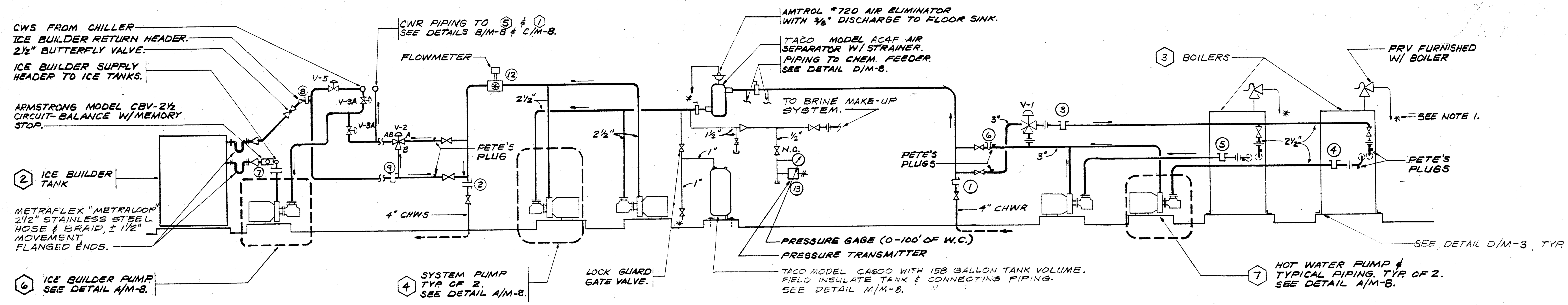


CENTRAL SYSTEM PIPING AND FLOW DIAGRAM

DETAIL (A / M-3)

DIAGRAMMATIC

NOTES:

1. PIPING SYMBOLIZED WITH * INDICATES PIPING TO BE ROUTED DOWN TO NEAREST FLOOR SURFACE + 6". PIPING SO ROUTED FROM PRESSURE RELIEF VALVES SHALL BE FULL SIZE AND SHALL BE SUPPORTED INDEPENDENTLY SO THAT NO WEIGHT IS APPLIED TO THE PRV.

2. MANUAL FILL VALVE WITH LABEL TO READ: "MANUAL FILL VALVE IS ONLY TO BE USED TO FILL SYSTEM UPON START-UP OR LOSS OF SYSTEM FLUID AS DETERMINED BY SYSTEM PRESSURE. VALVE SHALL BE LEFT IN THE NORMALLY CLOSED POSITION."

CENTRAL PLANT HEATING AND COOLING SEQUENCE OF OPERATION

HEATING

THE LEAD BOILER AND PUMP START AS A FUNCTION OF THE "EMS/CPU" (ENERGY MANAGEMENT SYSTEM CENTRAL PROCESSING UNIT) WHICH IS PROGRAMMED TO CONSIDER TIME OF DAY AND OUTSIDE AIR TEMPERATURE (BELOW 65°). THE BOILER WILL NOT START UNTIL FLOW HAS BEEN ESTABLISHED THROUGH THE BOILER FLOW SWITCH. THE EMS/CPU WILL MONITOR THE LEAVING AND ENTERING WATER TEMPERATURES TO THE BOILER AND WILL PROVIDE A STRAIGHT-LINE HOT WATER RESET: WHEN THE O.A. IS 30°, THE HWS TEMPERATURE SHALL BE 160°; AND WHEN THE O.A. IS 65°, THE HWS TEMPERATURE SHALL BE 140°. THE EMS/CPU SHALL BE PROGRAMMED SO THAT AN INLET TEMPERATURE OF LESS THAN 60° (SOFTWARE ADJUSTABLE) TO THE BOILER WILL CAUSE THE "BOILER LOOP MIXING VALVE", V-1 TO MODULATE OPEN AND BYPASS SUPPLY HOT WATER DIRECTLY BACK TO THE RETURN. THE BOILER PUMP WILL STAY ON FOR A MINIMUM OF 5 MINUTES AFTER THE BOILER HAS SHUT OFF (AS DETERMINED BY TEMPERATURE DIFFERENCE ACROSS THE BOILER), TYPICAL OF THE LEAD AND LAG BOILERS.

THE LAG BOILER AND PUMP WILL START WHEN THE SYSTEM HEATING DEMAND BTUH'S EQUALS 90% OF THE BOILER OUTPUT CAPACITY AND WILL SHUT OFF AT 75% CAPACITY OF ONE BOILER. A TIME DELAY ON THE LAG BOILER WILL ALLOW THE LEAD BOILER A 30 MINUTE HEAD START TO BRING THE SYSTEM UP TO 90% CAPACITY DURING MORNING WARMUP.

COOLING

COOLING FROM THE CENTRAL SYSTEM CAN BE SUPPLIED UNDER ANY ONE OF THREE DIFFERENT MODES: 1) CHILLER ONLY, 2) ICE TANKS ONLY, AND 3) A COMBINATION OF BOTH. COOLING IS INITIATED BY OUTDOOR AIR TEMPERATURE AND BUILDING LOAD, BUT THE PARTICULAR MODE TO BE USED IS PRIMARILY DETERMINED BY TIME-OF-DAY AS ESTABLISHED BY THE PG&E RATE SCHEDULE, A-11, TIME-OF-USE METERING.

THE INTENT OF THE SYSTEM DESIGN IS OPTIMIZE COOLING PERFORMANCE BY:

1. NOT ALLOWING THE CHILLER AND CHILLER PUMP TO START DURING "ON-PEAK" HOURS AS DEFINED BY PG&E RATE STRUCTURE A-11.
2. RUNNING THE CHILLER AT FULL-LOAD DURING "OFF-PEAK" HOURS TO MAXIMIZE TANK CHARGING.
3. MINIMIZE CHILLER USAGE THE NEXT DAY DURING "PARTIAL-PEAK" HOURS BY USING UP STORED ICE FROM THE NIGHT BEFORE. SOME OPERATION DURING "PARTIAL-PEAK" HOURS WILL OCCUR BUT IN NO CASE SHOULD THE ICE STORAGE CAPACITY AT THE END OF THE DAY EXCEED 20% OF TOTAL STORAGE CAPACITY.
4. ALLOW SCHOOL PERSONNEL TO INTERACT WITH THE LOCAL EMS/CPU FOR SPECIAL PROGRAMMING THAT MAY BE REQUIRED ON ANY PARTICULAR DAY.

WHEN THE OUTSIDE AIR SENSOR SENSES A TEMPERATURE ABOVE 75°, THE CHILLED WATER PUMP, MARK 2, WILL START. WHEN FLOW HAS BEEN ESTABLISHED THROUGH THE CHILLED WATER LOOP FLOW SWITCH, THE AIR COOLED CHILLER WILL BE ABLE TO START UPON A SIGNAL FROM THE EMS/CPU.

A MIXING VALVE PLACED IN THE CHILLED WATER LOOP WILL BE CONTROLLED BY THE EMS/CPU AND WILL BYPASS SUPPLY WATER DIRECTLY BACK TO THE RETURN SO THAT WATER TEMPERATURE ENTERING THE CHILLER DOES NOT EXCEED 80°. IF THE SYSTEM WATER TEMPERATURE IS BELOW 80°, THE VALVE WILL BE FULLY OPEN. THE CHILLED WATER PUMP SHALL STAY ON AN ADDITIONAL 5 MINUTES AFTER SHUTDOWN OF THE CHILLER.

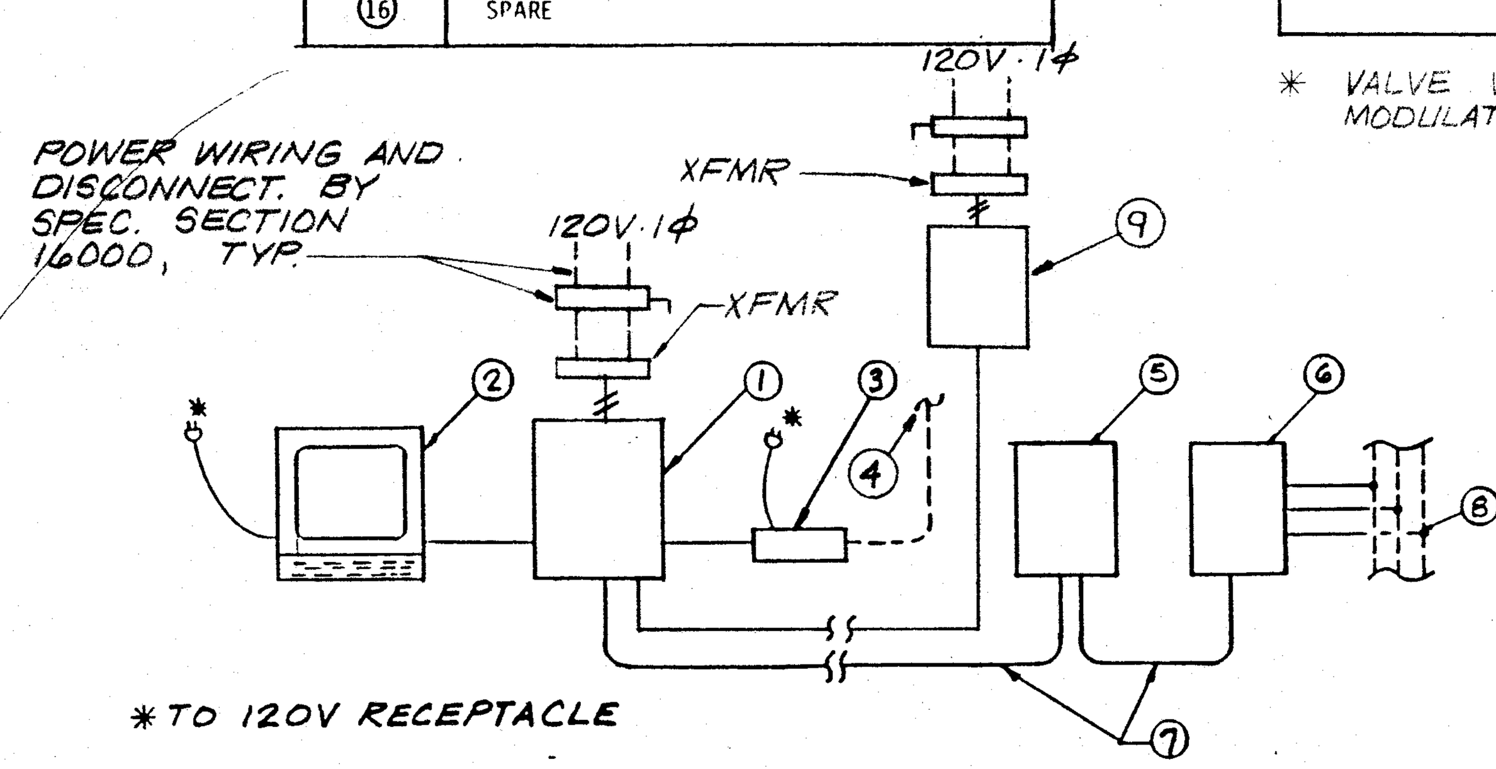
THE SYSTEM PUMP, MARK 4, WILL BE DIRECTED TO START BY THE EMS/CPU UPON A CALL FOR EITHER HEATING OR COOLING. IT WILL STAY ON FOR THE DURATION OF THE DAY AND WILL STAY ON AN ADDITIONAL 5 MINUTES AT THE END OF THE DAY TO MATCH THE DELAY OF THE BOILER OR CHILLER LOOP PUMP. THE SECOND SYSTEM PUMP, ALSO MARK 4, WILL COME ON AT ANY TIME DURING THE DAY AS REQUIRED BY THE COOLING OR HEATING "BTUH" REQUIREMENTS OF THE SYSTEM.

SYSTEM LOOP PRESSURIZATION

A SYSTEM PRESSURE TRANSMITTER IS LOCATED IN THE LOOP PIPING TO SENSE SYSTEM PRESSURIZATION. SYSTEM PRESSURE SHALL BE NOTED AND RECORDED AT LOOP WATER TEMPERATURE OF APPROXIMATELY 60°. THE SYSTEM PRESSURE SHALL BE CHECKED EACH MORNING, PRIOR TO STARTUP, BY THE EMS/CPU. IF SYSTEM PRESSURE SHOULD FALL MORE THAN 15% BELOW THIS INITIAL VALUE, THE EMS/CPU SHALL ISSUE A WARNING MESSAGE: "SYSTEM PRESSURE IS xx % BELOW INITIAL FILL VALUE. POSSIBLE SYSTEM LEAK. SYSTEM LOOP MAY NEED TO BE MANUALLY REFILLED AND GLYCOL LEVEL RECHECKED."

INPUT CONTROL POINT SCHEDULE

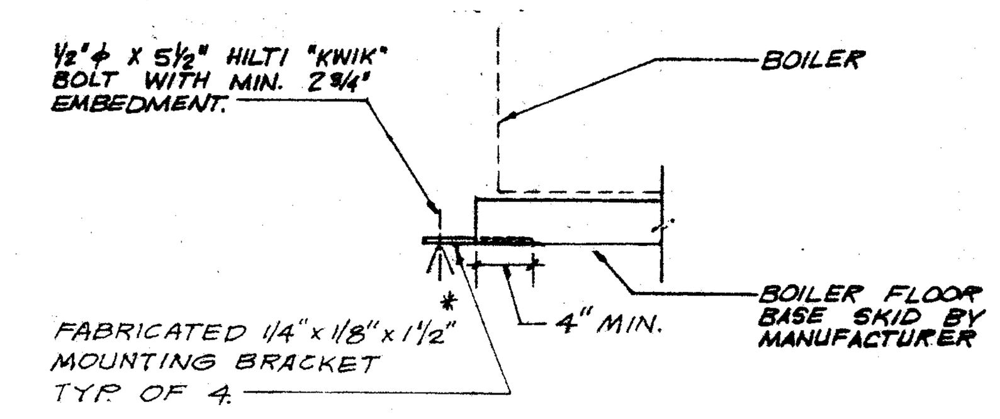
INPUT POINT #	DESCRIPTION OF CONTROL POINT
1	SYSTEM RETURN WATER TEMPERATURE
2	SYSTEM SUPPLY WATER TEMPERATURE
3	WATER TEMPERATURE ENTERING BOILER(S)
4	WATER TEMPERATURE LEAVING BOILER #1
5	WATER TEMPERATURE LEAVING BOILER #2
6	HOT WATER TEMPERATURE SUPPLY TO MAIN LOOP
7	WATER TEMPERATURE ENTERING ICE BANK
8	WATER TEMPERATURE LEAVING ICE BANK
9	CHILLED WATER LOOP SUPPLY TEMPERATURE
10	WATER TEMPERATURE ENTERING CHILLER
11	WATER TEMPERATURE LEAVING CHILLER
12	SYSTEM LOOP FLOWMETER
13	SYSTEM LOOP PRESSURE
14	OUTSIDE AIR SENSOR
15	PULSE RESET SWITCH FROM UTILITY METER
16	SPARE



"EMS" SINGLE LINE DIAGRAM

DIAGRAMMATIC

DETAIL (B / M-3)



BOILER ANCHORAGE

DETAIL (D / M-3)

NO SCALE

NOTE:
TO PROVIDE SNUG FIT IN BOILER BASE SKID.

COOLING CONTROL SCHEDULE

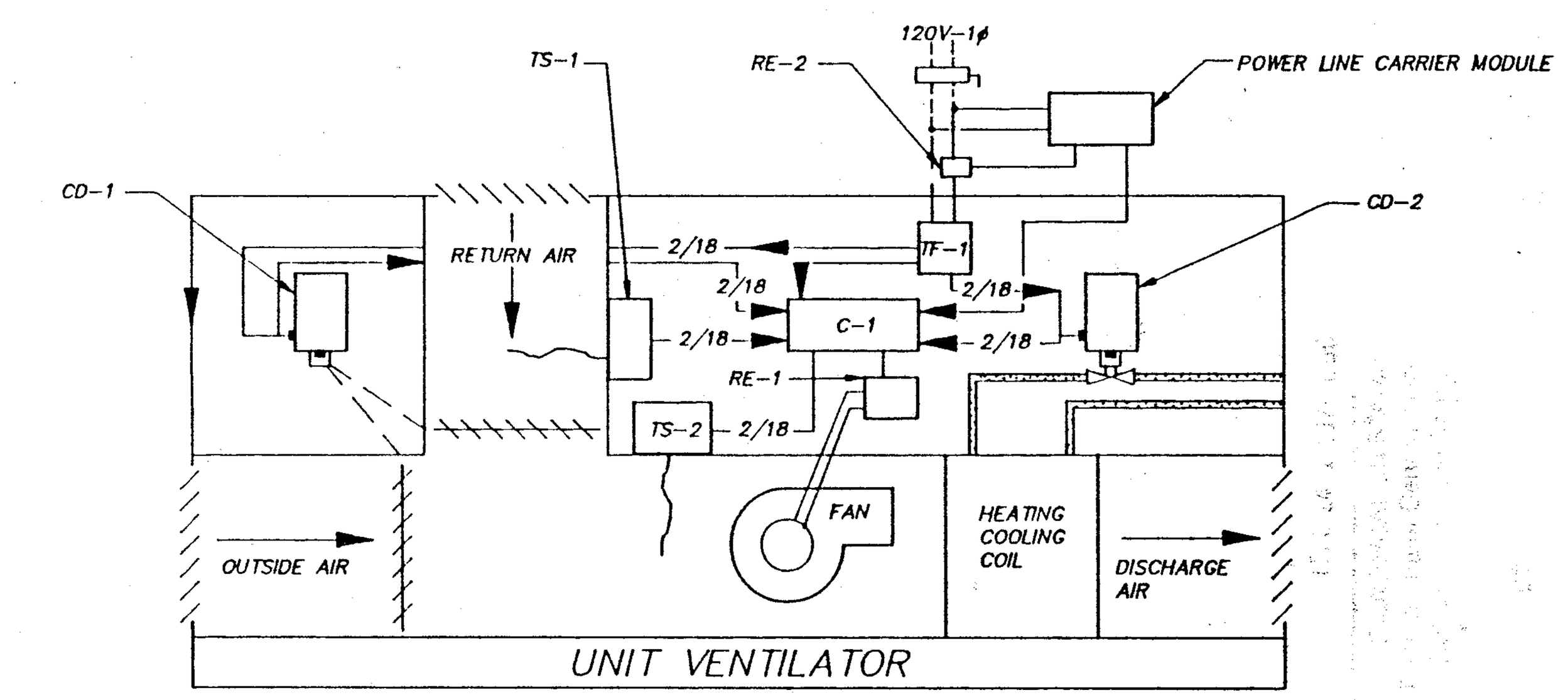
COOLING MODE	VALVE V-2 A	VALVE V-2 B	VALVE V-3* A	VALVE V-3* B	VALVE V-5	PUMPS: 6 ICE BUILDER	PUMPS: 4 SYSTEM	PUMPS: 5 CHILLER
CHILLER ONLY COOLING	OP	CL	CL	OP	OP	OFF	ON	ON
ICE BUILDER ONLY COOLING	MOD	MOD	CL	OP	CL	ON	ON	OFF
ICE BUILDING MODE	CL	OP	OP	CL	CL	ON	OFF	ON
CHILLER & ICE BUILDER COOLING	MOD	MOD	CL	MOD	OP	ON	ON	ON

* VALVE V-3 CONSISTS OF 2 INDEPENDENTLY CONTROLLED 2-WAY MODULATING VALVES.

NOTES FOR DETAIL B/M-3:

1. BARBER-COLMAN NETWORK 8000 MODEL GCM-84211 "GLOBAL CONTROL MODULE".
2. DUMB TERMINAL CONSISTING OF MONOCHROME SCREEN VIEWING TERMINAL AND KEYBOARD; WYSE-85. CONNECT TO (1).
3. 1200 BAUD EXTERNAL MODEM CONNECTING TO (1) VIA RS-232 CONNECTION.
4. DEDICATED TELEPHONE LINE TO BE FURNISHED BY OWNER, INCLUDING ALL CONNECTION COSTS.
5. BARBER-COLMAN MODEL GCS 81000 POWER LINE CARRIER COMMAND SYNTHESIZER FURNISHED UNDER SPECIFICATION SECTION 15900. INSTALL AT LOCATION TO PROVIDE BEST SIGNAL DISTRIBUTION.

   NOTE! CONTRACTOR FURNISHING POWER LINE CARRIER EQUIPMENT SHALL COORDINATE THE INSTALLATION WITH LIGHT DIMMING SYSTEM AS SPECIFICIED ON THE ELECTRICAL PLANS AND PROVIDE EQUIPMENT THAT WILL NOT BE AFFECTED BY SIGNALS GENERATED THROUGH THE LIGHT DIMMING SYSTEM.
6. BARBER-COLMAN COMMAND TRANSMITTER RECIEVER.
7. INTERCONNECTING WIRING BETWEEN GLOBAL CONTROL MODULE AND POWER LINE CARRIER COMMAND SYNTHESIZER BY SPECIFICATION SECTION 15900.
8. EXISTING A.C. WIRING.
9. BARBER-COLEMAN NETWORK 8000 LCM CONTROLLER AT MECHANICAL EQUIPMENT ENCLOSURE.



LEGEND

NO.	DESCRIPTION	REQ'D.	B-C PART NO.
C-1	DUAL SETPOINT PROGRAMMABLE CONTROLLER	1	CP-8261-333/702
TS-1	ROOM TEMPERATURE SENSOR (1K BALCO @ 70° F)	1	TS-8000 SERIES
TS-2	MIXED AIR LOW LIMIT SENSOR (1K BALCO @ 70° F)	1	TS-8000 SERIES
RE-1	FAN SPEED RELAY	1	AE-900
C/D-1	DAMPER ACTUATOR (24 VAC HYDRAULIC)	1	MP-5433
C/D-2	VALVE ACTUATOR (24VAC HYDRAULIC WITH AV-601 EXTENSION)	1	MP-5413/AV-601
TF-1	24 VAC, 50 VA TRANSFORMER	1	AE-201
R1	2.2 MEG., ±5%, 1/4 W, MF, TC=200? RESISTOR	1	40-1846
R2	56.2K, ±1%, 1/8 W, MF, TC=100 RESISTOR	1	CYZR-932-165
RE-2	START RELAY	1	AE-900

8, 9 UNIT VENTILATOR 10, 11 FAN COIL CONTROL DIAGRAM

DETAIL (C / M-3)

FAN COIL SEQUENCE OF OPERATION

FAN COIL CONTROLS AND SEQUENCE OF OPERATION SIMILAR TO UNIT VENTILATOR: PROVIDE WALL MOUNTED TEMPERATURE CONTROLS IN LIEU OF CABINET MOUNTED FOR ROOM TEMPERATURE SENSING. OMIT ECONMIZER CONTROLS. SET MINIMUM O.A. AS INDICATED ON PLANS.

UNIT VENTILATOR SEQUENCE OF OPERATION

THE UNIT VENTILATORS ARE STARTED AND STOPPED BY GROUPS (WINGS, USE, ETC.) FROM THE ENERGY MANAGEMENT SYSTEM/CENTRAL PROCESSING UNIT (EMS/CPU). THE START-STOP SIGNAL SHALL BE SENT VIA POWER LINE CARRIER TO RECEIVING MODULES AT THE UNIT VENTILATORS. THE CENTRAL PLANT SHALL BE IN OPERATION WHENEVER A GROUP OF UNIT VENTILATORS IS IN OPERATION.

A SOLID STATE SENSOR LOCATED IN THE UNIT VENTILATOR SAMPLING CHAMBER (SAMPLING CHAMBER PROVIDED AS AN INTEGRAL PART OF THE UNIT VENTILATOR) SHALL INPUT TO A DUAL SET-POINT CONTROLLER; HEATING SET AT 70° AND COOLING SET AT 78°. EACH SET-POINT SHALL BE ADJUSTABLE OVER A RANGE OF 45-75 DEGREES FOR HEATING AND 40-90 DEGREES FOR COOLING. SET-POINTS ARE FACTORY SET WITH A FIELD ADJUSTABLE THROTTLING RANGE.

A MIXED AIR LOW-LIMIT SENSOR (LOCATED IN THE UNIT VENTILATOR MIXED AIR) SHALL INPUT TO THE UNIT CONTROLLER AND PROVIDE AN ADJUSTABLE SET-POINT FROM 40-90 DEGREES. FACTORY SET TO 60° AND ADJUSTABLE MINIMUM SET-POINT TO 20% OUTSIDE AIR.

HEATING MODE (ASHRAE CYCLE I):

WHEN THE SAMPLING CHAMBER TEMPERATURE IS BELOW THE HEATING SET-POINT THE OUTSIDE AIR DAMPER IS CLOSED, THE RETURN AIR DAMPER IS OPEN AND THE COIL VALVE IS OPEN. AS THE TEMPERATURE RISES TOWARD SET-POINT (THROTTLING RANGE 3°) THE OUTSIDE AIR DAMPER OPENS TO THE ADJUSTABLE MINIMUM POSITION AND THE COIL VALVE BEGINS TO MODULATE CLOSED. AT SET-POINT THE OUTSIDE AIR DAMPER IS AT MINIMUM AND THE COIL VALVE IS CLOSED. AS THE TEMPERATURE CONTINUES TO RISE THE OUTSIDE AIR DAMPER MODULATES OPEN. THE LEAVING AIR TEMPERATURE FROM THE UNIT VENTILATOR IS LIMITED TO A MINIMUM OF 60° (ADJUSTABLE) BY THE LOW LIMIT SENSOR AND CONTROLLER SET-POINT.

COOLING MODE (ASHRAE CYCLE I):

WHEN THE SAMPLING CHAMBER SET-POINT IS ABOVE THE COOLING SET-POINT, THE OUTSIDE AIR DAMPER CLOSES TO THE MINIMUM POSITION AND THE COIL VALVE MODULATES OPEN. THE THROTTLING RANGE ON COOLING START-UP IS 4 DEGREES.

HEATING/COOLING MODE SELECTION:

THE UNIT VENTILATOR HEATING OR COOLING MODE IS SELECTED FROM THE SIGNAL FROM THE "EMS/CPU" TO EACH UNIT VENTILATOR CONTROLLER. THE UNIT CONTROLLER SHALL BE IN THE HEATING MODE UNTIL THE SYSTEM LOOP WATER TEMPERATURE IS LESS THAN 60 DEGREES.

ONCE STARTED, THE UNIT VENTILATOR FAN SHALL RUN CONTINUOUSLY UNTIL SHUT OFF BY THE "EMS/CPU". THE FAN WILL OPERATE AT HIGH SPEED WHEN THE UNIT CONTROLLER CALLS FOR HEATING OR COOLING, BUT WILL STEP DOWN TO LOW SPEED WHEN ROOM TEMPERATURE IS IN THE "DEAD BAND" REGION. WHEN THE UNIT VENTILATOR IS TURNED OFF FROM THE "EMS/CPU", THE COIL VALVE AND THE OUTSIDE AIR DAMPER SHALL CLOSE TO CONSERVE ENERGY.

DESIGNATED UNIT VENTILATOR:

⊛ DENOTES A UNIT VENTILATOR (ONE PER WING) THAT CONTAINS A ROOM SENSOR FOR TEMPERATURE FEEDBACK TO THE "EMS/CPU". THIS TEMPERATURE WILL WORK IN CONJUNCTION WITH OUTSIDE AIR TEMPERATURE FOR OPTIMAL START DURING BUILDING WARMUP.

⊛ ⊛ DENOTES AN "END-OF-LINE" UNIT VENTILATOR WITH THE SENSOR AS DESCRIBED ABOVE AND A 3-WAY CONTROL VALVE FOR BYPASSING WATER WHEN THE VALVE IS CLOSED TO THE COIL.

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revisions

MUNSEY SCHOOL MODERNIZATION
BAKERSFIELD CITY SCHOOL DISTRICT
BAKERSFIELD, CALIFORNIA

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