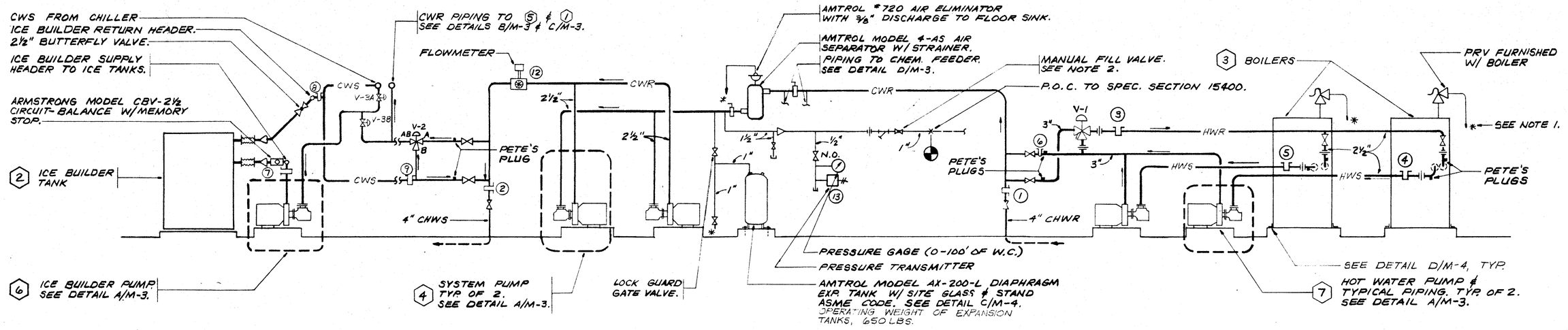
COOLING CONTROL SCHEDULE							
COOLING MODE	VALVE V-2		VALVE V-3*		PUMPS		
	A	B	A	B	⑤ CHILLER	⑥ ICE BUILDER	④ SYSTEM
CHILLER ONLY COOLING	OP	CL	CL	OP	ON	OFF	ON
ICE BUILDER ONLY COOLING	MOD	MOD	CL	OP	OFF	ON	ON
ICE BUILDING MODE	CL	OP	OP	CL	ON	ON	OFF
CHILLER & ICE BUILDER COOLING	MOD	MOD	CL	MOD	ON	ON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

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



CENTRAL SYSTEM PIPING AND FLOW DIAGRAM

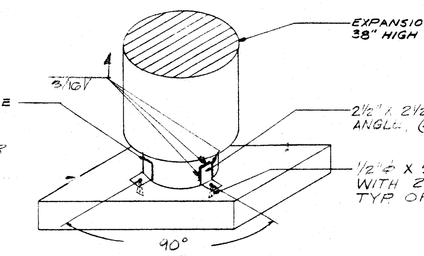
DETAIL B/M-4

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."

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



EXPANSION TANK MOUNTING

DETAIL C/M-4

NO SCALE

CONSULTANTS

FRANK MITCHELL M12910 Expires 9/1/90
JOHN FRANK MITCHELL, INC.
CONSULTING MECHANICAL ENGINEERS
PHONE 275-3299 4644 WEST JEFFERSON, SUITE 107 FRESNO, CALIFORNIA 93722

PROJECT

BAKERSFIELD CITY SCHOOL DISTRICT

FREMONT ELEMENTARY SCHOOL MODERNIZATION

THE ABOVE DRAWINGS AND SPECIFICATIONS AND IDEAS, DESIGNS AND ARRANGEMENTS REPRESENTED THEREBY ARE AND SHALL REMAIN THE PROPERTY OF THE ARCHITECT AND NO PART THEREOF SHALL BE COPIED, DISCLOSED TO OTHERS OR USED IN CONNECTION WITH ANY WORK OR PROJECT OTHER THAN THE SPECIFIC PROJECT FOR WHICH THEY HAVE BEEN PREPARED AND DEVELOPED WITHOUT THE WRITTEN CONSENT OF THE ARCHITECT. VISUAL CONTACT WITH THESE DRAWINGS OR SPECIFICATIONS SHALL CONSTITUTE CONCLUSIVE EVIDENCE OF ACCEPTANCE OF THESE RESTRICTIONS.

WRITTEN DIMENSIONS ON THESE DRAWINGS SHALL HAVE PRECEDENCE OVER SCALED DIMENSION. CONTRACTORS SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS AND CONDITIONS ON THE JOB AND THIS OFFICE MUST BE NOTIFIED OF ANY VARIATIONS FROM THE DIMENSIONS AND CONDITIONS SHOWN BY THESE DRAWINGS. SHOP DETAILS MUST BE SUBMITTED TO THIS OFFICE FOR APPROVAL BEFORE PROCEEDING WITH FABRICATION.

RENFRO RUSSELL & ASSOCIATES
Architecture • Engineering • Interior Design/Space Planning
Donald W. Renfro AIA C 5283
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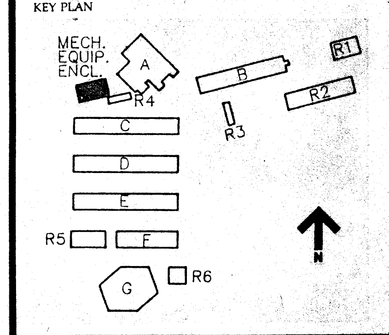
KEY PLAN



BAKERSFIELD CITY SCHOOL DISTRICT BOARD OF EDUCATION	
DATE	APPROVED
DATE	ISSUED FOR
9.3.91	BIDDING
DATE	REVISIONS

SHEET TITLE

MECHANICAL EQUIP. AREA SYSTEM PIPING DIAGRAM & CONTROLS

APPROVED/ARCHITECT Tommy W. Russell
CHECKED JFM DATE 8-1-89
DRAWN BY MJB PROJECT NO. 86-216 FM

SHEET NUMBER

M - 4

OF 7 SHEETS

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 100°. 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."

PACKAGE UNIT CONTROL TYP. FOR STAGE, ADMIN., TEACHERS LOUNGE

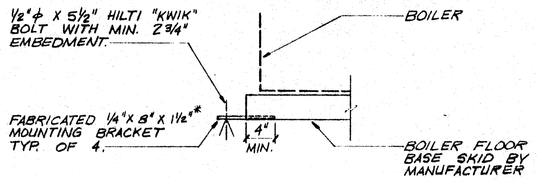
PACKAGE GAS-ELECTRIC AIR CONDITIONING UNITS ARE STARTED IN THE MORNING AND SHUT OFF IN THE AFTERNOON BY THE EMS/CPU. PROVIDE WALL MTD. SENSOR AND OPTIMAL START CAPABILITIES. THESE UNITS HAVE BYPASS TIMERS TO ALLOW FOR AIR CONDITIONING AT TIMES OTHER THAN SCHEDULED HOURS.

MULTI-USE ROOM AIR CONDITIONING CONTROL

EACH ROOFTOP HEATING-COOLING UNIT IS STARTED OR STOPPED FROM THE CENTRAL E.M.S. OR BY A REMOTE 2-HOUR BYPASS TIMER. THE BYPASS TIMERS FOR ALL FOUR HEATING-COOLING UNITS ARE GROUPED TOGETHER IN ONE LOCATION.

EXHAUST FAN CONTROL THERE ARE FOUR STEPS OF EXHAUST FAN CONTROL: 1) ONE FAN ON LOW SPEED, 2) THE SAME FAN ON HIGH SPEED, 3) THE SECOND FAN ON LOW SPEED, AND 4) THE SECOND FAN ON HIGH SPEED. IF 3 OR MORE UNITS ARE ON, ONE OF THE ECONOMIZER EXHAUST FANS WILL START ON LOW SPEED. IF ANY TWO UNITS ARE ON, INCREMENT STEPS BY ONE FOR EACH "AUXILIARY POSITION SWITCH" THAT CLOSES (INDICATING ECONOMIZER O.A. DAMPER IS 80% OPEN).

NOTE: ALL VALUES SUCH AS TEMPERATURE AND PRESSURE SETTINGS, TIME DELAYS, FLOW RATE SETTINGS, MACHINE CAPACITIES, ETC., SHALL BE SET UP AS SYSTEM VARIABLES AND SHALL BE CHANGEABLE BY OWNER.

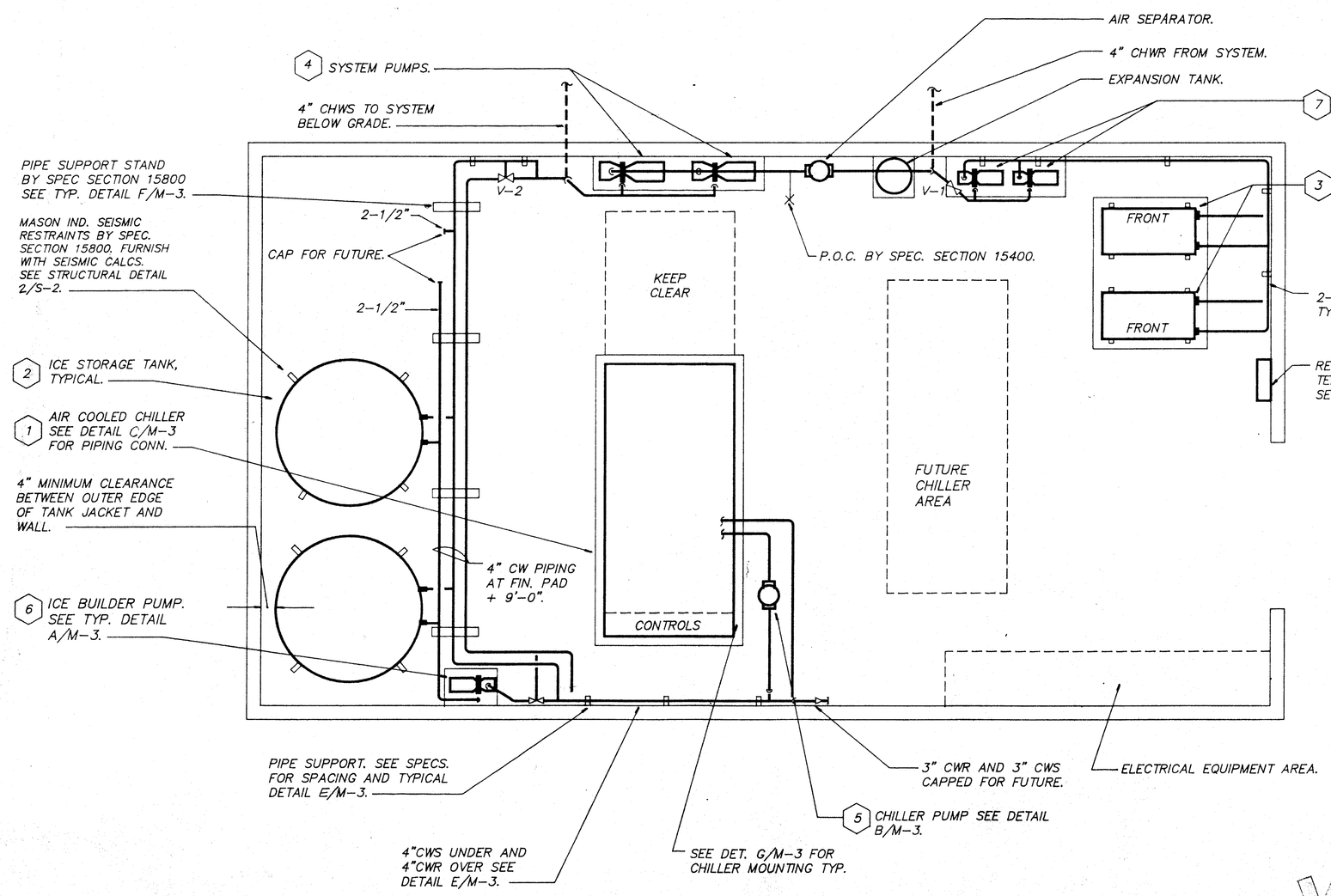


BOILER ANCHORAGE

DETAIL D/M-4

NO SCALE

NOTE:
* TO PROVIDE SNUG FIT IN BOILER BASE SKID.



MECHANICAL EQUIPMENT ENCLOSURE A/M-4

SCALE: 1/4"=1'-0"

NOTES: 1. PIPING LAYOUT SHOWN ABOVE IS DIAGRAMATIC.
2. CONTRACTOR TO PROVIDE COMPLETE SYSTEM PIPING ISOMETRIC FOR REVIEW ALONG WITH EQUIPMENT AND MATERIAL SUBMITTALS.

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Office of the State Architect
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