC-7, XAC-8, XAC-9, AC-51, XAC-39, XAC-48)  
IF CHILLED WATER PLANT SHUTS DOWN, OUTSIDE AIR TEMPERATURE IS ABOVE 55°F (ADJ.) AND ENTERING WATER TEMPERATURE TO THE 5TH FLOOR CRITICAL AC UNITS RISES ABOVE 45°F (ADJ.), SEQUENCE EXISTING 5TH FLOOR CHANGEOVER VALVES TO DIVERT WATER FROM THE PLANT TO THE BACK-UP CHILLER. CHANGEOVER VALVES TO AC-48/AC-39 SHALL ALSO DIVERT WATER FROM THE PLANT TO THE BACK-UP CHILLER AFTER PROOF OF MINIMUM WATER FLOW (SEE ALSO MINIMUM CHILLER FLOW BELOW). ENERGIZE THE "BACK-UP" CHILLER. CHILLER FACTORY CONTROLS TO MAINTAIN 42°F (ADJ.) CHILLED WATER TO THE CRITICAL AIR HANDLING UNITS.

**AC-50, AC-51, AC-55 SEQUENCE OF OPERATION**

**I. OCCUPIED MODE:**  
**VENTILATION**  
THE OUTSIDE AIR DAMPER SHALL OPEN BEFORE FAN STARTS TO PROVIDE MINIMUM SCHEDULED OUTDOOR AIRFLOW.  
**SUPPLY FAN START/STOP:** THE SUPPLY FAN WILL BE STARTED ACCORDING TO THE SCHEDULE. IF THE SUPPLY FAN STATUS DOES NOT MATCH THE COMMANDED VALUE, AN ALARM WILL BE GENERATED.  
**VFD FAULT DETECTION/RESET:** IF THE SUPPLY FAN DOES NOT START, THE DDC SYSTEM SHALL WAIT 30 SECONDS (ADJ.) AND RE-ATTEMPT. IF THE VFD DOES NOT START AGAIN THE THIRD TIME, AN ALARM WILL BE GENERATED.  
**STATUS:** IF CURRENT STATUS SWITCH DOES NOT PROVE OPERATION, THE UNIT SHALL SHUT DOWN AND AN ALARM WILL BE GENERATED.  
**SPEED CONTROL:** THE SUPPLY FAN WILL MODULATE TO MAINTAIN A MINIMUM STATIC PRESSURE IN THE SUPPLY DUCTWORK. ON A DECREASE IN SYSTEM LOAD, THE DDC SYSTEM SHALL REDUCE THE SUPPLY DUCT DIFFERENTIAL STATIC PRESSURE UNTIL ONE TERMINAL AIR BOX DAMPER IS 90% OPEN. ON AN INCREASE IN SYSTEM LOAD, THE DDC SYSTEM SHALL INCREASE THE SUPPLY DUCT DIFFERENTIAL STATIC PRESSURE NOT TO EXCEED THE FINAL SETPOINT UNTIL ONE TERMINAL AIR BOX DAMPER IS 95% OPEN. COORDINATE SYSTEM AIRFLOW WITH TEST AND BALANCING CONTRACTOR.

**II. SHUTDOWN MODE:**  
WHEN THE UNIT IS SHUT DOWN BY EITHER A STOP COMMAND OR SYSTEM SAFETY THE UNIT WILL BE SET AS FOLLOWS:  
- SUPPLY FAN VFD WILL BE COMMANDED TO 0%  
- RETURN FAN VFD WILL BE COMMANDED TO 0%  
- RETURN FAN VFD WILL BE OFF  
- SUPPLY FAN VFD WILL BE OFF  
- HUMIDIFIER WILL BE OFF  
- HEATING COIL CONTROL VALVE(S) SHALL CLOSE. UNLESS OUTSIDE AIR TEMPERATURE IS BELOW 55°F THEN IT WILL REMAIN 10% OPEN.  
- COOLING COIL VALVES WILL CLOSE  
- ALL FIRE/SMOKE AND SMOKE DAMPERS ASSOCIATED WITH THE AIR HANDLING SYSTEM WILL CLOSE  
- UV LIGHTS WILL BE OFF

**III. UNOCCUPIED MODE:**  
**VENTILATION**  
THE OUTSIDE AIR DAMPER SHALL REMAIN OPEN TO PROVIDE THE SAME MINIMUM SCHEDULED OUTDOOR AIRFLOW AS OCCUPIED MODE.  
**SUPPLY AND RETURN FANS**  
FANS WILL MODULATE AS NECESSARY TO MAINTAIN THE SHARED NIGHT SETBACK ZONE PRESSURE SETPOINTS.  
**DISCHARGE AIR CONTROL**  
THE UNIT DISCHARGE AIR TEMPERATURE WILL RESET AS NECESSARY TO MAINTAIN THE SHARED NIGHT SETBACK ZONE TEMPERATURE SETPOINTS.

**IV. SAFETY MODES:**  
**GENERAL**  
ALL OF THE SAFETY DEVICES ARE MANUAL RESET. THE DEVICE THAT HAS TRIPPED MUST BE MANUALLY RESET BEFORE RESTARTING THE AIR HANDLING UNIT.  
**TEMPERATURE LOW LIMIT**  
IF TEMPERATURE FALLS BELOW SETPOINT THE SUPPLY AND RETURN FANS WILL BE SHUT DOWN. THE OUTDOOR AIR DAMPER SHALL CLOSE, AND STEAM VALVE COMMANDED 100% OPEN.  
**SMOKE ALARM:** THE SUPPLY AND RETURN FANS WILL SHUT DOWN.  
**DISCHARGE AIR TEMPERATURE LIMITS:** IF MORE THAN 9°F (ADJ.) ABOVE OR BELOW THE SETPOINT, AN ALARM WILL BE GENERATED.  
**DUCTWORK HIGH STATIC PRESSURE:** IF THE DIFFERENTIAL PRESSURE SWITCH SENSES A DISCHARGE PRESSURE THAT IS GREATER THAN SETPOINT, THE FAN SHALL BE SHUT DOWN.  
**DUCTWORK LOW STATIC PRESSURE:** IF THE DIFFERENTIAL PRESSURE SWITCH SENSES A DISCHARGE PRESSURE THAT IS LESS THAN SETPOINT, THE FAN SHALL BE SHUT DOWN.  
**DDC SYSTEM SHALL MONITOR THE STATUS OF THE DIFFERENTIAL PRESSURE SWITCH.**  
**DISCHARGE AIR TEMPERATURE:** IF THE DIFFERENTIAL PRESSURE SWITCH SENSES A DISCHARGE PRESSURE THAT IS GREATER THAN SETPOINT, THE FAN SHALL BE SHUT DOWN.  
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**UPS PROTECTION: SEQUENCE OF OPERATION**

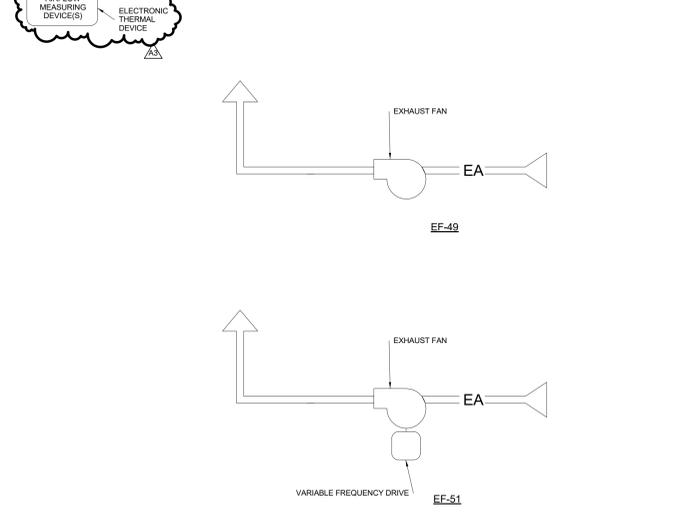
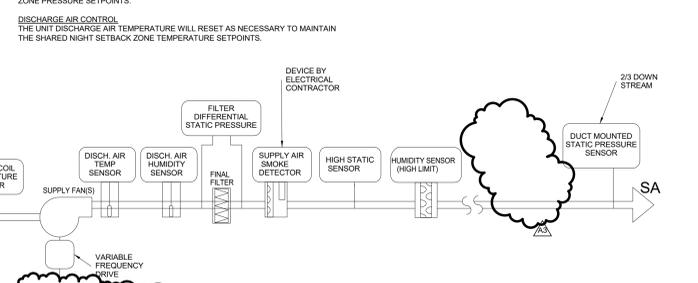
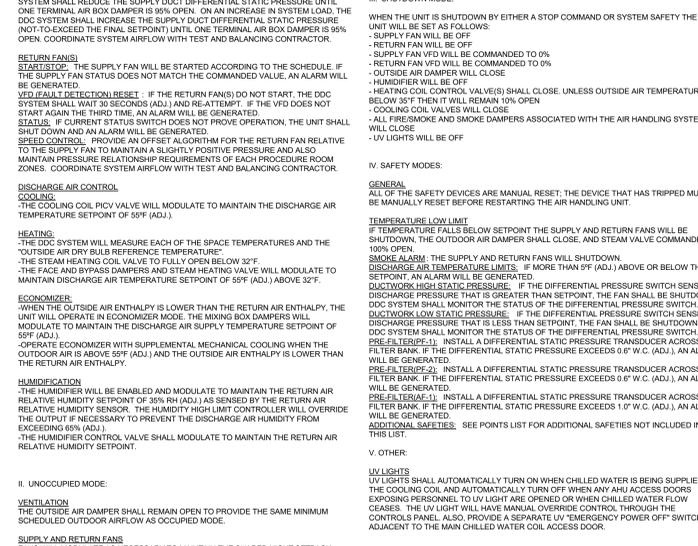
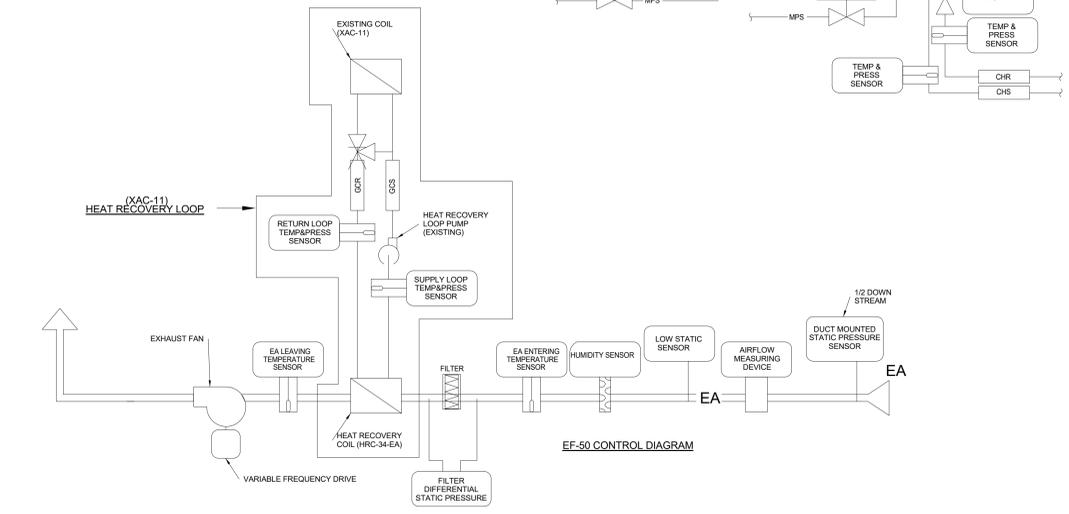
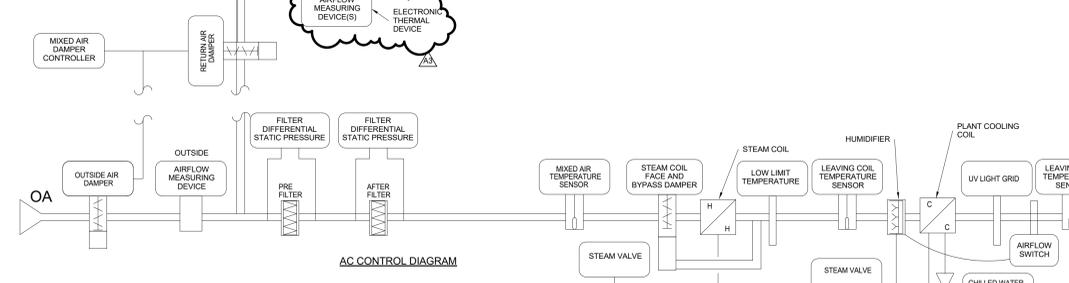
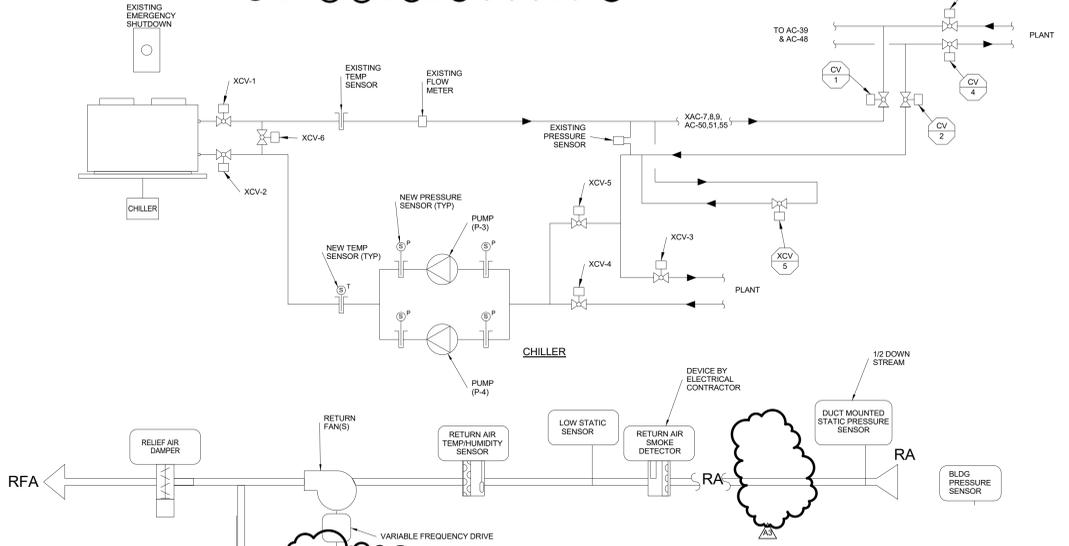
MONITOR MOISTURE SENSOR ROPE AT NEW CONTAINMENT DRIP PAN ABOVE EXISTING UPS GROUPS ON THE 5TH FLOOR INTERSTITIAL.  
**HEAT RECOVERY LOOP SEQUENCE OF OPERATION**  
THE CONTROLLER SHALL ENERGIZE AND MODULATE LOOP PUMP FOR ENERGY RECOVERY AS FOLLOWS:  
**COOLING RECOVERY MODE:** THE LOOP PUMP SHALL RUN CONTINUOUSLY. THE CONTROLLER SHALL MEASURE THE DISCHARGE AIR TEMPERATURE (DOWNSTREAM OF THE OUTSIDE AIR COIL) AND MODULATE THE RUN-AROUND LOOP PUMP TO MAINTAIN A SETPOINT OF 2°F (ADJ.) LESS THAN THE UNIT SUPPLY AIR TEMPERATURE SETPOINT. THE RUN-AROUND LOOP SHALL RUN FOR COOL RECOVERY WHENEVER:  
A) EXHAUST AIR TEMPERATURE (EF-3) IS 5°F (ADJ.) OR MORE BELOW THE OUTSIDE AIR TEMPERATURE.  
B) AND THE UNIT IS IN A COOLING MODE.  
C) AND THE SUPPLY FAN IS ON.  
**HEATING RECOVERY MODE:** THE LOOP PUMP SHALL RUN CONTINUOUSLY. THE CONTROLLER SHALL MEASURE THE DISCHARGE AIR TEMPERATURE (DOWNSTREAM OF THE OUTSIDE AIR COIL) AND MODULATE THE RUN-AROUND LOOP PUMP TO MAINTAIN A SETPOINT OF 2°F (ADJ.) GREATER THAN THE UNIT SUPPLY AIR TEMPERATURE SETPOINT. THE RUN-AROUND LOOP SHALL RUN FOR HEAT RECOVERY WHENEVER:  
A) EXHAUST AIR TEMPERATURE (EF-3) IS 5°F (ADJ.) OR MORE ABOVE THE OUTSIDE AIR TEMPERATURE.  
B) AND THE UNIT IS IN A HEATING MODE.  
C) AND THE SUPPLY FAN IS ON.

**FROST PROTECTION:** THE LOOP PUMP SHALL RUN AT 100% IN ORDER TO CIRCULATE WATER THROUGH THE EXHAUST AIR COIL WHENEVER:  
A) LOOP TEMPERATURE DROPS BELOW 33°F (ADJ.)  
B) OR THE EXHAUST AIR TEMPERATURE DROPS BELOW 30°F (ADJ.) ALARMS SHALL BE PROVIDED AS FOLLOWS:  
I) LOOP PUMP FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.  
II) LOOP PUMP IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.  
III) LOOP PUMP RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).

**EXHAUST FAN (VFD) SEQUENCE OF OPERATION**  
**START/STOP:** THE EXHAUST FAN WILL BE STARTED ACCORDING TO THE SCHEDULE. IF THE EXHAUST FAN STATUS DOES NOT MATCH THE COMMANDED VALUE, AN ALARM WILL BE GENERATED.  
**VFD FAULT DETECTION/RESET:** IF THE EXHAUST FAN DOES NOT START, THE DDC SYSTEM SHALL WAIT 30 SECONDS (ADJ.) AND RE-ATTEMPT. IF THE VFD DOES NOT START AGAIN THE THIRD TIME, AN ALARM WILL BE GENERATED.  
**STATUS:** IF CURRENT STATUS SWITCH DOES NOT PROVE OPERATION, THE UNIT SHALL SHUT DOWN AND AN ALARM WILL BE GENERATED.  
**SPEED CONTROL:** EXHAUST FAN TO MAINTAIN SCHEDULED AIRFLOW.

**UPS CONTAINMENT PAN LEAK DETECTION**  
LEAK DETECTORS SHALL BE CONNECTED TO DDC SYSTEM TO PROVIDE IMMEDIATE ALARM NOTIFICATION INDICATING PROBLEM AND LOCATION.  
**5TH AND 6TH FLOOR PRESSURIZATION**  
LEAK DETECTORS SHALL BE CONNECTED TO DDC SYSTEM TO PROVIDE IMMEDIATE ALARM NOTIFICATION INDICATING PROBLEM AND LOCATION.

**VFDs HAVE BEEN PURCHASED FOR AC-50 AND AC-51 ONLY.**  
**COORDINATE ALL SEQUENCE OF OPERATIONS WITH TEST AND BALANCING CONTRACTOR.**



POINT ID	POINT LEGEND	SYSTEM OUTPUTS		SYSTEM INPUTS		SYSTEM SOFTWARE/CONTROL		PAGE
		BINARY	ANALOG	BINARY	ANALOG	ALARM PROCESSING	APPLICATION/FUNCTION	
AC-50	Return Air Temperature	AI						
AC-50	Return Air Humidity	AI						
AC-50	Return Air Flow (cfm)	AI						
AC-50	Mixed Air Temperature	AI						
AC-50	Pre-Heat Coil Temperature	AI						
AC-50	Cooling Coil Temperature	AI						
AC-50	Discharge Air Temperature	AI						
AC-50	Discharge Static Pressure	AI						
AC-50	Supply Air Flow (cfm)	AI						
AC-50	Mixed Air Low Limit	AI						
AC-50	OUTSIDE AIR TEMPERATURE	AI						
AC-50	RETURN LOW PRESSURE	BI						
AC-50	RETURN FAN STATUS	BI						
AC-50	SUPPLY FAN STATUS	BI						
AC-50	MIXED AIR LOW LIMIT	BI						
AC-50	SUPPLY PRESSURE HIGH LIMIT	BI						
AC-50	SUPPLY FAN VFD ALARM	BI						
AC-50	RETURN FAN VFD ALARM	BI						
AC-50	PRE-FINAL FILTER STATUS	BI						
AC-50	SMOKE DETECTOR STATUS	BI						
AC-50	AHU ACCESS DOORS STATUS	BI						
AC-50	RETURN FAN VFD SPEED	AO						
AC-50	SUPPLY FAN VFD SPEED	AO						
AC-50	OUTSIDE AIR DAMPER	AO						
AC-50	RETURN AIR DAMPER	AO						
AC-50	RELIEF AIR DAMPER	AO						
AC-50	STEAM HEAT VALVE	AO						
AC-50	PRE-HEAT FACE & BYPASS	AO						
AC-50	COOLING VALVE	AO						
AC-50	STEAM HUMIDIFIER VALVE	AO						
AC-50	RETURN FAN START/STOP	BO						
AC-50	SUPPLY FAN START/STOP	BO						
AC-50	UV LIGHTS	BO						
AC-50	BUILDING PRESSURE	BI						
AC-50	CHR Temp & Press	AI						
AC-50	CHR Temp & Press	AI						
AC-50	CHANGEOVER CONTROL VALVES	AO						
AC-50	CONTROL VALVES (EXISTING)	AO						
AC-50	EXHAUST FAN (EF-49)	BO						
AC-50	Exhaust Fan Start/Stop	BO						
AC-50	Exhaust Fan Status	BI						
AC-50	EXHAUST FAN (EF-50,51)	BO						
AC-50	Exhaust Fan Start/Stop	BO						
AC-50	Exhaust Fan Status	BI						
AC-50	VFD Alarm/Status	BI						
AC-50	HEAT RECOVERY LOOP (EF-50, XAC-11)	AI						
AC-50	Exhaust Air Temperature (EF-3)	AI						
AC-50	Exhaust Air Humidity (EF-3)	AI						
AC-50	EA Recovery Coil LAT	AI						
AC-50	Exhaust Air Flow Status	BI						
AC-50	TERMINAL UNIT (RETURN ON 5TH AND 6TH FLOORS)	AI						
AC-50	Airflow (cfm)	AI						
AC-50	Space Pressure	AI						
AC-50	Air Valve	AO						
AC-50	Supply Loop Air Flow (cfm)	AI						

Revisions:	Date
AMENDMENT A0003	06/01/16

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**Drawing Title:** MECHANICAL CONTROL DIAGRAMS AND POINT LISTS  
Approved: Associate Director Approved: Chief Engineer  
Approved: Chief of Staff Approved: Safety Officer  
Approved: Infection Control Approved: Chief, Police & Security

**Project Title:** FCA-Upgrade Air Handling Units/Systems  
Project Number: 657-15-101JC  
Building Number: 01  
Drawing Number: 1-2BI-M-505

**Location:** V.A.M.C. ST. LOUIS, MO JOHN COCHRAN DIVISION  
Date: 02/24/16  
Checked: SSC  
Drawn: Author

**BID DOCUMENTS**  
Veterans Health Administration  
Department of Veterans Affairs