ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS

SAN ONOFRE NUCLEAR GENERATING STATION

UNIT 1

NOVEMBER 1987

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ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE NUCLEAR GENERATING STATIONS UNIT 1

I. INTRODUCTION:

A. On July 30, 1986, a failure of main steam pressure transmitter PT-459 at SONGS 1 caused a transient in all three channels of the feedwater control system and concurrent inoperability of all three channels of the Steam/Feedwater Flow Mismatch Scram in the Reactor Protection System. In response to this event, SCE committed to several actions, including completion of single failure analyses (SFAs) for the SONGS 1 Reactor Protection System (RPS) and Engineered Safety Features (ESF) Systems to determine susceptibility of the SONGS 1 design to single failures.

B. Previous single failure analyses (submitted per SCE letter dated 12/21/76 to the NRC) were performed for the systems required to mitigate a postulated loss of coolant accident (LOCA), including safety injection, charging, containment spray and recirculation, component cooling water, salt water cooling, and the auxiliary power system. However, this analyses did not evaluate the single failure susceptibility of the containment isolation or main feedwater isolation functions associated with emergency core cooling system (ECCS) operation during a LOCA or secondary system rupture, respectively. Subsequently, containment isolation was reviewed as part of Systematic Evaluation Program Topic VI-4.

C. The Auxiliary Feedwater (AFW) ESF system was previously identified as susceptible to single active failures during postulated secondary system pipe ruptures. Correction of the AFW single failure susceptibilities will be performed as part of the work scope for the Cycle X refueling outage.

D. The Reactor Coolant System (RCS) Overpressure Mitigation System (OMS), which provides protection of the RCS pressure boundary at low temperatures, has not been previously evaluated for single failure susceptibility.

II. SCOPE:

A. A review of the previous ECCS Single Failure Analysis against the resulting design changes was performed to verify that an acceptable plant configuration has been maintained.

B. A module-level failure mode and effects analysis of the Containment Isolation ESF function was performed from input instrumentation through final actuated devices, including vital/regulated bus/DC system dependencies, for function during a LOCA.

C. A module-level failure mode and effects analysis of the Main Feedwater Isolation ESF function was performed from SLSS sequencer outputs though final actuated devices, including vital/regulated bus/DC system dependencies, 4kV pump trips, valve position changes and auxiliary power system dependencies, for function during a main steam line break.

D. A module-level failure mode and effects analysis of the Over-pressure Mitigation ESF function was performed from input instrumentation through final actuated devices, including vital/regulated bus/DC system dependencies, for function in response to RCS overpressure challenges during reactor shutdown conditions.

E. A module-level failure mode and effects analysis of the Auxiliary Feedwater ESF function was performed based on the implementation of the currently proposed Cycle X modifications.

In addition, because of the event-specific safety analysis requirements for, and potentially event-specific impacts on, the Main Feedwater Isolation (ECCS) and Auxiliary Feedwater ESF functions (Items C and E above, respectively), an event-specific single failure response evaluation was performed for these functions which explicitly accounts for the location of an initiating fault, the availability or loss of off-site power, and any inter-system dependencies and common-cause effects, as applicable. These event-specific single failure response evaluations were prepared based on the module-level failure mode and effects analysis results.

III. METHODOLOGY:

A. To the extent practical, the Single Failure Analyses for the ESF functions were performed using notation, format and assumptions consistent with the Reactor Protection System Single Failure Analysis submitted to the NRC on March 11, 1987. Specifically:

1. The module level failure mode and effects analyses were performed in accordance with the applicable criteria of IEEE Standard 279-1971. Specifically, Parts 2, 4.2, and 4.7 of the Standard were applied as follows:

a. Single failures were postulated at the level of tag-numbered devices (modules) which resulted in the most limiting effects or combination of effects on the ESF functions. Credit was conservatively not taken for module internal design features (components) which could preclude such failures except where specifically identified. All tag-numbered and interface devices which could affect the ESF output functions were so addressed.

b. The failure modes for each device which result in the most limiting effects or combination of effects were selected so that all pertinent ESF output and interface (including isolation device) failure combinations were bounded. The failure modes considered for each type of device were:

- Transmitter (e.g., PT, LT, FT): SIGNAL HIGH or LOW
- Power Supply (e.g., YE): OUTPUT VOLTS HIGH or ZERO
- Indicator (e.g., PI, LI, FI): INPUT OPEN or SHORT
- Test Switch (e.g., Y): OPEN or SHORT (CLOSED)
- Controller or Bistable (e.g., PC, LC, FC): INPUT OPEN or SHORT, OUTPUT TRIPPED or UNTRIPPED (or OUTPUT HIGH or LOW)
- Valves: OPEN or CLOSED
- Pumps: TRIPPED, UNTRIPPED

c. Where a portion of a channel had only a single output and the net effect of the failures could be expressed in terms of that output, the devices in that portion of the circuit were permitted to be treated as a single entity (e.g., Postulated failures of the pressure regulating valve or solenoid operated pilot valve for a pneumatically activated isolation valve are bounded by failures of the isolation valve itself).

d. The failure modes for any channel-common devices (e.g., selector switches, transfer switches, auctioneering or signal comparison devices) were conservatively considered to result in channel-common failures, if unisolated channel signals were present in the device and channel separation and identity were not maintained through the device. The postulated failure modes were:

- OPEN (at all input channels)
- SHORT (of all like poles or phases, resulting in paralleling of all inputs
- GROUND (of all poles or phases)

e. It was assumed that events requiring ESF actuation could be initiated from any applicable plant condition.

f. The only applicable ESF actuation instrumentation which have control functions are associated with the Reactor Protection System and have been previously analyzed. Accordingly, a control/protection system interaction (multiple failure) analysis was not performed as part of the ESF evaluation.

2. The vital and regulated bus system and the auxiliary power system were previously analyzed as part of the RPS Single Failure Analysis and the ECCS Single Failure Analysis, respectively.

B. Because the ESF systems include final actuated devices different than the RPS (e.g., pumps and valves vs. scram breakers), the following additional criteria were applied:

1. Power-operated valve/actuator mechanical failures (e.g., as-is due to stem binding), were considered as single active failures separate from those of the actuating circuitry and motive power source where local manual actuation could be credited for performing the ESF function within the required time. Per Section III.A.1 above, the actuator control circuit was considered as a single entity (black box) if no interface devices (such as interlocks, overrides, or selector switches) were in the circuit. Motor breaker failures were specifically addressed: for example, those which affect MOV operation (e.g., as-is) as well as those which cause loss of the supply bus (e.g., input short).

2. Manually-operated valve single failures were considered; for example, due to operator error or mechanical failure, respectively. Valves subject to the valve locking program were so noted under "remarks." Consistent with current NRC criteria, check valves were considered as active devices (i.e., as subject to single active failure) only for the containment isolation and reactor coolant pressure boundary functions.

3. For containment isolation, penetration isolation redundancy was considered relative to the criteria of Standard Review Plan Section 6.4.

C. Notation/Numbering

Each SFA item in the module-level FMEAs for the existing plant configuration was assigned a unique item number, made up of [system].[train].[device].[failure mode] similar to the RPS-SFA. Train - or channel-common devices for a system were generally addressed following the items for each train; for example, in a 2-train 2-channel system, item [system].3.[device]. [failure mode] would be a train-common device.

IV. SUMMARY OF RESULTS

The findings of the single failure evaluation for each of the applicable ESF functions are summarized below:

A. Emergency Core Cooling System (ECCS)

The 1976 ECCS Single Failure Analysis (SFA) evaluated the SONGS 1 systems required to mitigate the effects of a postulated Loss of Coolant Accident, for potential susceptibility to single failures; the systems evaluated included the safety injection, charging, containment spray and recirculation, component cooling water, salt water cooling and auxiliary power systems. The results of the 1976 analysis included several recommended modifications to eliminate potential single failure susceptibilities in these systems. For the current review, the modifications performed in response to the 1976 analysis were reviewed to determine their acceptability relative to meeting the single failure criterion.

The review confirmed that the ECCS single failure susceptibilities identified in the 1976 analysis have been corrected. However, new susceptibilities have been identified which are associated with postulated failure of ECCS realignment valves HV-852A and HV-852B and 480V Switchgear No. 3. The failure of HV-852A or B is discussed under item C below. The single failure susceptibilities identified with 480V Switchgear No. 3 affect recirculation capabilities. Single failure of either DC train concurrently with a SIS/LOP could result in loss of 480V switchgear No. 3 and, therefore, result in loss of recirculation.

B. Containment Isolation

The evaluation of the containment isolation ESF function included an analysis of the containment isolation actuation instrumentation relative to applicable IEEE criteria as well as the isolation provisions for each containment penetration relative to Standard Review Plan criteria.

No single failure susceptibilities were identified in the containment isolation actuation system, although several containment penetrations were determined to have isolation valve configurations which are not consistent with Standard Review Plan 6.4 redundancy criteria. However, each of these penetrations was previously evaluated against the applicable criteria and determined to provide an acceptable level of safety by the NRC Integrated Plant Safety Assessment (IPSAR) for SONGS 1.

C. Main Feedwater Isolation

The Main Feedwater Isolation function of the ECCS was evaluated against four specific main steam line break event scenarios (inside containment, with and without loss of offsite power, and outside containment, with and without loss of offsite power), and two loss of coolant accident scenarios (LOCA with and without loss of offsite power) considering credible common-cause failures resulting from the event plus a concurrent single active failure. Main feedwater isolation has been assumed to occur within 5 seconds following a Safety Injection Signal, to terminate secondary side mass addition to the steam generators and to backup the safety injection realignment valves, in both the MSLB and LOCA accident analyses.

The evaluation identified the following common-cause and single failure susceptibilities of the main feedwater isolation function of the ECCS, which could result in continued feedwater addition or diversion of both trains of safety injection flow to the steam generators for an MSLB, and in concurrent flooding of the main steam header inside containment during a loss of coolant accident:

1. None of the three main feedwater isolation Motor-Operated Valves (MOVS) or six main feedwater Flow Control Valve (FCV) and FCV bypass valve pilot solenoids have been qualified for the environmental conditions resulting from a main steam line break outside containment.

2. All three FCVs fail open on loss of the instrument air system and do not have a safety related back-up gas supply. (Although initiated as part of the 1985 water hammer corrective actions, installation of the safety related back-up gas supply was delayed as a result of redesign to address SEP-Topic XV-1 concerns).

3. All three FCV and FCV bypass valve pilot solenoids are powered from a common electrical supply. (To maintain train separation and power alignment, the FCV and FCV bypass valve pilot solenoids actuated by Safeguards Load System Sequencer #2 should be powered from 125 VDC Bus #2 in lieu of 125 VDC Bus #1.)

4. All three MOVs and all three FCVs and FCV bypass valves close too slowly to meet the current 5 second isolation requirement. Isolation times are currently less than 60 seconds for the MOVs, 60 seconds for the FCVs and 30 seconds for the FCV bypass valves (including pilot solenoid time delay relay response). It is noted that Diesel Generator starting and loading delays are not applicable, since flow would not occur without bus power.

5. Redundant isolation valves or redundant FCV bypass actuation has not been provided in the FCV bypass lines.

The above described susceptibilities affect the feedwater isolation capability of the FCVs and bypasses which prevent loss of both ECCS trains by acting as back-ups to ECCS realignment valves HV-852A or HV-852B during a LOCA. However, the limiting small break LOCA events (in which RCS pressure would be higher than steam generator pressure but less than SI system shut off head during the 60 second closure time of the slowest back-up valves) have been evaluated for this condition and found to remain within applicable acceptance criteria.

The single failure susceptibilities identified relative to Main Steam Line Breaks (MSLB) or steam generator overfill events were concluded to be outside the current design basis for San Onofre Unit 1 because:

1) The plant is presently not designed to be able to withstand a MSLB concurrently with a single failure of the auxiliary feedwater system. This single failure susceptibility has been recognized by the NRC and a relaxation of single failure criteria for this event has been granted until the next refueling outage.

2) The plant is presently not designed to mitigate the consequences of a feedwater system malfunction which could result in a steam generator overfill condition. The NRC has recognized this susceptibility as part of the Systematic Evaluation Program. SCE has committed to evaluate the overfill issue as an open item from the San Onofre Unit 1 Integrated Assessment.

D. Overpressure Mitigation

The evaluation of the Overpressure Mitigation ESF function included an analysis of the OMS instrumentation (which is different than the normal PORV control system instrumentation) as well as the pressurizer power operated relief valves and associated block valves. No single failure susceptibilities were identified. However, a potential failure of the dedicated shutdown (DSD) control transfer switches for one train of PORV/block valve was discovered. As corrective action, the 120VAC circuit breakers for the associated pneumatic control transfer solenoid valves will be maintained open by administrative control whenever OMS operability is required.

E. Auxiliary Feedwater

The proposed modifications to the Auxiliary Feedwater System (AFWS) and Reactor Protection System (RPS) were conceptually developed based on scoping studies which included hydraulic calculations and event-specific single failure response analyses for the integrated RPS/AFW systems. The resulting design will ensure an acceptable RPS scram response for the available AFW flow into the intact feedwater lines for any applicable design basis event with or without concurrent loss of offsite power and a single active failure. Operator actions, when required (e.g., to close a diesel generator breaker or to equalize flow), are not needed outside the control room. In addition, water-hammer limits are precluded from being exceeded by design (hydraulic resistances and interlocks) rather than operator action as in the existing configuration. Relief from the single failure criterion for these systems will no longer be needed following completion of the proposed modifications.

V.A EMERGENCY CORE COOLING SYSTEM (ECCS)

Two evaluations were performed for the emergency core cooling functions of the ECCS:

a. A review of the mitigating measures implemented as a result of the single failure susceptibilities identified in the 1976 SONGS 1 single failure analysis for Loss of Coolant Accidents (submitted by SCE (K. P. Baskin) letter to the NRC (A. Schwencer) on December 21, 1976), and

b. An event-specific single failure response evaluation for those ECCS functions in which a redundant post-accident load is powered from swing 480 V Switchgear (SWGR) #3. (SWGR #3 was identified as having time and event-dependent alignment as a result of the Main Feedwater Isolation single failure analysis in Appendix V.C.)

The single failure modifications performed as a result of the 1976 SONGS1 single failure analysis were determined to correct the identified susceptibilities, with the exception of control redundancy for each of the recirculation flow control valves. Only one of the two control paths for each of these valves was provided with a seismically qualified air supply. However, this configuration was previously reviewed and accepted by the NRC in paragraph 4.25.2 of the Integrated Plant Safety Assessment for SONGS 1.

The event-specific single failure evaluation determined that the ECCS has time-dependent single failure susceptibilities not previously identified, which could result in loss of post-LOCA recirculation capability.

APPENDIX A

REVIEW OF EMERGENCY CORE COOLING SYSTEM SINGLE FAILURE ANALYSIS (1976)

The ECCS review addresses the 1976 Single Failure Analysis (SFA) identified single failure susceptibilities and those mitigating measures implemented. To provide continuity, the 1976 SFA finding has been reproduced on the computer sheets and given the 1976 SFA number (e.g., 307.1). Following that is an expanded item number(s) (e.g., 307.1.1) which describes the SFA performed on the measures implemented (plant modifications or operational controls) to determine the effect on the ESF function.

The abbreviations used in the 1976 SFA and referred to in this study are defined below:

AMF	Active Mechanical Failure
CSS	Containment Spray System
EF	Electrical Failure
HE	Human Error
HLRS	Hot Leg Recirculation System
RS	Recirculation System
SIS	Safety Injection System
VPL	Valve Position Light

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
REVIEW OF ECCS SINGLE FAILURE ANALYSIS
FILE: ECCS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
307.1	LCV 1100C	FAIL OPEN OR NORMAL	WATER DRAWN FROM THE VOLUME CONTROL TANK AND MIXED WITH BORATED RECIRCULATION WATER. GAS FROM VOLUME CONTROL TANK DRAWN INTO CHARGING PUMPS	VPL, PERIODIC TEST	NONE	RECIRCULATED WATER WILL BE DILUTED. EMPTY TANK MAY RESULT IN CAVITATION AND FAILURE OF CHARGING PUMP	AMF, EFFECTS UNACCEPTABLE FOR ECCS OPERATON. SEE RECOMMENDATIONS IN SECTION 4.2.1.4.
307.1.1	MOV 1100C (OLD MOV/LCV 1100C)	FAIL OPEN	WATER DRAWN FROM VOLUME CONTROL TANK AND MIXED WITH BORATED RECIRCULATION WATER BY RUNNING (PREFERRED) CHARGING PUMP G36A OR G36B ONLY. H2 GAS IN EMPTY VOLUME CONTROL TANK DRAWN INTO THIS CHARGING PUMP CAUSING CAVITATION AND EVENTUAL PUMP FAILURE	VALVE POSITION LIGHT AND FLOW INDICATORS IN MCR. PERIODIC TESTING	REMOTE MANUAL START OF THE STANDBY CHARGING PUMP TO SUPPORT RECIRCULATION REQUIREMENTS. RECIRC PUMP DISCHARGE PRESSURE CLOSES CHECK VALVE VCC 301	NO ADVERSE EFFECTS ON RECIRCULATION. ONLY THE RUNNING PUMP IS LOST. STANDBY PUMP REMAINS OPERATIONAL AND IS PREVENTED FROM AUTOMATIC START UPON SIS (CHARGING PUMP NOT REQUIRED FOR SIS).	REF P&ID 5178136
362.2	ACTUATION FOR MOV/LCV 1100C	FAIL TO OPEN VALVE POSITION	WATER DRAWN FROM THE VOLUME CONTROL TANK AND MIXED WITH BORATED RECIRCULATION WATER. GAS FROM VOLUME CONTROL TANK DRAWN INTO CHARGING PUMPS	VPL, PERIODIC TEST	NONE	RECIRCULATED WATER WILL BE DILUTED. EMPTY TANK MAY RESULT IN CAVITATION AND FAILURE OF CHARGING PUMP	EF, HE. EFFECTS ON ECCS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.4.
362.2.1	MOV 1100C (OLD MOV/LCV 1100C)	FAIL OPEN	WATER DRAWN FROM VOLUME CONTROL TANK AND MIXED WITH BORATED RECIRCULATION WATER BY RUNNING (PREFERRED) CHARGING PUMP G36A OR G36B ONLY. H2 GAS IN EMPTY VOLUME CONTROL TANK DRAWN INTO THIS CHARGING PUMP CAUSING CAVITATION AND EVENTUAL PUMP FAILURE	VALVE POSITION LIGHT AND FLOW INDICATORS IN MCR. PERIODIC TESTING	REMOTE MANUAL START OF THE STANDBY CHARGING PUMP TO SUPPORT RECIRCULATION REQUIREMENTS. RECIRC PUMP DISCHARGE PRESSURE CLOSES CHECK VALVE VCC 301	NO ADVERSE EFFECTS ON RECIRCULATION. ONLY THE RUNNING PUMP IS LOST. STANDBY PUMP REMAINS OPERATIONAL AND IS PREVENTED FROM AUTOMATIC START UPON SIS (CHARGING PUMP NOT REQUIRED FOR SIS).	REF P&ID 5178136
368.2	AIR SUPPLY	LOW PRESSURE OR LOSS OF AIR SUPPLY	1. FCV 1115D,E,F CLOSE. 2. FCV 1112 OPENS CV 304,5 AND PCV 430C,H CLOSE. 3. SV 117, SV 93, CV 82, CV 114 OPEN.	1. FI 1114 A,B,C. 2. VPL, FI 1112 3. VPL	1. NONE 2. NONE 3. NONE REQUIRED	1. RS DISABLED 2. HLRS DISABLED 3. NONE	1. AMF, HE. EFFECTS ON ECCS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.5. 2. DITTO, SECTION 4.2.1.6. 3. AMF, HE
368.2.1	FCV 1115D	FAIL CLOSED	FLOW BLOCKAGE OF THE RECIRCULATION LINE TO RCS COLD LEG A	FLOW INDICATOR FI 3114A IN MCR	COLD LEGS B AND C CAN SUPPORT RECIRCULATION REQUIREMENTS (FCV 1115E,F)	RECIRCULATION INJECTION LINE REDUNDANCY REDUCED FROM 2/3 TO 2/2. BACKUP N2 SYSTEM PREVENTS COMMON MODE FAILURE OF ALL THREE VALVES DUE TO LOSS OF INSTRUMENT AIR	REF P&ID 5178110
368.2.2	FCV 1115E	FAIL CLOSED	FLOW BLOCKAGE OF THE RECIRCULATION LINE TO RCS COLD LEG B	FLOW INDICATOR FI 2114B IN MCR	COLD LEGS A AND C CAN SUPPORT RECIRCULATION REQUIREMENTS (FCV 1115D,F)	RECIRCULATION INJECTION LINE REDUNDANCY REDUCED FROM 2/3 TO 2/2. BACKUP N2 SYSTEM PREVENTS COMMON MODE FAILURE OF ALL THREE VALVES DUE TO LOSS OF INSTRUMENT AIR	REF P&ID 5178110
368.2.3	FCV 1115F	FAIL CLOSED	FLOW BLOCKAGE OF THE RECIRCULATION LINE TO RCS COLD LEG C	FLOW INDICATOR FI 2114C IN MCR	COLD LEGS A AND B CAN SUPPORT RECIRCULATION REQUIREMENTS (FCV 1115D,E)	RECIRCULATION INJECTION LINE REDUNDANCY REDUCED FROM 2/3 TO 2/2. BACKUP N2 SYSTEM PREVENTS COMMON MODE FAILURE OF ALL THREE VALVES DUE TO LOSS OF INSTRUMENT AIR	REF P&ID 5178110
369.2	120 VAC UTILITY BUS	LOSS OF POWER	1. FCV 1115D,E,F CLOSE 2. FCV 1112 NOT AFFECTED, CV 304,5 CLOSE, PCV 430 C,H OPEN	1. FI 1114A,B,C 2. VPL	1. NONE 2. NONE	1. RS DISABLED 2. HLRS DISABLED	1. EF, HE. EFFECTS ON ECCS UNACCEPTABLE. SEE RECOMMENDATIONS IN SECTION 4.2.1.5 2. DITTO, 4.2.1.6.
369.2.1	125 VDC BUS 2	LOSS OF POWER	BACKUP N2 CANNOT BE ALIGNED TO FCV 1115D,E,F. FCV 1115D,E,F CLOSE IF NON-SEISMICALLY QUALIFIED AIR SYSTEM IS UNAVAILABLE.	FLOW INDICATION (FI 2114B, 2114C) IN MCR	NONE	RECIRCULATION SYSTEM DISABLED FOR ACCIDENT CONCURRENT WITH SEISMIC EVENT	EFFECTS ON ECCS UNACCEPTABLE. RECOMMENDATION 4.2.1.5 HAS NOT BEEN MET BY ASSOCIATED DESIGN CHANGE. REF P&ID 5178110, ELEM 456246

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
REVIEW OF ECCS SINGLE FAILURE ANALYSIS
FILE: ECCS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
369.2.2	120 VAC UTILITY BUS	LOSS OF POWER	CV 304 (CHARGING ISOLATION VALVE) AND CV 305 (PRESSURIZER AUXILIARY SPRAY VALVE) FAIL CLOSED. FCV 1112 (CHARGING FLOW CONTROL VALVE), PCV 430C,H (PRESSURIZER SPRAY VALVES) REMAIN UNAFFECTED DUE TO SEPARATE POWER SOURCE (VITAL BUS 1)	VALVE POSITION LIGHTS	NONE	HOT LEG RECIRCULATION FLOW PATH TO LOOP B HOT LEG THROUGH PRESSURIZER BLOCKED DUE TO CLOSURE OF CV 304. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178105, 5178135
370.2	125 VDC BUS #1	LOSS OF POWER	FCV 1112 FAILS CLOSED	FI 1112	NONE	HLRS DISABLED	EF, HE. EFFECTS ON ECCS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
370.2.1	125 VDC BUS 1	LOSS OF POWER	FCV 1112. PCV 430C AND PCV 430H FAIL CLOSED DUE TO LOSS OF VITAL BUS 1	VALVE POSITION LIGHTS, FLOW INDICATOR AND BUS STAUS INDICATORS. PERIODIC TEST	NONE	BLOCKAGE OF HOT LEG RECIRCULATION FLOW PATH TO LOOP B HOT LEG THROUGH PRESSURIZER. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178105, 5178135
401.1	FCV 1112	FAIL CLOSED	BLOCKAGE OF HLR FLOW PATH	VPL, FI 1112, PERIODIC TEST	NONE	HOT LEG RECIRCULATION NOT AVAILABLE	AMF, EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
401.1.1	FCV 1112	FAIL CLOSED	BLOCKAGE OF HOT LEG RECIRCULATION FLOW PATH TO LOOP B HOT LEG THROUGH PRESSURIZER	VALVE POSITION LIGHTS AND FLOW INDICATOR. PERIODIC TEST	NONE	HOT LEG RECIRCULATION THROUGH PRESSURIZER NOT AVAILABLE. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178135
401.2	FCV 1112	FAIL OPEN	LOSS OF FLOW CONTROL FOR HLR LINE	VPL, FI 1112, PERIODIC TEST	NONE	FLOW THROUGH FCV 1115D,E,F REDUCED	AMF, EFFECT ON HLR UNACCEPTABLE, SEE RECOMMENDATION IN SECTION 4.2.1.6
401.2.1	FCV 1112	FAIL OPEN	LOSS OF FLOW CONTROL FOR HOT LEG RECIRCULATION FLOW PATH TO LOOP B HOT LEG THROUGH PRESSURIZER	VALVE POSITION LIGHTS AND FLOW INDICATOR. PERIODIC TEST	NONE	FLOW THROUGH FCV 1115D,E,F REDUCED. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178135
402.1	CV 305	FAIL CLOSED OR NORMAL	BLOCKAGE OF HLR FLOW PATH	VPL, FI 1112	NONE	HOT LEG RECIRCULATION NOT AVAILABLE	AMF, EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
402.1.1	CV 305	FAIL CLOSED	BLOCKAGE OF HOT LEG RECIRCULATION FLOW PATH TO LOOP B HOT LEG THROUGH PRESSURIZER	VALVE POSITION LIGHTS AND FLOW INDICATOR. PERIODIC TEST	NONE	HOT LEG RECIRCULATION THROUGH PRESSURIZER NOT AVAILABLE. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178135
403.1	CHECK VALVE 354	FAIL CLOSED	BLOCKAGE OF HLR FLOW PATH	FI 1112	NONE	HOT LEG RECIRCULATION NOT AVAILABLE	AMF, EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
403.1.1	CHECK VALVE VCC 003 (VCC 354)	FAIL CLOSED	BLOCKAGE OF HOT LEG RECIRCULATION FLOW PATH TO LOOP B HOT LEG THROUGH PRESSURIZER	FLOW INDICATION	NONE	HOT LEG RECIRCULATION THROUGH PRESSURIZER NOT AVAILABLE. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&I 5178135 (OLD P&ID 568767)

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
REVIEW OF ECCS SINGLE FAILURE ANALYSIS
FILE: ECCS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
404.2	CV 304	FAIL OPEN OR NORMAL	BORATED WATER DIVERTED TO COLD LEG A	VPL	NONE	HLR FLOW IS REDUCED	AMF, EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
404.2.1	CV 304	FAIL OPEN	BORATED WATER DIVERTED TO COLD LEG A	VALVE POSITION LIGHT	NONE	HOT LEG RECIRCULATION FLOW IS REDUCED. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178135
406.1	PCV 430C	FAIL OPEN	BORATED WATER DIVERTED TO COLD LEG B	VPL	NONE	HLR FLOW IS REDUCED	AMF, EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
406.1.1	PCV 430C	FAIL OPEN	BORATED WATER DIVERTED TO COLD LEG B	VALVE POSITION LIGHT	NONE	HOT LEG RECIRCULATION FLOW IS REDUCED. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178105
407.1	PCV 430H	FAIL OPEN	BORATED WATER DIVERTED TO COLD LEG A	VPL	NONE	HLR FLOW IS REDUCED	AMF, EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
407.1.1	PCV 430H	FAIL OPEN	BORATED WATER DIVERTED TO COLD LEG A	VALVE POSITION LIGHT	NONE	HOT LEG RECIRCULATION FLOW IS REDUCED. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178105
450.1	ACTUATION CIRCUITRY FCV 1112	FAIL TO CLOSE VALVE POSITION	WORST CASE FAILURE RESULTS IN FLOW BLOCKAGE TO HLR LINE	FI 1112, VPL, PERIODIC TEST	NONE	HOT LEG RECIRCULATION NOT AVAILABLE	EF, EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
450.1.1	ACTUATION CIRCUITRY FCV 1112	FAIL TO CLOSE VALVE POSITION	WORST CASE FAILURE RESULTS IN FLOW BLOCKAGE OF HLR LINE	VALVE POSITION LIGHTS AND FLOW INDICATOR. PERIODIC TEST	NONE	HOT LEG RECIRCULATION FLOW THROUGH PRESSURIZER NOT AVAILABLE. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178135
450.2	ACTUATION CIRCUITRY FCV 1112	FAIL TO OPEN VALVE POSITION	WORST CASE FAILURE RESULTS IN LOSS OF FLOW CONTROL IN HLR LINE	FI 1112, VPL, PERIODIC TEST	NONE	RECIRCULATION COLD LEG FLOW THROUGH FCV 1115D,E,F IS REDUCED	EF, HE. EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
450.2.1	ACTUATION CIRCUITRY FCV 1112	FAIL TO OPEN VALVE POSITION	WORST CASE FAILURE RESULTS IN LOSS OF FLOW CONTROL IN HLR LINE	VALVE POSITION LIGHTS AND FLOW INDICATOR. PERIODIC TEST	NONE	FLOW THROUGH FCV 1115D,E,F REDUCED. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178135
451.2	ACTUATION CIRCUITRY CV 304	FAIL TO OPEN VALVE POSITION	WORST CASE FAILURE RESULTS IN BORATED WATER DIVERTED TO COLD LEG A	VPL	NONE	HLR FLOW IS REDUCED	EF, HE. EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
451.2.1	ACTUATION CIRCUITRY CV 304	FAIL TO OPEN VALVE POSITION	WORST CASE FAILURE RESULTS IN BORATED WATER DIVERTED TO COLD LEG A	VALVE POSITION LIGHT	NONE	HOT LEG RECIRCULATION FLOW IS REDUCED. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178135
452.1	ACTUATION CIRCUITRY CV 305	FAIL TO CLOSE VALVE POSITION	WORST CASE FAILURE RESULTS IN FLOW BLOCKAGE TO HLR LINE	VPL, FI 1112	NONE	HOT LEG RECIRCULATION NOT AVAILABLE	EF, HE. EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.

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452.1.1	ACTUATION CIRCUITRY CV 305	FAIL TO CLOSE VALVE POSITION	BLOCKAGE OF HOT LEG RECIRCULATION FLOW PATH TO LOOP B HOT LEG THROUGH PRESSURIZER	VALVE POSITION LIGHTS AND FLOW INDICATOR. PERIODIC TEST	NONE	HOT LEG RECIRCULATION FLOW THROUGH PRESSURIZER NOT AVAILABLE. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178135
453.2	ACTUATION CIRCUITRY PCV 430C	FAIL TO OPEN VALVE POSITION	WORST CASE FAILURE RESULTS IN BORATED WATER DIVERTED TO COLD LEG B	VPL	NONE	HLR FLOW IS REDUCED	EF, HE. EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
453.2.1	ACTUATION CIRCUITRY PCV 430C	FAIL TO OPEN VALVE POSITION	WORST CASE FAILURE RESULTS IN BORATED WATER DIVERTED TO COLD LEG B	VALVE POSITION LIGHT	NONE	HOT LEG RECIRCULATION FLOW IS REDUCED. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178105
454.2	ACTUATION CIRCUITRY PCV 430H	FAIL TO OPEN VALVE POSITION	WORST CASE FAILURE RESULTS IN BORATED WATER DIVERTED TO COLD LEG A	VPL	NONE	HLR FLOW IS REDUCED	EF, HE. EFFECT ON HLR UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.6.
454.2.1	ACTUATION CIRCUITRY PCV 430H	FAIL TO OPEN VALVE POSITION	WORST CASE FAILURE RESULTS IN BORATED WATER DIVERTED TO COLD LEG A	VALVE POSITION LIGHT	NONE	HOT LEG RECIRCULATION FLOW IS REDUCED. THE ALTERNATE HOT LEG RECIRCULATION FLOW PATH TO LOOP C HOT LEG THROUGH MODIFIED PIPING AND VALVING ACCOMPLISHES THE DESIRED FUNCTION	REF P&ID 5178105
600.1	4160V BUS 1C UV RELAY	FAILS UNTRIPPED OR NORM	"AND" MODULE A3 TRAINS 1 AND 2 INPUT FAILURE - DISABLES LOSS OF POWER INFORMATION TO SIS/CSS	CR INDICATION, NO DIESELS START/SEQUENCER OPERATION	MANUAL CAPABILITY TO INITIATE SIS/CSS	AUTO SIS/CSS OPERATION DISABLED	EF, PREVENTS LOP TRIP SIGNAL TO RPS, MANUAL ACTION CONSIDERED UNAVAILABLE UNTIL 10 MINUTES AFTER LOCA AND LOSS OF POWER EVENT. EFFECTS ON ECCS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.1
600.1.1	4160 V BUS 1C UV RELAY 127-3	FAILS UNTRIPPED	LOSS OF BUS 1C UNDER VOLTAGE SIGNALS TO AUXILIARY RELAYS 127-3X AND 127-7X WITH CONSEQUENT LOSS OF REDUNDANCY IN LOP OR LOB SIGNAL TO SEQUENCER 1 & 2	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 1C UNDER VOLTAGE DETECTION LOGIC REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS OR RPS TRIP SIGNAL CAPABILITIES SINCE BOTH SEQUENCERS RECEIVE UNDER VOLTAGE SIGNALS FROM THE REDUNDANT UV RELAY 127-9	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
600.1.2	AUX RELAY 127-3X	FAILS UNTRIPPED	LOSS OF BUS 1C REDUNDANT UV SIGNALS TO SEQUENCER 1 ONLY	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 1C UNDER VOLTAGE DETECTION LOGIC FOR SEQUENCER 1 REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS CAPABILITY SINCE SEQUENCER 1 RECEIVES REDUNDANT UNDER VOLTAGE SIGNAL FROM THE UV RELAY 127-9 VIA AUX RELAY 127-9X	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
600.1.3	AUX RELAY 127-7X	FAILS UNTRIPPED	LOSS OF BUS 1C REDUNDANT UV SIGNALS TO SEQUENCER 2 ONLY	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 1C UNDER VOLTAGE DETECTION LOGIC FOR SEQUENCER 2 REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS CAPABILITY SINCE SEQUENCER 2 RECEIVES REDUNDANT UNDER VOLTAGE SIGNAL FROM THE UV RELAY 127-9 VIA AUX RELAY 127-11X	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
600.1.4	4160 V BUS 1C UV RELAY 127-9	FAILS UNTRIPPED	LOSS OF BUS 1C UNDER VOLTAGE SIGNALS TO AUXILIARY RELAYS 127-9X AND 127-11X WITH CONSEQUENT LOSS OF REDUNDANCY IN LOP OR LOB SIGNAL TO SEQUENCER 1 & 2	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 1C UNDER VOLTAGE DETECTION LOGIC REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS OR RPS TRIP SIGNAL CAPABILITIES SINCE BOTH SEQUENCERS RECEIVE UNDER VOLTAGE SIGNALS FROM THE REDUNDANT UV RELAY 127-3.	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876

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600.1.5	AUX RELAY 127-9X	FAILS UNTRIPPED	LOSS OF BUS 1C REDUNDANT UV SIGNALS TO SEQUENCER 1 ONLY	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 1C UNDER VOLTAGE DETECTION LOGIC FOR SEQUENCER 1 REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS CAPABILITY SINCE SEQUENCER 1 RECEIVES REDUNDANT UNDER VOLTAGE SIGNAL FROM THE UV RELAY 127-3 VIA AUX RELAY 127-3X	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
600.1.6	AUX RELAY 127-11X	FAILS UNTRIPPED	LOSS OF BUS 1C REDUNDANT UV SIGNALS TO SEQUENCER 2 ONLY	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 1C UNDER VOLTAGE DETECTION LOGIC FOR SEQUENCER 2 REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS CAPABILITY SINCE SEQUENCER 2 RECEIVES REDUNDANT UNDER VOLTAGE SIGNAL FROM THE UV RELAY 127-3 VIA AUX RELAY 127-7X	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
601.1	4160V BUS 2C UV RELAY	FAILS UNTRIPPED OR NORM	SEE 600.1	SEE 600.1	SEE 600.1	SEE 600.1	EF, SEE 600.1
601.1.1	4160 V BUS 2C UV RELAY 127-4	FAILS UNTRIPPED	LOSS OF BUS 2C UNDER VOLTAGE SIGNALS TO AUXILIARY RELAYS 127-4X AND 127-8X WITH CONSEQUENT LOSS OF REDUNDANCY IN LOP OR LOB SIGNAL TO SEQUENCER 1 & 2	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 2C UNDER VOLTAGE DETECTION LOGIC REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS OR RPS TRIP SIGNAL CAPABILITIES SINCE BOTH SEQUENCERS RECEIVE UNDER VOLTAGE SIGNALS FROM THE REDUNDANT UV RELAY 127-10	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
601.1.2	AUX RELAY 127-4X	FAILS UNTRIPPED	LOSS OF BUS 2C REDUNDANT UV SIGNALS TO SEQUENCER 1 ONLY	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 2C UNDER VOLTAGE DETECTION LOGIC FOR SEQUENCER 1 REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS CAPABILITY SINCE SEQUENCER 1 RECEIVES REDUNDANT UNDER VOLTAGE SIGNAL FROM THE UV RELAY 127-10 VIA AUX RELAY 127-10X	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
601.1.3	AUX RELAY 127-8X	FAILS UNTRIPPED	LOSS OF BUS 2C REDUNDANT UV SIGNALS TO SEQUENCER 2 ONLY	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 2C UNDER VOLTAGE DETECTION LOGIC FOR SEQUENCER 2 REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS CAPABILITY SINCE SEQUENCER 2 RECEIVES REDUNDANT UNDER VOLTAGE SIGNAL FROM THE UV RELAY 127-10 VIA AUX RELAY 127-12X	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
601.1.4	4160 V BUS 2C UV RELAY 127-10	FAILS UNTRIPPED	LOSS OF BUS 2C UNDER VOLTAGE SIGNALS TO AUXILIARY RELAYS 127-10X AND 127-12X WITH CONSEQUENT LOSS OF REDUNDANCY IN LOP OR LOB SIGNAL TO SEQUENCER 1 & 2	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 2C UNDER VOLTAGE DETECTION LOGIC REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS OR RPS TRIP SIGNAL CAPABILITIES SINCE BOTH SEQUENCERS RECEIVE UNDER VOLTAGE SIGNALS FROM THE REDUNDANT UV RELAY 127-4	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
601.1.5	AUX RELAY 127-10X	FAILS UNTRIPPED	LOSS OF BUS 2C REDUNDANT UV SIGNALS TO SEQUENCER 1 ONLY	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 2C UNDER VOLTAGE DETECTION LOGIC FOR SEQUENCER 1 REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS CAPABILITY SINCE SEQUENCER 1 RECEIVES REDUNDANT UNDER VOLTAGE SIGNAL FROM THE UV RELAY 127-4 VIA AUX RELAY 127-4X	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876
601.1.6	AUX RELAY 127-12X	FAILS UNTRIPPED	LOSS OF BUS 2C REDUNDANT UV SIGNALS TO SEQUENCER 2 ONLY	CONTROL ROOM BUS STATUS INDICATION AND ANNUNCIATORS	NONE REQUIRED	BUS 2C UNDER VOLTAGE DETECTION LOGIC FOR SEQUENCER 2 REVERTS FROM 1/2 TO 1/1. NO EFFECT ON ECCS CAPABILITY SINCE SEQUENCER 2 RECEIVES REDUNDANT UNDER VOLTAGE SIGNAL FROM THE UV RELAY 127-4 VIA AUX RELAY 127-8X	REF LOGIC 514980, ONE LINE 5102173, 5149348, ELEM 5130351, 5150876

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602.1	"AND" A3 FOR SUBCHAN X OR Y	FAILS UNTRIPPED OR NORM	DISABLES LOSS OF POWER INFORMATION TO SIS/CSS TRAIN A OR B	SEE 600.1 (FOR TRAIN 1 OR 2)	REDUNDANT TRAIN CAN SUPPORT ECCS REQUIREMENTS	ECCS TRAIN REDUNDANCY IS REDUCED FROM 1/2 TO 1/1	EF
602.1.1	"AND" A3 LOGIC GATE, SEQ 1	FAILS UNTRIPPED	DISABLES LOSS OF POWER (LOP) INFORMATION TO SEQUENCER 1 DUE TO ELECTRIC FAILURE OF THE "AND" GATE IN THE SEQUENCER SUBCHANNEL X OR Y. THE "AND" GATE COMBINES BUS 1C AND BUS 2C UNDER VOLTAGE SIGNALS TO GENERATE LOP SIGNAL IN EACH SUBCHANNEL	BUS STATUS INDICATIONS IN CR, DIESEL GEN 1 NON-START AND SEQUENCER SURVEILLANCE INDICATIONS	REDUNDANT TRAIN B, DIESEL GEN 2 (SEQUENCER 2) CAN SUPPORT ECCS REQUIREMENTS. MANUAL START DIESEL GEN 1	TRAIN A IS UNAVAILABLE UNDER SISLOP. FOR SIS ALONE, TRAIN A REMAINS FUNCTIONAL. ALSO DIESEL GENERATOR START UNDER LOB IS UNAFFECTED	REF LOGIC 514980
602.1.2	"AND" A3 LOGIC GATE, SEQ 2	FAILS UNTRIPPED	DISABLES LOSS OF POWER (LOP) INFORMATION TO SEQUENCER 2 DUE TO ELECTRIC FAILURE OF THE "AND" GATE IN THE SEQUENCER SUBCHANNEL X OR Y. THE "AND" GATE COMBINES BUS 1C AND BUS 2C UNDER VOLTAGE SIGNALS TO GENERATE LOP SIGNAL IN EACH SUBCHANNEL	BUS STATUS INDICATIONS IN CR, DIESEL GEN 2 NON-START AND SEQUENCER SURVEILLANCE INDICATIONS	REDUNDANT TRAIN A, DIESEL GEN 1 (SEQUENCER 1) CAN SUPPORT ECCS REQUIREMENTS. MANUAL START DIESEL GEN 2	TRAIN B IS UNAVAILABLE UNDER SISLOP. FOR SIS ALONE, TRAIN B REMAINS FUNCTIONAL. ALSO DIESEL GENERATOR START UNDER LOB IS UNAFFECTED	REF LOGIC 514980
603.1	125 VDC BUS 1	LOSS OF POWER	ALL SIS INSTRUMENTATION CHANNELS TRIP RESULTING IN SIS SEQUENCER 2 ACTUATION. UV RELAY ON 4160V BUS 1C FAILS UNTRIPPED DISABLING LOP INFORMATION TO SEQUENCERS 1 AND 2. LOSS OF POWER TO SEQUENCER 1. SEQUENCER 2 LOADS ECCS EQUIPMENT ON DEAD BUSES.	TRANS SW 1,2,3 OPERATION, LOSS OF ALL IND/CONT EX 125VDC BUS #2 SUPPLIED, NO SEQ TRAIN 1 OPERATION	MANUAL CAPABILITY TO CONNECT DIESEL GENERATOR TO 4160V BUS 2C AND LOAD ECCS EQUIPMENT BY SEQUENCER 2	AUTO SIS/CSS OPERATION DISABLED	EF, MANUAL ACTION UNAVAILABLE UNTIL 10 MINUTES AFTER LOCA. EFFECTS ON ECCS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.1
603.1.1	125 VDC BUS 1	LOSS OF POWER	LOSS OF SEQ 1 DUE TO LOSS OF POWER SOURCE AND CONSEQUENT LOSS OF SIS TRAIN A, CSAS TRAIN A, CIS TRAIN A ACTUATION THROUGH SEQ 1. REDUNDANT UV RELAYS ON 4160 V BUS 1C DE-ENERGIZE TO ACTIVATE BUS 1C UV SIGNALS TO BOTH SEQ 1 & 2 IN A FAIL SAFE MANNER	TRANS SW 1,2,3 OPERATION, LOSS OF ALL INDICATION/CONTROL EX 125VDC BUS 2 SUPPLIED, NO SEQ 1 OPER	REDUNDANT TRAIN 2, (SEQUENCER 2) CAN SUPPORT ECCS REQUIREMENTS	ECCS TRAIN REDUNDANCY IS REDUCED FROM 1/2 TO 1/1 FOR BOTH SISLOP OR LOB. SEQ 2 AND REDUNDANT UV RELAYS ON BUS 2C POWERED THRU 125VDC BUS 2 REMAIN OPERATIONAL. COMBINED BUS 1C FAIL SAFE UV SIGNAL AND ANY BUS 2 UV SIGNAL GENERATES LOP SIGNAL FOR SEQ 2	REF LOGIC 514980, ONE LINE 5146828, 5102173, 5149348
616.1	OVERRIDE/BLOCK SWITCH	FAIL IN BLOCK POSITION	AUTOMATIC SIS ACTUATION DISABLED	CR INDICATION, NO SIS OPERATION	MANUAL CAPABILITY TO INITIATE SIS/CSS	AUTOMATIC SIS CAPABILITY DISABLED	EF, HE, MANUAL ACTION CONSIDERED UNAVAILABLE UNTIL 10 MINUTES AFTER LOCA. EFFECTS ON ECCS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.1.2.
616.1.1	CS-1 SIS OVERRIDE/BLOCK SEQ 1	FAIL IN BLOCK POSITION	AUTOMATIC SIS ACTUATION CAPABILITY FOR TRAIN 1 IS LOST	SEQUENCER STATUS AND SI FLOW INDICATIONS IN CONTROL ROOM	MANUAL CAPABILITY TO INITIATE SEQUENCER 1 FUNCTION	AUTOMATIC CAPABILITY TO INITIATE SIS TRAIN 1 IS LOST BUT TRAIN 2 REMAINS FUNCTIONAL DUE TO SEPARATE BLOCK SWITCH AND POWER SOURCE (125 VDC BUS 2) FOR SEQUENCER 2. REDUNDANT SIS TRAIN B CAN SUPPORT SIS REQUIREMENTS	REF LOGIC 5149180, ELEMENTARY 63715
616.1.2	CS-2 SIS OVERRIDE/BLOCK SEQ 2	FAIL IN BLOCK POSITION	AUTOMATIC SIS ACTUATION CAPABILITY FOR TRAIN 2 IS LOST	SEQUENCER STATUS AND SI FLOW INDICATIONS IN CONTROL ROOM	MANUAL CAPABILITY TO INITIATE SEQUENCER 2 FUNCTION	AUTOMATIC CAPABILITY TO INITIATE SIS TRAIN 2 IS LOST BUT TRAIN 1 REMAINS FUNCTIONAL DUE TO SEPARATE BLOCK SWITCH AND POWER SOURCE (125 VDC BUS 2) FOR SEQUENCER 1. REDUNDANT SIS TRAIN A CAN SUPPORT SIS REQUIREMENTS	REF LOGIC 5149180, ELEMENTARY 63715

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653.1	COMPARATOR A10	FAILS SUCH THAT RELAY X11 IS ACTIVATED.	PERMISSIVE RELAY X11 IS ACTIVATED. INPUT FLOW NORMAL AND EQUAL SO PERMISSIVE RELAY X12 IS ACTIVATED AND PERMISSIVE RELAY X13 IS ACTIVATED WHEN ALL 850 VALVES ARE OPEN. ALL FLOW SIGNALS ACTIVATE VALVE SELECT RELAYS X4, X5, X6.	FLOW COMPARATOR PERIODIC TEST DURING REFUELING SHUTDOWN OR VALVE INDICATORS 850 A,B,C.	NONE	ONE OF THE 850 VALVES WILL CLOSE. THE REMAINING TWO VALVES WILL BE PARTIALLY CLOSED. NONE OF THE VALVES CAN BE RESTORED TO THEOPEN POSITION.	EF, EFFECT ON ECCS UNACCEPTABLE, SEE RECOMMENDATION IN SECTION 4.2.1.3.
653.1.1	FLOW COMPARATOR	NONE. COMPARATOR REMOVED	NONE. SIMULTANEOUS CLOSURE (FULL OR PARTIAL) OF SI HEADER VALVES MOV 850 A,B,C DUE TO SINGLE FAILURE IN FLOW COMPARATOR IS ELIMINATED WITH THE REMOVAL OF THE FLOW COMPARATOR.	NONE, NO FAILURE	NONE REQUIRED	NONE	REF P&ID 568769 (OLD P&ID)
654.1	RELAY X11	CONTACT FAILS CLOSED	PERMISSIVE RELAY X11 IS ACTIVATED. INPUT FLOW NORMAL AND EQUAL SO PERMISSIVE RELAY X12 IS ACTIVATED AND PERMISSIVE RELAY X13 IS ACTIVATED WHEN ALL 850 VALVES OPEN. ALL FLOW SIGNALS ACTIVATE VALVE SELECT RELAYS X4, X5, X6.	FLOW COMPARATOR PERIODIC TEST DURING REFUELING SHUTDOWN OR VALVE INDICATORS 850 A,B,C	NONE	ONE OF THE 850 VALVES WILL CLOSE. THE REMAINING TWO VALVES WILL BE PARTIALLY CLOSED. NONE OF THE VALVES CAN BE MANUALLY RESTORED TO THE OPEN POSITION.	EF, EFFECT ON ECCS UNACCEPTABLE, SEE RECOMMENDATION IN SECTION 4.2.1.3.
654.1.1	FLOW COMPARATOR	NONE. COMPARATOR REMOVED	NONE. SIMULTANEOUS CLOSURE (FULL OR PARTIAL) OF SI HEADER VALVES MOV 850 A,B,C DUE TO SINGLE FAILURE IN FLOW COMPARATOR IS ELIMINATED WITH THE REMOVAL OF THE FLOW COMPARATOR.	NONE, NO FAILURE	NONE REQUIRED	NONE	REF P&ID 568769 (OLD)
655.1	RELAY 7-A,B,C COMMON ACT BUS	SHORT TO +18 VDC SUPPLY	PERMISSIVE RELAY X11 IS ACTIVATED. INPUT FLOW NORMAL AND EQUAL SO PERMISSIVE RELAY X12 IS ACTIVATED AND PERMISSIVE RELAY X13 IS ACTIVATED WHEN ALL 850 VALVES OPEN. ALL FLOW SIGNALS ACTIVATE VALVE SELECT RELAYS X4, X5, X6.	FLOW COMPARATOR PERIODIC TEST DURING REFUELING SHUTDOWN OR VALVE INDICATORS 850 A,B,C	NONE	ONE OF THE 850 VALVES WILL CLOSE. THE REMAINING TWO VALVES WILL BE PARTIALLY CLOSED. NONE OF THE VALVES CAN BE MANUALLY RESTORED TO THE OPEN POSITION.	EF, EFFECT ON ECCS UNACCEPTABLE, SEE RECOMMENDATION IN SECTION 4.2.1.3.
655.1.1	FLOW COMPARATOR	NONE. COMPARATOR REMOVED	NONE. SIMULTANEOUS CLOSURE (FULL OR PARTIAL) OF SI HEADER VALVES MOV 850 A,B,C DUE TO SINGLE FAILURE IN FLOW COMPARATOR IS ELIMINATED WITH THE REMOVAL OF THE FLOW COMPARATOR.	NONE, NO FAILURE	NONE REQUIRED	NONE	REF P&ID 568769 (OLD)
656.1	COMPARATOR A3	FAILS TO LOW OR OPEN	PERMISSIVE RELAY X11 IS ACTIVATED. INPUT FLOW NORMAL AND EQUAL SO PERMISSIVE RELAY X12 IS ACTIVATED AND PERMISSIVE RELAY X13 IS ACTIVATED WHEN ALL 850 VALVES OPEN. ALL FLOW SIGNALS ACTIVATE VALVE SELECT RELAYS X4, X5, X6.	FLOW COMPARATOR PERIODIC TEST DURING REFUELING SHUTDOWN OR VALVE INDICATORS 850 A,B,C	NONE	ONE OF THE 850 VALVES WILL CLOSE. THE REMAINING TWO VALVES WILL BE PARTIALLY CLOSED. NONE OF THE VALVES CAN BE MANUALLY RESTORED TO THE OPEN POSITION.	EF, EFFECT ON ECCS UNACCEPTABLE, SEE RECOMMENDATION IN SECTION 4.2.1.3.
656.1.1	FLOW COMPARATOR	NONE. COMPARATOR REMOVED	NONE. SIMULTANEOUS CLOSURE (FULL OR PARTIAL) OF SI HEADER VALVES MOV 850 A,B,C DUE TO SINGLE FAILURE IN FLOW COMPARATOR IS ELIMINATED WITH THE REMOVAL OF THE FLOW COMPARATOR.	NONE, NO FAILURE	NONE REQUIRED	NONE	REF P&ID 568769 (OLD)
657.1	COMPARATOR (MODULE A7 & A8)	UNIT FAILS TO HIGH OUTPUT	RELAYS X11, X12, X13, K7A, K7B, K7C, X4, X5, X6 ARE ACTIVATED. MOV 850A & B ARE COMMANDED CLOSED.	FLOW COMPARATOR PERIODIC TEST DURING REFUELING SHUTDOWN OR VALVE INDICATORS 850 A,B,C	NONE	ONE OF THE 850 VALVES WILL CLOSE. THE REMAINING TWO VALVES WILL BE PARTIALLY CLOSED. NONE OF THE VALVES CAN BE MANUALLY RESTORED TO THE OPEN POSITION.	EF, EFFECT ON ECCS UNACCEPTABLE, SEE RECOMMENDATION IN SECTION 4.2.1.3. (ONLY SINGLE LOCA CONSIDERED DUE TO UNIT SYMMETRY, EFFECTS FOR OTHER LEGS IDENTICAL)

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657.1.1	FLOW COMPARATOR	NONE. COMPARATOR REMOVED	NONE. SIMULTANEOUS CLOSURE (FULL OR PARTIAL) OF SI HEADER VALVES MOV 850 A,B,C DUE TO SINGLE FAILURE IN FLOW COMPARATOR IS ELIMINATED WITH THE REMOVAL OF THE FLOW COMPARATOR.	NONE, NO FAILURE	NONE REQUIRED	NONE	REF P&ID 568769 (OLD)
815.1	TRANSFER SWITCH NO. 7	SHORT BOTH INPUTS TO GROUND	THIS SHORT WOULD BE TRANSFERRED TO MCC #1 & #2. LOSS OF POWER TO VITAL BUS #4	BUS INDICATORS FOR MCC #1 & #2 AND VITAL BUS NO. 4	NONE	RS AND CSS DISABLED. SIS INJECTION LINE REDUNDANCY REDUCED FROM 1/3 TO 1/1	EF, EFFECTS ON RS AND CSS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.2.1.
815.1.1	TRANSFER SWITCH NO. 7	NONE (AUTOMATIC TRANSFER DISABLED)	NONE. AUTOMATIC SWITCHING FROM MCC 2 TO MCC 1 HAS BEEN DISABLED AND THE SWITCH ALIGNED TO MCC 2 WITH ITS BREAKER 8-1238 CLOSED. MCC 1 BREAKER 8-1181 FUSE BLOCK HAS BEEN REMOVED. THIS PREVENTS LOSS OF BOTH MCC DUE TO LOAD SHORT TO GROUND.	STATUS INDICATORS FOR MCC 1 & 2 AND VITAL BUS 4 IN MCR. PERIODIC INSPECTION	ALTERNATE AC POWER FROM DIESEL GENERATOR 2	LOSS OF ALTERNATE POWER SOURCE FROM MCC1 FOR VITAL BUS 4. HOWEVER IF 125 VDC BUS 1 SHORTS TO GROUND SF, VITAL BUS 4 IS POWERED FROM DIESEL GENERATOR 2. NO EFFECT ON ESF SINCE VITAL BUS 4 SERVES NON-ESSENTIAL COMP. AND MCC 1,2,3 POWER REDUNDANT COMPS.	REF ONE LINE 5102166
825.1	TRANSFER SWITCH EMER SIREN	COMMON SHORT ON BOTH INPUTS	SHORT CAUSES FAULTS ON BOTH MCC #1 & #2	BREAKER INDICATORS FOR SIREN AND MCC #1 & #2	NONE	RS AND CSS DISABLED. SIS INJECTION LINE REDUNDANCY REDUCED FROM 1/3 TO 1/1	EF, EFFECTS ON RS AND CSS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.2.2.
825.1.1	TRANSFER SWITCH EMER SIREN	NONE (AUTOMATIC TRANSFER DISABLED)	NONE. AUTOMATIC SWITCHING FROM MCC 1 TO MCC 2 HAS BEEN DISABLED AND THE SWITCH ALIGNED TO MCC 1 WITH ITS BREAKER 42-1145 CLOSED. MCC 2 BREAKER 8-1293A FUSE BLOCK HAS BEEN REMOVED. THIS PREVENTS LOSS OF BOTH MCC DUE TO LOAD SHORT TO GROUND.	STATUS INDICATORS FOR MCC 1 & 2 AND SIREN IN MCR. PERIODIC INSPECTION	NONE	LOSS OF ALTERNATE POWER SOURCE FROM MCC 2 FOR SIREN. ANY SHORT TO GROUND FAULT IN THE SIREN SYSTEM WILL RENDER BOTH SIREN AND MCC 1 INOPERATIVE. NO EFFECT ON ESF SINCE MCC 1,2,3 POWER REDUNDANT COMPONENTS	REF ONE LINE 5102165
826.1	TRANSFER SWITCH MOV/LCV 1100C	COMMON SHORT ON BOTH INPUTS	SHORT CAUSES FAULTS ON BOTH MCC #1 & #2.	BREAKER INDICATORS FOR MOV/LCV 1100C AND MCC #1 & #2	NONE	RS AND CSS DISABLED. SIS INJECTION LINE REDUNDANCY REDUCED FROM 1/3 TO 1/1	EF, EFFECTS ON RS AND CSS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.2.4.
826.1.1	TRANSFER SWITCH MOV 1100C	NONE (AUTOMATIC TRANSFER DISABLED)	NONE. AUTOMATIC TRANSFER SWITCH HAS BEEN DISABLED. A MANUAL TRANSFER CAPABILITY REQUIRING TWO SEPARATE OPERATOR ACTION, ACTIVATING A CONTROL SWITCH AND CLOSING A NORMALLY RACKED-OUT FEEDER BREAKER TO THE ALTERNATE POWER SOURCE IS PROVIDED	BREAKER INDICATORS FOR MOV 1100C AND MCC 1 & 2A	AVAILABILITY OF ALTERNATE POWER SOURCE TO CLOSE MOV 1100C	INABILITY TO ISOLATE THE VOLUME CONTROL TANK FROM THE RUNNING CHARGING PUMP SUCTION IN A TIMELY MANNER FOLLOWING THE LOSS OF PRIMARY POWER TO MOV 1100C. THE RUNNING PUMP MAY BE LOST DUE TO CAVITATION, HOWEVER THE STANDBY PUMP SUPPORTS RECIRCULATION	REF ONE LINE 5102169
827.1	TRANSFER SWITCH COMM PWR DIST	COMMON SHORT ON BOTH INPUTS	SHORT CAUSES FAULTS ON BOTH MCC #1 & #2	BREAKER INDICATORS FOR COMM. POWER AND MCC #1 & #2	NONE	RS AND CSS DISABLED. SIS INJECTION LINE REDUNDANCY REDUCED FROM 1/3 TO 1/1	EF, EFFECTS ON RS AND CSS UNACCEPTABLE. SEE RECOMMENDATION IN SECTION 4.2.2.3.
827.1.1	TRANSFER SWITCH COMM PWR DIST	NONE (AUTOMATIC TRANSFER DISABLED)	NONE. AUTOMATIC SWITCHING FROM MCC 1 TO MCC 2 HAS BEEN DISABLED AND THE SWITCH ALIGNED TO MCC 1 WITH ITS BREAKER 8-1195 CLOSED. MCC 2 BREAKER 8-1293B FUSE BLOCK HAS BEEN REMOVED. THIS PREVENTS LOSS OF BOTH MCC DUE TO LOAD SHORT TO GROUND.	STATUS INDICATORS FOR MCC 1 & 2 AND COMMUNICATION PANEL IN MCR. PERIODIC INSPECTION	NONE	LOSS OF ALTERNATE POWER SOURCE FROM MCC 2 FOR COMM. PANEL. ANY SHORT TO GROUND FAULT IN THE COMM. PANEL WILL RENDER BOTH COMM. PANEL AND MCC 1 INOPERATIVE. NO EFFECT ON ESF SINCE MCC 1,2,3 POWER REDUNDANT COMPONENTS	REF ONE LINE 5102166

480 V SWGR #3/MCC-3
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

As a result of the event-specific single failure response evaluation for the Main Feedwater Isolation function of the Emergency Core Cooling System (ECCS), a previously unrecognized potential single failure susceptibility was identified for ESF functions which rely on swing 480 V SWGR #3 or MCC-3 to power one or more redundant components. This susceptibility occurs as a result of the normal/SIS alignment of SWGR #3 to Train 1/125 VDC Bus #1, the SISLOP alignment of SWGR #3 to Train 2/125 VDC Bus #2, and the dependency on both 125 VDC Bus #1 (to trip the normal feeder breaker) and Bus #2 (to close the Train 2 bus tie breaker) to effect the bus transfer.

A review of the applicable one-line, elementary and emergency operating condition diagrams (5148063, 5151906, 5149958) identified the following safety-related loads on SWGR #3 and MCC-3:

DEVICE	DESCRIPTION	ACTUATION	REDUNDANT POST-ACCIDENT LOAD
G-12	Boric Acid Inj.	Remote-man.	NO
G-15C	South CCW Pump	SEQ #2	YES (G-15A, B)
MOV-22	Loop C FW Isol.	SEQ #1	YES (FCV-458)
MOV-358	Recirc to Loop C	Remote-man.	YES (MOV-356, 357)
MOV-883	RWST isol to Chg.	Remote-man.	NO
MOV-850C	UPS backup supply	-----------	NO
MOV-1100D	Recirc to Chg Pp.	SEQ #2	YES (MOV-1100B)

Of the above items which are redundant post-accident loads, MOV-22 has already been addressed under the MFI (ECCS) evaluation, and susceptibility of CCW to common-mode failure via SWGR #3 would only occur if G-15A or G-15B were out of service and G-15C had been creditted to meet the Technical Specification Limiting Conditions for Operation. (Such a susceptibility can be prevented by administrative control.) The remaining redundant post-accident loads are associated with the ECCS recirculation function.

For the ECCS recirculation function, at least one of the redundant valves MOV-1100B or MOV-1100D must open to provide suction to a charging pump, and at least 2 of the 3 redundant valves MOV-356, MOV-357 and MOV-358 must open to provide adequate recirculation flow to the reactor core with one loop spilling. Because the volume control tank (ie., normal) suction path isolation valve MOV-1100C is also interlocked with MOV-1100B and MOV-1100D and is powered in association with whichever charging pump train has been pre-selected to start on a SIS or SISLOP, an evaluation which specifically considers the integrated response of these features to single failures was performed.

The following assumptions were made:

1. The existing design is as follows:

   a. Train 1 components are charging pump G-8B (4160 V Bus #1C power, 125 VDC Bus #1 control, SEQ #1 actuation), MOV-1100B (480 V MCC-1 power and control, SEQ #1 actuation), MOV-356 (480 V MCC-1 power and control, remote-manual actuation).

   b. Train 2 components are charging pump G-8A (4160 V Bus #2C power, 125 VDC Bus #2 control, SEQ #2 actuation) and MOV-357 (MCC-2 power and control, remote-manual actuation).

   c. Components associated with swing 480 V MCC-3 are MOV-1100D (SEQ #2 actuation) and MOV-358 (remote-manual actuation). Transfer of swing 480 V SWGR #3 (and MCC-3) will occur on a SEQ #2 SISLOP if 125 VDC Bus #1 power is available to trip Train 1 feeder breaker 1303, and 125 VDC Bus #2 power is available to close SWGR 2-3 tie breaker 1203. (Interlocks prevent closing the tie breaker until the Train 1 feeder breaker is open.)

   d. If Bus #1C is pre-selected, MOV-1100C is aligned to Train 1 (MCC-1 power and control) and G-8B will start/G-8A will trip on respective SEQ signals. If Bus #2C is pre-selected, MOV-1100C is aligned to Train 2 (MCC-2 power and control) and G-8A will start/G-8B will trip on respective SEQ signals. MOV-1100C actuation occurs on either SEQ signal via energizing of a relay (SIX) in the respective MOV-1100B or MOV-1100D control circuit.

   e. MOV-1100C is interlocked to prevent closing until at least one of MOV-1100B or D is fully open, irrespective of train pre-selection.

   f. Loss of 125 VDC power will disable the associated SEQ and diesel generator governor, and prevent operating 4160 V and 480 V switchgear breakers. Loss of the 125 VDC bus is assumed to result in failure of the diesel generator even if already loaded. However, loss of control for 480 V MCC powered valves would only occur if 480 V (or the 4160 V supply) power was lost.

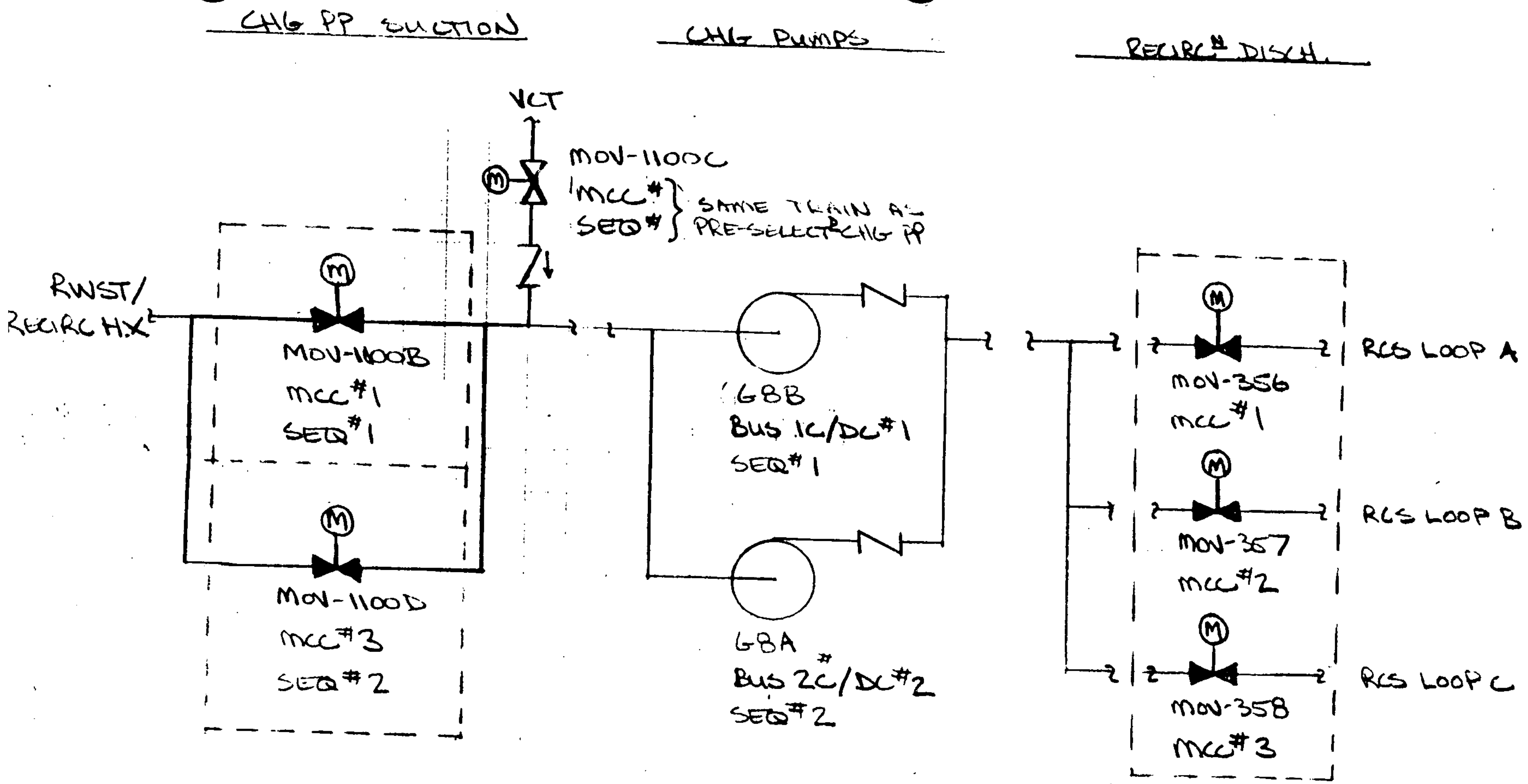
2. The charging pump suction transfer on low-low volume control tank (VCT) level and the low-low-low VCT level trip of G-8A are not fully qualified and are therefore not creditted post-accident. Thus, whether the valves are in AUTO or not, failure of VCT isolation valve MOV-1100C to shut in response to SIS or SISLOP conditions is assumed to result in failure of the pre-selected charging pump, if it can be started (i.e, 125 VDC and 4160 VAC power available), due to cavitation/gas binding.

3. Other than as specified in assumption 2 above, both charging pumps are assumed to be idle at the time of the event. This assumption is conservative because:

   a. It permits credit for a charging pump only if control power is available to close its breaker (continued running of a pump without control power is not creditted), and

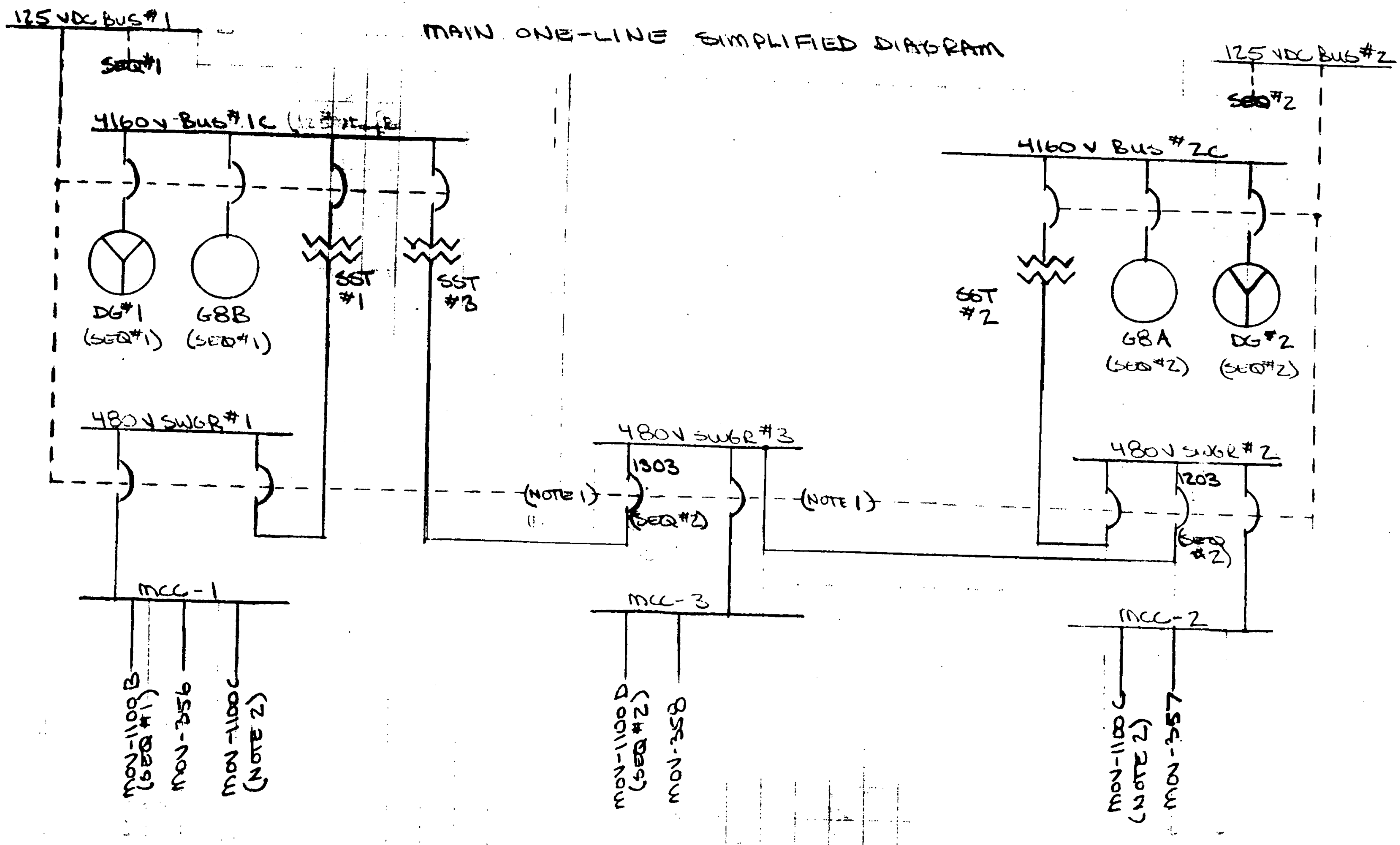
   b. Undesired auto-start or failure of the de-selected pump to trip (if running) could only occur as a result of loss of its SEQ or 125 VDC control power. Failure of DC control power is already assumed to result in loss of the pump per assumption 3.a, and failure of the de-selected pump's SEQ could not affect the VCT isolation valve (MOV-1100C) since it would be aligned to the opposite (selected) train. Thus, loss of both pumps from this failure could only occur if both recirculation suction valves (MOV-1100B and D) failed to open. Since these valves are actuated from opposite SEQs, common failure could only occur if they were subject to a loss of common AC electrical power. And, since the failure is a SEQ (and not a 4160 V bus), such a loss of power could only occur (as a result of failure to start a diesel generator) during a SISLOP. However, since 125 VDC control power would not be affected, the SWGR #3 powered valve (MOV-1100D) would either remain energized from Train 1 (failure to transfer the bus due to loss of SEQ #2) or would become energized from Train 2 (SEQ #2 initiated bus transfer). As neither of these cases results in loss of power to both MOV-1100B and D, such a loss of suction can not occur due to loss of a SEQ, and the identity of the running charging pump need not be considered in this single failure response evaluation.

4. Consequences of an event/single failure combination are considered acceptable if at least one suction valve (MOV-1100B or D), one charging pump (G-8B or A) and two cold leg recirculation valves (MOV-356, 357 and 358) remain available and can be operated from the control room.



POST-LOCA RECIRCULATION
SIMPLIFIED DIAGRAM

MAIN ONE-LINE SIMPLIFIED DIAGRAM



NOTES: 1) SWGR #3 125 VDC CONTROL POWER SWITCHED ~~BY CONTACTOR~~ BASED ON BUS 2-3 TIE BRKR POSITION
2) MOV-1100C POWER & CONTROL PRE-SELECTED TO MATCH PRE-SELECTED CHARGING TRAIN

480 V SWGR #3/MCC-3
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
PREFERRED CHARGING ALIGNMENT: TRAIN 1 (G-8B)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	SWGR 3 ALIGNMENT/PWR/CNTRL	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Train 1 Power available DC available	FAILS (SIGNAL) Shuts normally Opens normally	Available Available	Available Available Available	2 pumps available to 3 cold legs
SEQ #2	Power available DC available	Power available DC available	Train 1 Power available DC available	Opens normally Shuts normally FAILS (SIGNAL)	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs
DC BUS #1	Power available DC FAILS	Power available DC available	Train 1 Power available DC FAILS	FAILS (SIGNAL) Shuts normally Opens normally	FAILS (CONTROL) Available	Available Available Available	1 pump available to 3 cold legs
DC BUS #2	Power available DC available	Power available DC FAILS	Train 1 Power available DC available	Opens normally Shuts normally FAILS (SIGNAL)	Starts normally FAILS (CONTROL)	Available Available Available	1 pump available to 3 cold legs
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Train 1 POWER FAILS DC available	FAILS (POWER) FAILS (POWER) FAILS (POWER)	FAILS (POWER) Available	FAILS (POWER) Available FAILS (POWER)	C/R action required to realign SWGR 3
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Train 1 Power available DC available	Opens normally Shuts normally Opens normally	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs

480 V SWGR #3/MCC-3
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
PREFERRED CHARGING ALIGNMENT: TRAIN 2 (G-8A)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	SWGR 3 ALIGNMENT/PWR/CNTRL	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Train 1 Power available DC available	FAILS (SIGNAL) Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs
SEQ #2	Power available DC available	Power available DC available	Train 1 Power available DC available	Opens normally Shuts normally FAILS (SIGNAL)	Available Available	Available Available Available	2 pumps available to 3 cold legs
DC BUS #1	Power available DC FAILS	Power available DC available	Train 1 Power available DC FAILS	FAILS (SIGNAL) Shuts normally Opens normally	FAILS (CONTROL) Starts normally	Available Available Available	1 pump available to 3 cold legs
DC BUS #2	Power available DC available	Power available DC FAILS	Train 1 Power available DC available	Opens normally Shuts normally FAILS (SIGNAL)	Available FAILS (CONTROL)	Available Available Available	1 pump available to 3 cold legs
4kV Bus 1C	POWER FAILS DC available	Power available DC available	Train 1 POWER FAILS DC available	FAILS (POWER) FAILS (INTERLOCK) FAILS (POWER)	FAILS (POWER) FAILS (CAVITATION)	FAILS (POWER) Available FAILS (POWER)	LOSS OF RECIRC (PUMPS)
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Train 1 Power available DC available	Opens normally FAILS (POWER) Opens normally	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs

480 V SWGR #3/MCC-3
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
PREFERRED CHARGING ALIGNMENT: TRAIN 1 (G-8B)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	SWGR 3 ALIGNMENT/PWR/CNTRL	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Train 1 Power available DC available	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs
SEQ #2	Power available DC available	Power available DC available	Train 1 Power available DC available	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs
DC BUS #1	Power available DC FAILS	Power available DC available	Train 1 Power available DC FAILS	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs
DC BUS #2	Power available DC available	Power available DC FAILS	Train 1 Power available DC available	Opens normally Shuts normally Opens normally	Starts normally FAILS (CONTROL)	Available Available Available	1 pump available to 3 cold legs
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Train 1 POWER FAILS DC available	Opens normally Shuts normally Opens normally	FAILS (POWER) Available	FAILS (POWER) Available FAILS (POWER)	C/R action required to realign SWGR 3
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Train 1 Power available DC available	Opens normally Shuts normally Opens normally	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs

480 V SWGR #3/MCC-3
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
PREFERRED CHARGING ALIGNMENT: TRAIN 2 (G-8A)

SINGLE FAILURE	EFFECT ON RECIRCULATION: TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	SWGR 3 ALIGNMENT/PWR/CNTRL	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Train 1 Power available DC available	Opens normally Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs
SEQ #2	Power available DC available	Power available DC available	Train 1 Power available DC available	Opens normally Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs
DC BUS #1	Power available DC FAILS	Power available DC available	Train 1 Power available DC FAILS	Opens normally Shuts normally Opens normally	FAILS (CONTROL) Starts normally	Available Available Available	1 pump available to 3 cold legs
DC BUS #2	Power available DC available	Power available DC FAILS	Train 1 Power available DC available	Opens normally Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Train 1 POWER FAILS DC available	Opens normally Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available FAILS (POWER)	C/R action required to realign SWGR 3
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Train 1 Power available DC available	Opens normally Shuts normally Opens normally	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs

480 V SWGR #3/MCC-3
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
PREFERRED CHARGING ALIGNMENT: TRAIN 1 (G-8B)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	SWGR 3 ALIGNMENT/PWR/CNTRL	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	POWER FAILS DC available	Power available DC available	Train 2 Power available DC available	FAILS (POWER) FAILS (POWER) Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs
SEQ #2	Power available DC available	POWER FAILS DC available	Train 1 Power available DC available	Opens normally Shuts normally FAILS (SIGNAL)	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs
DC BUS #1	POWER FAILS DC FAILS	Power available DC available	Train 1 POWER FAILS DC FAILS	FAILS (POWER) FAILS (POWER) FAILS (POWER)	FAILS (POWER) Available	FAILS (POWER) Available FAILS (POWER)	LOSS OF RECIRC (VALVES)
DC BUS #2	Power available DC available	POWER FAILS DC FAILS	Train 1 Power available DC available	Opens normally Shuts normally FAILS (SIGNAL)	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Train 2 Power available DC available	FAILS (POWER) FAILS (POWER) Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Train 2 POWER FAILS DC available	Opens normally Shuts normally FAILS (POWER)	Starts normally FAILS (POWER)	Available FAILS (POWER) FAILS (POWER)	C/R action required to realign SWGR 3

480 V SWGR #3/MCC-3
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
PREFERRED CHARGING ALIGNMENT: TRAIN 2 (G-8A)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	SWGR 3 ALIGNMENT/PWR/CNTRL	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	POWER FAILS DC available	Power available DC available	Train 2 Power available DC available	FAILS (POWER) Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs
SEQ #2	Power available DC available	POWER FAILS DC available	Train 1 Power available DC available	Opens normally FAILS (POWER) FAILS (SIGNAL)	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs
DC BUS #1	POWER FAILS DC FAILS	Power available DC available	Train 1 POWER FAILS DC FAILS	FAILS (POWER) FAILS (INTERLOCK) FAILS (POWER)	FAILS (POWER) FAILS (CAVITATION)	FAILS (POWER) Available FAILS (POWER)	LOSS OF RECIRC (PUMPS, VALVES)
DC BUS #2	Power available DC available	POWER FAILS DC FAILS	Train 1 Power available DC available	Opens normally FAILS (POWER) FAILS (SIGNAL)	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Train 2 Power available DC available	FAILS (POWER) Opens normally Shuts normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Train 2 POWER FAILS DC available	Opens normally FAILS (POWER) FAILS (POWER)	Available FAILS (POWER)	Available FAILS (POWER) FAILS (POWER)	C/R action required to realign SWGR 3

480 V SWGR #3/MCC-3
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
PREFERRED CHARGING ALIGNMENT: TRAIN 1 (G-8B)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	SWGR 3 ALIGNMENT/PWR/CNTRL	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Train 2 Power available DC available	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs
SEQ #2	Power available DC available	Power available DC available	Train 2 Power available DC available	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs
DC BUS #1	POWER FAILS DC FAILS	Power available DC available	Train 2 Power available DC available	Opens normally Shuts normally Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs
DC BUS #2	Power available DC available	POWER FAILS DC FAILS	Train 2 POWER FAILS DC FAILS	Opens normally Shuts normally Opens normally	Starts normally FAILS (POWER)	Available FAILS (POWER) FAILS (POWER)	LOSS OF RECIRC (VALVES)
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Train 2 Power available DC available	Opens normally Shuts normally Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Train 2 POWER FAILS DC available	Opens normally Shuts normally Opens normally	Starts normally FAILS (POWER)	Available FAILS (POWER) FAILS (POWER)	C/R action required to realign SWGR 3

480 V SWGR #3/MCC-3
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
PREFERRED CHARGING ALIGNMENT: TRAIN 2 (G-8A)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	SWGR 3 ALIGNMENT/PWR/CNTRL	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Train 2 Power available DC available	Opens normally Shuts normally Opens normally	Available starts normally	Available Available Available	2 pumps available to 3 cold legs
SEQ #2	Power available DC available	Power available DC available	Train 2 Power available DC available	Opens normally Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs
DC BUS #1	POWER FAILS DC FAILS	Power available DC available	Train 2 Power available DC available	Opens normally Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs
DC BUS #2	Power available DC available	POWER FAILS DC FAILS	Train 2 POWER FAILS DC FAILS	Opens normally Shuts normally Opens normally	Available FAILS (POWER)	Available FAILS (POWER) FAILS (POWER)	LOSS OF RECIRC (VALVES)
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Train 2 Power available DC available	Opens normally Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Train 2 POWER FAILS DC available	Opens normally Shuts normally Opens normally	Available FAILS (POWER)	Available FAILS (POWER) FAILS (POWER)	C/R action required to realign SWGR 3

SWING 480 V SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

In Revision 0 of this evaluation, a previously unrecognized potential single failure susceptibility was identified for ESF functions which rely on swing 480 V SWGR #3 or MCC-3 to power one or more redundant components. This susceptibility occurred as a result of the normal/SIS alignment of SWGR #3 to Train 1/125 VDC Bus #1, the SISLOP alignment of SWGR #3 to Train 2/125 VDC Bus #2, and the dependency on both 125 VDC Bus #1 (to trip the normal feeder breaker) and Bus #2 (to close the Train 2 bus tie breaker) to effect the bus transfer.

Subsequently, PFCs 1-88-039, 1-88-5113.02 and 1-88-5113.04 eliminated the SISLOP realignment of SWGR #3 and provided a SIS/SISLOP trip of SWGR #3 (Station Service Transformer 3) normal feeder breaker 152-11C11. Additionally, a SIS/SISLOP trip of SWGR #1 - #3 tie breaker 52-1103 from Sequencer #1, and SWGR #2 - #3 tie breaker 52-1203 from Sequencer #2 was added, to permit normal operation with SWGR #3 powered from SST #3 (as previously) or via the bus tie breakers from SWGR #1 or #2. Further modifications in PFCs 1-88-3501.00 and 1-88-3501.03 reassigned those redundant post-accident loads which would be required before operator action could be creditted outside the control room, including the Charging System recirculation realignment valves.

A review of the applicable one-line, elementary and emergency operating condition diagrams (drawings 5148063, 5151906, 5149958) following implementation of the above identified modifications identified the following safety-related loads remaining on SWGR #3 and MCC-3:

DEVICE	DESCRIPTION	ACTUATION	REDUNDANT POST-ACCIDENT LOAD
G-12	Boric Acid Inj.	Remote-man.	NO
G-15C	South CCW Pump	SEQ #2 *	NO *
MOV-883	RWST isol to Chg.	Remote-man.	YES (CRS-301)
UPS	Battery charger for MOV-850C/358 UPS	-----------	YES (MOV-850A,-850B, -356, -357)

* The susceptibilities of CCW to common-mode failure via SWGR #3 identified in Revision 0 of this evaluation could only occur if G-15A or G-15B were out of service and G-15C had been creditted to meet the Technical Specification Limiting Conditions for Operation. This has been precluded by administratativly prohibiting credit for G-15C under the Technical Specifications. As such, it is no longer a redundant post-accident load.

The redundant post-accident loads which remain on SWGR #3 and MCC-3 (MOV-883 and the MOV-850C/MOV-358 UPS battery charger) are required for the post-LOCA ECCS recirculation function, in the time-frame for which manual action outside the control room can be creditted. Consequently, in Revision 2 of this evaluation, the evaluation of Charging System recirculation short-term realignment will be moved to a separate Part (Part 4), and this Part (Part 3) will evaluate the automatic trip and subsequent long-term operator actions to re-energize SWGR #3 and MCC-3 for the above identified redundant post-accident loads.

The following assumptions are applicable to this evaluation:

1. The electrical system control power and safeguards sequencer assignments are as shown per the attached sketch. Control power for SWGR #3 breakers (including 52-1303) is switched by a contactor controlled by the position of the SWGR #2 - #3 tie breaker, 52-1203 (or manually) as per elementary diagram 5151906.

2. Breakers 52-1103, 52-1203 and 52-1303 are interlocked as per the applicable elementary diagrams (455430, 455431 and 455429, respectively) so that closure of any one of these three breakers requires the other two to be open or racked out (ie, transfer must be by drop-and-pickup). Thus, spurious closure of breakers will not be considered. (Spurious opening of breakers is bounded by failure of the breaker in the open position after the safety signal.)

3. The status of each bus tie and feeder breaker following the single failure will be evaluated as:

   a. AVAILABLE if the respective source of DC control power remains available and the breaker can be opened and closed from the control room without local manual action (eg. to clear the interlock).

   b. INTERLOCKED if the breaker is open and the respective source of DC control power remains available, but the breaker can be closed from the control room only after local manual action to clear the interlock (ie, by tripping or racking open the other 480 V breaker which remains closed).

   c. UNAVAILABLE if the breaker is open and the respective source of DC control power is unavailable for reclosing and fault protection.

   d. LOCAL ONLY if the breaker is closed and the respective source of DC control power is unavailable, so that the breaker can only be opened (eg. to clear the interlock) by manually tripping it locally at the respective switchgear.

e. RACK-OUT ONLY if the breaker itself is failed in the closed position so that the circuit can only be opened (eg. to clear the interlock) by de-energizing the bus and racking out the breaker at the respective switchgear.

f. FAILED if the breaker itself is failed in the open position.

4. Loss of DC control power following failure of the respective Train's 480 V bus is not explicitly considered, because:

   a. Such a failure could not occur until after battery discharge (ie, at least 90 minutes).

   b. The affected breakers could still be tripped or racked open locally to permit realignment of SWGR #3 to the other Train's 480 V bus.

5. A Train/Bus is considered to be:

   a. AVAILABLE to SWGR 3 if it remains energized/energizable and can be aligned to power SWGR 3.

   b. UNAVAILABLE to SWGR 3 if it remains energized/energizable but cannot be aligned to power SWGR 3.

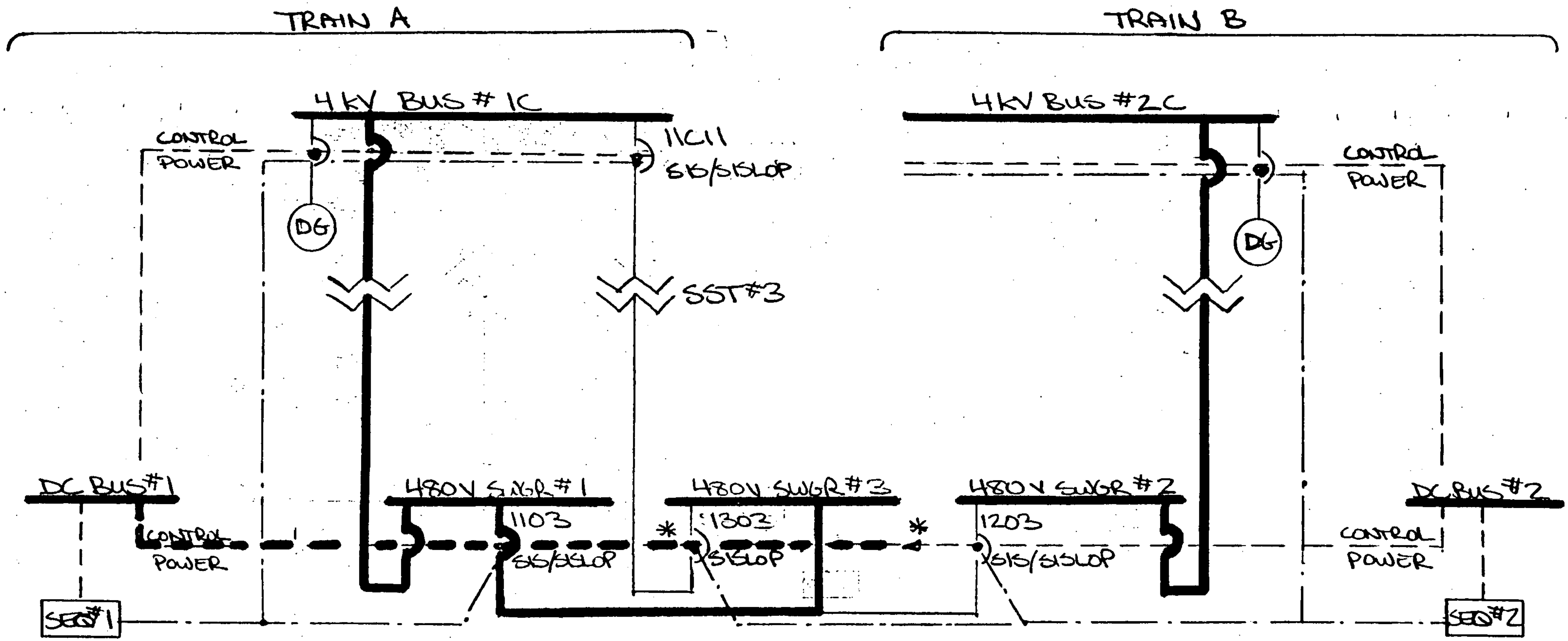
   c. FAILED (OVLD) due to bus undervoltage and/or diesel generator overload, if SWGR #3 remains connected to that Train during SIS/SISLOP loading (ie, with the respective SEQ and DC Bus available).

   d. FAILED (DG) due to Diesel Generator failure, if the DC bus for that Train fails at any time during a SISLOP condition. (Credit is taken for manual Diesel Generator start in the event of SEQ failure.)

6. The consequences of an event/single failure combination will be considered acceptable if at least one Train remains energized/energizable and 2 of the 3 480 V busses (Train A - SWGR #1, Train B - SWGR #2, Swing SWGR #3) remain available, with credit for operator action in the control room and locally at the switchgear, as needed.

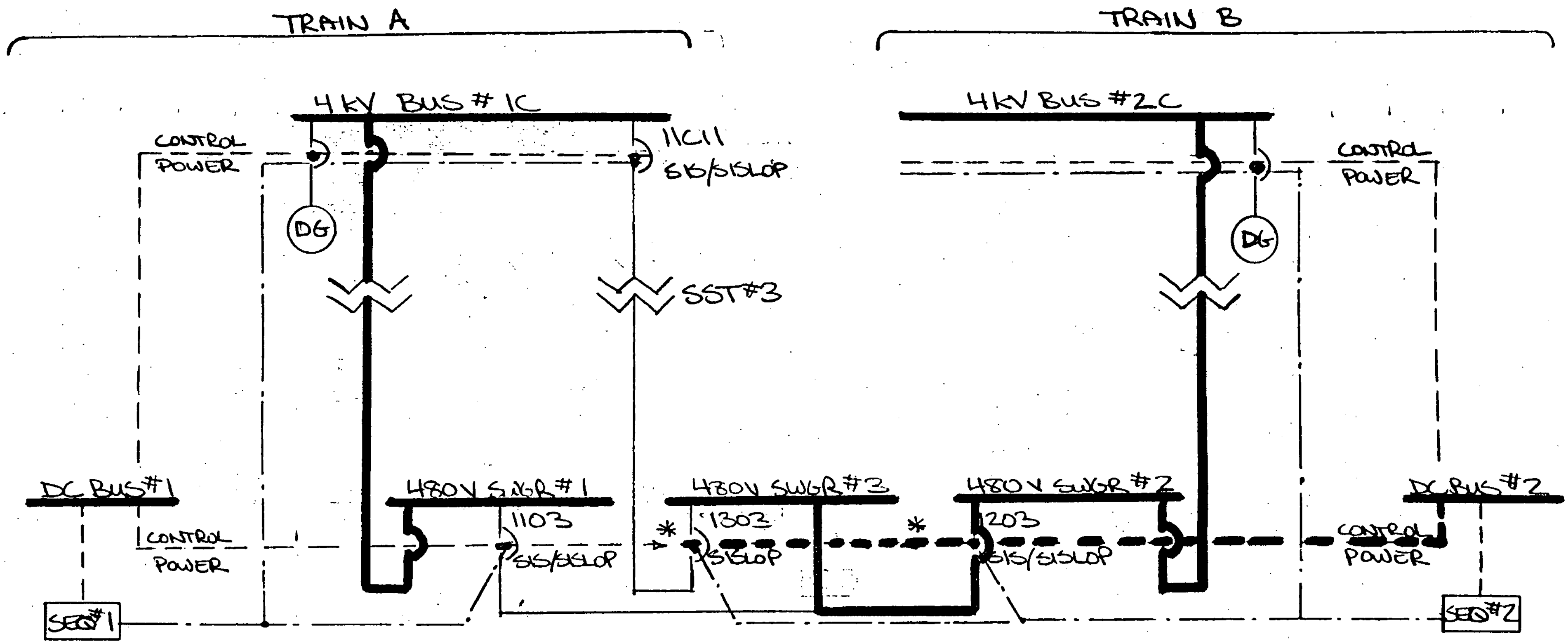
7. Events other than LOCA (with and without loss of off-site power) are not evaluated for SWGR #3 and MCC-3, since the only SWGR #3 and MCC-3 powered post-accident load creditted for a non-LOCA event is MOV-883, which can be closed manually for long-term steam generator recirculation following a MSLB or FWLB-D* event in containment. (MOV-850C is not creditted as a Safety Injection path in the transient analyses for MSLB outside containment, and MOV-358 is not required except for post-LOCA recirculation.)

*FWLB-D is defined in Part 1 of this document.



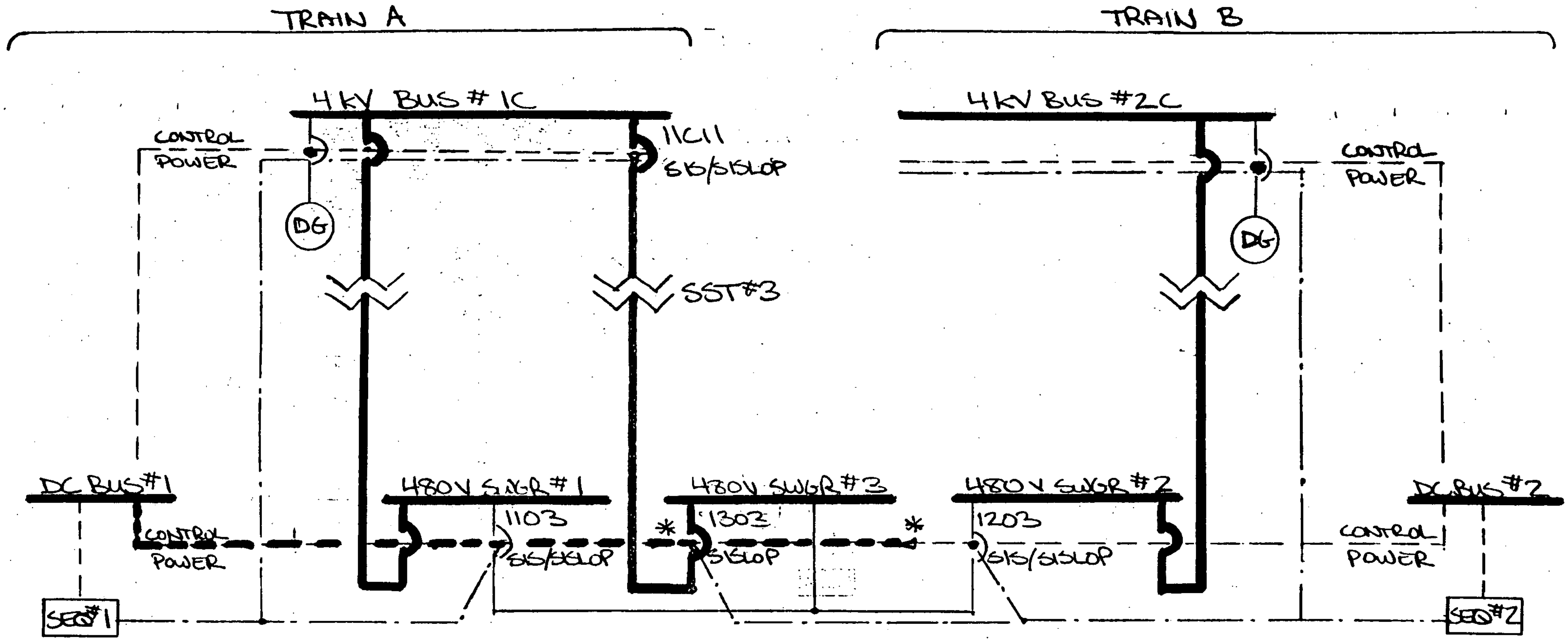
SIMPLIFIED MAIN ONE-LINE DIAGRAM
(SWGR#3 ALIGNED TO SWGR#1)

NOTES: * SWGR #3 CONTROL POWER SWITCHED THROUGH CONTACTOR BASED ON BRKR 52-1203 POSITION (DC#1 WHEN 1203 OPEN, DC#2 WHEN CLOSED)



SIMPLIFIED MAIN ONE-LINE DIAGRAM
(SWGR#3 ALIGNED TO SWGR#2)

NOTES: * SWGR #3 CONTROL POWER SWITCHED THROUGH CONTACTOR BASED ON BRKR 52-1203 POSITION (DC#1 WHEN 1203 OPEN; DC#2 WHEN CLOSED)



SIMPLIFIED MAIN ONE-LINE DIAGRAM
(SWGR#3 ALIGNED TO SST#3/BUS*1C)

NOTES: * SWGR #3 CONTROL POWER SWITCHED THROUGH CONTACTOR BASED ON BRKR 52-1203 POSITION (DC#1 WHEN 1203 OPEN, DC#2 WHEN CLOSED)

SWING 480 V SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
INITIAL SWGR #3 ALIGNMENT: SWGR #1 (BRKR 52-1103)

SINGLE FAILURE	EFFECTS ON: BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	CLOSED DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized Swgr 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
DC BUS #1	CLOSED DC FAILED LOCAL ONLY	Open DC available INTERLOCKED	Open DC (#1) FAILED UNAVAILABLE	Open DC FAILED UNAVAILABLE	Available UNAVAILABLE DC FAILED	Available DC available	2 trains energized SWGR 3 available to Train A from C/R Train B w/LOCAL TRIP
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC FAILED	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1103	CLOSED DC available RACK-OUT ONLY	Open DC available INTERLOCKED	Open DC (#1) available INTERLOCKED	Open DC available Available	FAILED (OVLD) FAILED DC available	Available DC available	Train B energized SWGR 3 available to Train B w/RACK-OUT
BRKR 1203	Open DC available Available	Open DC available FAILED	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available Available	Open DC available Available	Open DC (#1) available FAILED	Open DC available Available	Available UNAVAILABLE DC Available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING 480 V SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
INITIAL SWGR #3 ALIGNMENT: SWGR #2 (BRKR 52-1203)

	EFFECTS ON						
SINGLE FAILURE	BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	CLOSED DC available Available	Open DC (#2) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC available Available	Open DC (#1) FAILED UNAVAILABLE	Open DC FAILED UNAVAILABLE	UNAVAILABLE UNAVAILABLE DC FAILED	Available DC available	2 trains energized SWGR 3 available to Train B from C/R
DC BUS #2	Open DC available INTERLOCKED	CLOSED DC FAILED LOCAL ONLY	Open DC (#2) FAILED INTERLOCKED	Open DC available Available	Available Available DC available	Available DC FAILED	2 trains energized SWGR 3 available to Train A w/LOCAL TRIP Train B from C/R
BRKR 1103	Open DC available FAILED	Open DC available Available	Open DC (#1) available Available	Open DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available INTERLOCKED	CLOSED DC available RACK-OUT ONLY	Open DC (#2) available INTERLOCKED	Open DC available INTERLOCKED	Available Available DC available	FAILED (OVLD) DC available	Train A energized SWGR 3 available to Train A w/RACK-OUT
BRKR 1303	Open DC available Available	Open DC available Available	Open DC (#1) available FAILED	Open DC available Available	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING 480V SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
INITIAL SWGR #3 ALIGNMENT: SST #3 (BUS #1C, BRKRS 152-11C11, 52-1303)

	{———	———	———	———EFFECTS ON———	———	———	———}
SINGLE FAILURE	BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	CLOSED DC (#1) available Available	CLOSED DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	CLOSED DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC available INTERLOCKED	CLOSED DC (#1) FAILED LOCAL ONLY	CLOSED DC FAILED LOCAL ONLY	UNAVAILABLE available DC FAILED	Available DC available	2 trains energized SWGR 3 available to Train A from C/R Train B w/LOCAL TRIP
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	CLOSED DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC FAILED	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1103	Open DC available FAILED	Open DC available Available	CLOSED DC (#1) available Available	Open DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available Available	Open DC available FAILED	CLOSED DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available INTERLOCKED	Open DC available INTERLOCKED	CLOSED DC (#1) available RACK-OUT ONLY	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to Train A from C/R Train B w/RACK-OUT
BRKR 11C11	Open DC available Available	Open DC available Available	CLOSED DC (#1) available Available	CLOSED DC available RACK-OUT ONLY	FAILED (OVLD) FAILED DC available	Available DC available	Train B energized SWGR 3 available to Train B from C/R

SWING 480 SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
INITIAL SWGR #3 ALIGNMENT: SWGR #1 (BRKR 52-1103)

	EFFECTS ON						
SINGLE FAILURE	BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC available Available	Open DC (#1) FAILED UNAVAILABLE	Open DC FAILED UNAVAILABLE	UNAVAILABLE UNAVAILABLE DC FAILED	Available DC available	2 trains energized SWGR 3 available to Train B from C/R
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC FAILED	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1103	Open DC available FAILED	Open DC available Available	Open DC (#1) available Available	Open DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available Available	Open DC available FAILED	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available Available	Open DC available Available	Open DC (#1) available FAILED	Open DC available Available	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING 480 V SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
INITIAL SWGR #3 ALIGNMENT: SWGR #2 (BRKR 52-1203)

SINGLE FAILURE	EFFECTS ON: BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC FAILED UNAVAILABLE	UNAVAILABLE UNAVAILABLE DC FAILED	Available DC available	2 trains energized SWGR 3 available to Train B from C/R
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC FAILED	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1103	Open DC available FAILED	Open DC available Available	Open DC (#1) available Available	Open DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available Available	Open DC available FAILED	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available Available	Open DC available Available	Open DC (#1) available FAILED	Open DC available Available	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING 480 V SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
INITIAL SWGR #3 ALIGNMENT: SST #3 (BUS #1C, BRKRS 152-11C11, 52-1303)

	{----------	----------	----------	-----EFFECTS ON-----	----------	----------	----------}
SINGLE FAILURE	BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	CLOSED DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	CLOSED DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC available INTERLOCKED	CLOSED DC (#1) FAILED LOCAL ONLY	Open DC FAILED UNAVAILABLE	UNAVAILABLE UNAVAILABLE DC FAILED	Available DC available	2 trains energized SWGR 3 available to Train B W/LOCAL TRIP
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	CLOSED DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC FAILED	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1103	Open DC available FAILED	Open DC available Available	CLOSED DC (#1) available Available	Open DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available Available	Open DC available FAILED	CLOSED DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available INTERLOCKED	Open DC available INTERLOCKED	CLOSED DC (#1) available RACK-OUT ONLY	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to Train A from C/R Train B w/RACK-OUT
BRKR 11C11	Open DC available Available	Open DC available Available	CLOSED DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING [illegible] SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
INITIAL SWGR #3 ALIGNMENT: SWGR #1 (BRKR 52-1103)

	EFFECTS ON						
SINGLE FAILURE	BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	CLOSED DC available Available	Open DC available Avialable	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energizable SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energizable SWGR 3 available to 2 trains from C/R
DC BUS #1	CLOSED DC FAILED LOCAL ONLY	Open DC available INTERLOCKED	Open DC (#1) FAILED UNAVAILABLE	Open DC FAILED UNAVAILABLE	FAILED (DG) FAILED DC FAILED	Available DC available	Train B energized SWGR 3 available to Train B w/LOCAL TRIP
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC (#1) available Available	Open DC available Available	Available Available DC available	FAILED (DG) DC FAILED	Train A energized SWGR 3 available to Train A from C/R
BRKR 1103	CLOSED DC available RACK-OUT ONLY	Open DC available INTERLOCKED	Open DC (#1) available INTERLOCKED	Open DC available Available	FAILED (OVLD) FAILED DC available	Available DC available	Train B energized SWGR 3 available to Train B w/RACK-OUT
BRKR 1203	Open DC available Available	Open DC available FAILED	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available Available	Open DC available Available	Open DC (#1) available FAILED	Open DC available Available	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING 480 V SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
INITIAL SWGR #3 ALIGNMENT: SWGR #2 (BRKR 52-1203)

SINGLE FAILURE	EFFECTS ON: BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energizable SWGR 3 available to 2 Trains from C/R
SEQ #2	Open DC available Available	CLOSED DC available Available	Open DC (#2) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energizable SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC available Available	Open DC (#1) FAILED UNAVAILABLE	Open DC FAILED UNAVAILABLE	FAILED (DG) FAILED DC FAILED	Available DC available	Train B energized SWGR 3 available to Train B from C/R
DC BUS #2	Open DC available INTERLOCKED	CLOSED DC FAILED LOCAL ONLY	Open DC (#2) FAILED INTERLOCKED	Open DC available Available	Available Available DC available	FAILED (DG) DC FAILED	Train A energized SWGR 3 available to Train A w/LOCAL TRIP
BRKR 1103	Open DC available FAILED	Open DC available Available	Open DC (#1) available Available	Open DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available INTERLOCKED	CLOSED DC available RACK-OUT ONLY	Open DC (#2) available INTERLOCKED	Open DC available Available	Available Available DC Available	FAILED (OVLD) DC available	Train A energized SWGR 3 available to Train A w/RACK-OUT
BRKR 1303	Open DC available Available	Open DC available Available	Open DC (#1) available FAILED	Open DC available Available	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING 4[illegible] SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
INITIAL SWGR #3 ALIGNMENT: SST #3 (BUS #1C, BRKRS 152-11C11, 52-1303)

	EFFECTS ON						
SINGLE FAILURE	BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	Open DC (#1) available Available	CLOSED DC available Available	Available Available DC available	Available DC available	2 trains energizable SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	CLOSED DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energizable SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC Available INTERLOCKED	CLOSED DC (#1) FAILED LOCAL ONLY	CLOSED DC FAILED UNAVAILABLE	FAILED (DG) FAILED DC FAILED	Available DC available	Train B energized SWGR 3 available to Train B w/LOCAL TRIP
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC (#1) available Available	Open DC available Available	Available Available DC available	FAILED (DG) DC FAILED	Train A energized SWGR 3 available to Train A from C/R
BRKR 1103	Open DC available FAILED	Open DC available Available	Open DC (#1) available Available	Open DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available Available	Open DC available FAILED	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available INTERLOCKED	Open DC available INTERLOCKED	CLOSED DC (#1) available RACK-OUT ONLY	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to Train A from C/R Train B w/RACK-OUT
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	CLOSED DC available RACK-OUT ONLY	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING 480[illegible]WGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
INITIAL SWGR #3 ALIGNMENT: SWGR #1 (BRKR 52-1103)

	EFFECTS ON						
SINGLE FAILURE	BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC FAILED UNAVAILABLE	FAILED (DG) FAILED DC FAILED	Available DC available	Train B energized SWGR 3 available to Train B from C/R
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC (#1) available Available	Open DC available Available	Available Available DC available	FAILED (DG) DC FAILED	Train A energized SWGR 3 available to Train A from C/R
BRKR 1103	Open DC available FAILED	Open DC available Available	Open DC (#1) available Available	OPen DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available Available	Open DC available FAILED	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available Available	Open DC available Available	Open DC (#1) available FAILED	Open DC available Available	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING 480V SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
INITIAL SWGR #3 ALIGNMENT: SWGR #2 (BRKR 52-1203)

	EFFECTS ON						
SINGLE FAILURE	BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC FAILED UNAVAILABLE	FAILED (DG) FAILED DC FAILED	Available DC available	Train B energized SWGR 3 available to Train B from C/R
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC (#1) available Available	Open DC available Available	Available Available DC available	FAILED (DG) DC FAILED	Train A energized SWGR 3 available to Train A from C/R
BRKR 1103	Open DC available FAILED	Open DC available Available	Open DC (#1) available Available	Open DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available Available	Open DC available FAILED	Open DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available Available	Open DC available Available	Open DC (#1) available FAILED	Open DC available Available	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

SWING 480V SWGR #3/MCC-3 REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
INITIAL SWGR #3 ALIGNMENT: SST #3 (BUS #1C, BRKRS 152-11C11, 52-1303)

	{------	------	------	EFFECTS ON	------	------	------}
SINGLE FAILURE	BRKR 52-1103 POSITION/DC/STATUS	BRKR 52-1203 POSITION/DC/STATUS	BRKR 52-1303 POSITION/DC/STATUS	BRKR 152-11C11 POSITION/DC/STATUS	TRAIN A SWGR #1/SST #3/DC	TRAIN B SWGR #2 / DC	NET EFFECT
SEQ #1	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
SEQ #2	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available Available	Available Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
DC BUS #1	Open DC FAILED UNAVAILABLE	Open DC available Available	Open DC (#1) FAILED UNAVAILABLE	Open DC FAILED UNAVAILABLE	FAILED (DG) FAILED DC FAILED	Available DC available	Train B energized SWGR 3 available to Train B from C/R
DC BUS #2	Open DC available Available	Open DC FAILED UNAVAILABLE	Open DC (#1) available Available	Open DC available Available	Available Available DC available	FAILED (DG) DC FAILED	Train A energized SWGR 3 available to Train A from C/R
BRKR 1103	Open DC available FAILED	Open DC available Available	Open DC (#1) available Available	Open DC available Available	UNAVAILABLE Available DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 1203	Open DC available Available	Open DC available FAILED	OPEN DC (#1) available Available	Open DC available Available	Available Available DC available	UNAVAILABLE DC available	2 Trains energized SWGR 3 available to Train A from C/R
BRKR 1303	Open DC available Available	Open DC available Available	Open DC (#1) available FAILED	Open DC available Available	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R
BRKR 11C11	Open DC available Available	Open DC available Available	Open DC (#1) available Available	Open DC available FAILED	Available UNAVAILABLE DC available	Available DC available	2 trains energized SWGR 3 available to 2 trains from C/R

CHARGING SYSTEM RECIRCULATION REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

In Revision 0 of this evaluation, the charging cold-leg recirculation function was evaluated as part of the event-specific single failure response of SWGR #3 and MCC-3, which powered redundant post-LOCA recirculation valves MOV-1100D (redundant to MOV-1100B) and MOV-358 (redundant to MOV-356 and MOV-357). However, these valves were subsequently reconnected to other sources (MCC-2 and the MOV-850C UPS, respectively) by PFCs 1-88-3501.00 and 1-88-3501.03, respectively, to address the Revision 0 findings.

For the cold-leg recirculation function, at least one of the redundant valves MOV-1100B or MOV-1100D must open to provide suction to a charging pump, at least 2 of the 3 redundant valves MOV-356, MOV-357 and MOV-358 must open, and the normal charging path to the loop A cold leg and pressurizer auxiliary spray must be isolated (by closure of FCV-1112 or both of CV-304 and CV-305), to provide adequate cold-leg recirculation flow to the reactor core with one loop spilling. Because the volume control tank (ie., normal) suction path isolation valve MOV-1100C is also interlocked with MOV-1100B and MOV-1100D and is powered in association with whichever charging pump train has been pre-selected to start on a SIS or SISLOP, an evaluation which specifically considers the integrated response of these features to single failures was performed.

The following assumptions are applicable:

1. The design following implementation of PFCs 1-88-3501.00 and 1-88-3501.03 is as follows:

   a. Train 1 components are charging pump G-8B (4160 V Bus #1C power, 125 VDC Bus #1 control, SEQ #1 actuation), MOV-1100B (480 V MCC-1 power and control, SEQ #1 actuation), MOV-356 (480 V MCC-1 power and control, remote-manual actuation), and FCV-1112 (Vital Bus #4 power/control for closure, remote-manual actuation). FCV-1112 fails closed on loss of air. Vital Bus #4 will auto-transfer to a Train 2 (480 V MCC-2) powered source on loss of its normal Train 1 power source (125 VDC Bus #1 powered inverter).

   b. Train 2 components are charging pump G-8A (4160 V Bus #2C power, 125 VDC Bus #2 control, SEQ #2 actuation), MOV-1100D (480 V MCC-2 power and control, SEQ #2 actuation), MOV-357 (480 V MCC-2 power and control, remote-manual actuation), CV-304/HY-1304 and CV-305/HY-1305 (Utility Bus (MCC-2) power and control, remote-manual actuation). CV-304/HY-1304 and CV-305/HY-1305 fail closed on loss of power or loss of air.

c. The only component associated with swing 480 V MCC-3 is the MOV-850C/MOV-358 UPS, which is capable of supporting a 1/2 hour design duty cycle (opening of MOV-850C on SIS or SISLOP, then closing MOV-850C and opening MOV-358 remote-manually 30 minutes later) prior to restoring power to its battery charger. The actions required to re-energize SWGR #3 and MCC-3 to maintain power to MOV-850C and MOV-358 after 1/2 hour are evaluated in Part 3 of this document.

d. If Bus #1C is pre-selected, MOV-1100C is aligned to Train 1 (MCC-1 power and control) and G-8B will start/G-8A will trip on respective SEQ signals. If Bus #2C is pre-selected, MOV-1100C is aligned to Train 2 (MCC-2 power and control) and G-8A will start/G-8B will trip on respective SEQ signals. MOV-1100C actuation occurs on either SEQ signal via energizing of a relay (SIX) in the respective MOV-1100B or MOV-1100D control circuit.

e. MOV-1100C is interlocked to prevent closing until at least one of MOV-1100B or D is fully open, irrespective of train pre-selection.

f. Loss of 125 VDC power will disable the associated SEQ and diesel generator governor, and prevent operating 4160 V and 480 V switchgear breakers. Loss of the 125 VDC bus is assumed to result in failure of the diesel generator even if already loaded. However, loss of control for 480 V MCC powered valves would only occur if 480 V (or the 4160 V supply) power was lost.

2. The charging pump suction transfer on low-low volume control tank (VCT) level and the low-low-low VCT level trip of G-8A are not fully qualified and are therefore not creditted post-accident. Thus, whether the valves are in AUTO or not, failure of VCT isolation valve MOV-1100C to shut in response to SIS or SISLOP conditions is assumed to result in failure of the pre-selected charging pump, if it can be started (i.e, 125 VDC and 4160 VAC power available), due to cavitation/gas binding.

3. Credit is conservatively not taken for closure of FCV-1112, CV-304 or CV-305 on loss of air (eg. due to compressor lock-out on SISLOP or HELB-induced damage to air lines).

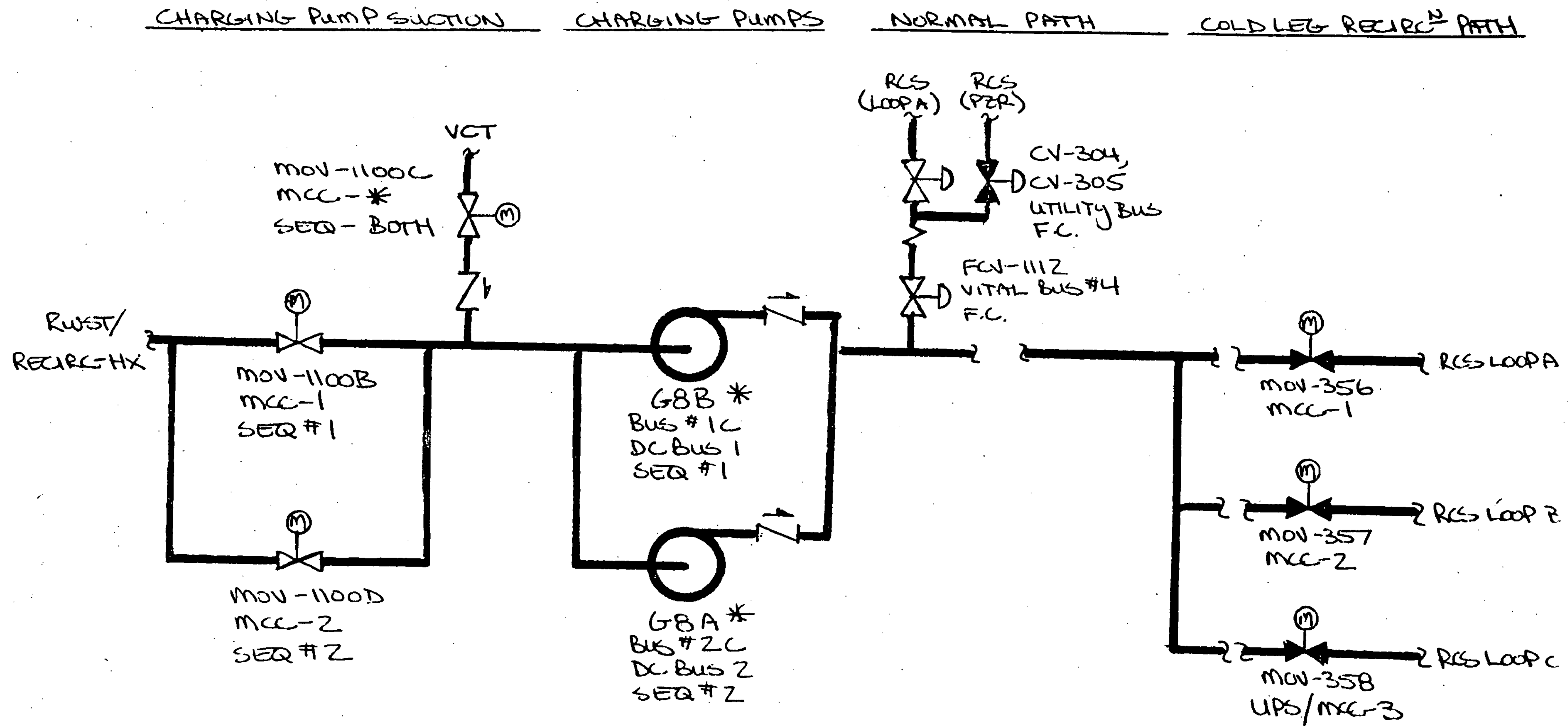
4. Other than as specified in assumption 2 above, both charging pumps are assumed to be idle at the time of the event. This assumption is conservative because:

a. It permits credit for a charging pump only if control power is available to close its breaker (continued running of a pump without control power is not creditted), and

b. Undesired auto-start or failure of the de-selected pump to trip (if running) could only occur as a result of loss of its SEQ or 125 VDC control power. Failure of DC control power is already assumed to result in loss of the pump per assumption 4.a, and failure of the de-selected pump's SEQ could not affect the VCT isolation valve (MOV-1100C) since it would be aligned to the opposite (selected) train. Thus, loss of both pumps from this failure could only occur if both recirculation suction valves (MOV-1100B and D) failed to open. However, since these valves are powered and actuated from opposite trains, such a common mode failure can not occur. Thus, the identity of the running charging pump need not be considered in this single failure response evaluation.

5. Credit is taken for operator action to prevent repositioning of MOV-1100B, C and D to their pre-SIS/SISLOP positions following Sequencer related failures (125 VDC Bus or Sequencer), in accordance with the current SONGS 1 resolution of NRC Inspection and Enforcement Bulletin 80-06.

6. Consequences of an event/single failure combination are considered acceptable if at least one suction valve (MOV-1100B or D), one charging pump (G-8B or A), and two cold leg recirculation valves (MOV-356, 357 and 358) remain available and can be operated from the control room, and the normal charging path can be isolated (by FCV-1112 or the CV-304/CV-305 valve pair) from the control room.



* ONE CHARGING PUMP PRESELECTED TO START / OTHER TO STOP & LOCK-OUT ON SIS/SISLOP; MOV-1100C POWER ALIGNED TO TRAIN PRESELECTED TO START.

CHARGING SYSTEM RECIRCULATION REALIGNMENT SIMPLIFIED DIAGRAM

CHARGING SYSTEM RECIRCULATION REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
PREFERRED CHARGING ALIGNMENT: TRAIN 1 (G-8B)

SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	FCV-1112 CV-304 & CV-305	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
	EFFECT ON RECIRCULATION						
SEQ #1	Power available DC available	Power available DC available	Available Available	FAILS (SIGNAL) Shuts normally Opens normally	Available Available	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
SEQ #2	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally FAILS (SIGNAL)	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
DC BUS #1	Power available DC FAILS	Power available DC available	Available Available	FAILS (SIGNAL) Shuts normally Opens normally	FAILS (CONTROL) Available	Available Available Available	1 pump available to 3 cold legs, normal path isolable
DC BUS #2	Power available DC available	Power available DC FAILS	Available Available	Opens normally Shuts normally FAILS (SIGNAL)	Starts normally FAILS (CONTROL)	Available Available Available	1 pump available to 3 cold legs, normal path isolable
4KV BUS 1C	POWER FAILS DC available	Power available DC available	Available Available	FAILS (POWER) FAILS (POWER) Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
4KV BUS 2C	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally Shuts normally FAILS (POWER)	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated

CHARGING SYSTEM RECIRCULATION REALIGNEMNT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
PREFERRED CHARGING ALIGNMENT: TRAIN 2 (G-8A)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	FCV-1112 CV-304 & CV-305	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Available Available	FAILS (SIGNAL) Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
SEQ #2	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally FAILS (SIGNAL)	Available Available	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
DC BUS #1	Power available DC FAILS	Power available DC available	Available Available	FAILS (SIGNAL) Shuts normally Opens normally	FAILS (CONTROL) Starts normally	Available Available Available	1 pump available to 3 cold legs, normal path isolable
DC BUS #2	Power available DC available	Power available DC FAILS	Available Available	Opens normally Shuts normally FAILS (SIGNAL)	Available FAILS (CONTROL)	Available Available Available	1 pump available to 3 cold legs, normal path isolable
4kV Bus 1C	POWER FAILS DC available	Power available DC available	Available Available	FAILS (POWER) Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
4kV Bus 2C	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally FAILS (POWER) FAILS (POWER)	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated

CHARGING SYSTEM RECIRCULATION REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
PREFERRED CHARGING ALIGNMENT: TRAIN 1 (G-8B)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	FCV-1112 CV-304 & CV-305	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
SEQ #2	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
DC BUS #1	Power available DC FAILS	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
DC BUS #2	Power available DC available	Power available DC FAILS	Available Available	Opens normally Shuts normally Opens normally	Starts normally FAILS (CONTROL)	Available Available Available	1 pump available to 3 cold legs, normal path isolable
4KV BUS 1C	POWER FAILS DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
4KV BUS 2C	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally Shuts normally Opens normally	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated

CHARGING SYSTEM RECIRCULATION REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
PREFERRED CHARGING ALIGNMENT: TRAIN 2 (G-8A)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	FCV-1112 CV-304 & CV-305	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
SEQ #2	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
DC BUS #1	Power available DC FAILS	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	FAILS (CONTROL) Starts normally	Available Available Available	1 pump available to 3 cold legs, normal path isolable
DC BUS #2	Power available DC available	Power available DC FAILS	Available Available	Opens normally Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
4KV BUS 1C	POWER FAILS DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
4KV BUS 2C	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally Shuts normally Opens normally	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated

CHARGING SYSTEM RECIRCULATION REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
PREFERRED CHARGING ALIGNMENT: TRAIN 1 (G-8B)

SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	FCV-1112 CV-304 & CV-305	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
	EFFECT ON RECIRCULATION						
SEQ #1	POWER FAILS DC available	Power available DC available	Available Available	FAILS (POWER) FAILS (POWER) Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
SEQ #2	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally Shuts normally FAILS (POWER)	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated
DC BUS #1	POWER FAILS DC FAILS	Power available DC available	Available Available	FAILS (POWER) FAILS (POWER) Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
DC BUS #2	Power available DC available	POWER FAILS DC FAILS	Available Fails shut	Opens normally Shuts normally FAILS (SIGNAL)	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Available Available	FAILS (POWER) FAILS (POWER) Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally Shuts normally FAILS (POWER)	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated

CHARGING SYSTEM RECIRCULATION REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: PRIOR TO SAFETY SIGNAL
PREFERRED CHARGING ALIGNMENT: TRAIN 2 (G-8A)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	FCV-1112 CV-304 & CV-305	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	POWER FAILS DC available	Power available DC available	Available Available	FAILS (POWER) Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
SEQ #2	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally FAILS (POWER) FAILS (POWER)	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated
DC BUS #1	POWER FAILS DC FAILS	Power available DC available	Available Available	FAILS (POWER) Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
DC BUS #2	Power available DC available	POWER FAILS DC FAILS	Available Fails shut	Opens normally FAILS (POWER) FAILS (POWER)	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Available Available	FAILS (POWER) Opens normally Shuts normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally FAILS (POWER) FAILS (POWER)	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated

CHARGING SYSTEM RECIRCULAITON REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
PREFERRED CHARGING ALIGNMENT: TRAIN 1 (G-8B)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	FCV-1112 CV-304 & CV-305	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
SEQ #2	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	Starts normally Available	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
DC BUS #1	POWER FAILS DC FAILS	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
DC BUS #2	Power available DC available	POWER FAILS DC FAILS	Available Fails shut	Opens normally Shuts normally Opens normally	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	FAILS (POWER) Available	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally Shuts normally Opens normally	Starts normally FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated

CHARGING SYSTEM RECIRCULATION REALIGNMENT
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

SINGLE FAILURE TIMING: AFTER SAFETY SIGNAL, BEFORE RECIRCULATION
PREFERRED CHARGING ALIGNMENT: TRAIN 2 (G-8A)

	EFFECT ON RECIRCULATION						
SINGLE FAILURE	TRAIN 1 POWER/DC CONTROL	TRAIN 2 POWER/DC CONTROL	FCV-1112 CV-304 & CV-305	MOV-1100B/C/D	PUMP G8B/PUMP G8A	MOV-356/-357/-358	NET EFFECT
SEQ #1	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	Available starts normally	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
SEQ #2	Power available DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	Available Starts normally	Available Available Available	2 pumps available to 3 cold legs, normal path isolable
DC BUS #1	POWER FAILS DC FAILS	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
DC BUS #2	Power available DC available	POWER FAILS DC FAILS	Available Fails shut	Opens normally Shuts normally Opens normally	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated
4kV BUS 1C	POWER FAILS DC available	Power available DC available	Available Available	Opens normally Shuts normally Opens normally	FAILS (POWER) Starts normally	FAILS (POWER) Available Available	1 pump available to 2 cold legs, normal path isolable
4kV BUS 2C	Power available DC available	POWER FAILS DC available	Available Fails shut	Opens normally Shuts normally Opens normally	Available FAILS (POWER)	Available FAILS (POWER) Available	1 pump available to 2 cold legs, normal path isolated

MAIN FEEDWATER PUMP REALIGNMENT AND INTERLOCKS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

This evaluation was initially developed as M40664, Revision 0, "Safety Evaluation of Changes to the HV-851/HV-854 Interlocks Not Addressed in Amendment 38 or 52 to the SONGS 1 Provisional Operating License". It has been incorporated verbatim into Revision 2 of this document. This evaluation, in conjunction with the evaluations of Main Feedwater Isolation in Part 2 of this document, and of the post-LOCA termination of Safety Injection/Main Feedwater Pump flow in Design Calculation DC-3089, assess the event-specific single failure response of the Safety Injection System.

BACKGROUND: The design of the main feedwater / safety injection systems at SONGS 1 includes safeguards against the accidental injection of unborated water to the reactor coolant system (RCS). These safeguards include interlocks between the condensate isolation valve on the feedwater pump suction (HV-854 A, B) and the safety injection isolation valve on the feedwater pump discharge (HV-851 A, B). The specific design of these safeguards described in FSA Section 4.1.6 was modified as part of the work described in Amendments 38 and 52. However, while the 10 CFR 50.59 evaluations for the modifications described by these Amendments went into considerable detail for the other facets of the main feedwater pump and isolation valve design (eg, the interlock from condensate suction valve HV-854 A, B position to the safety injection isolation valve HV-851 A, B controls), the modifications to the interlock from safety injection isolation valve (HV-851 A, B) position to the condensate suction isolation valve (HV-854 A, B) controls were not addressed.

The interlock from safety injection isolation valve (HV-851 A, B) position to the condensate suction isolation valve (HV-854 A, B) controls described in FSA Section 4.1.6 is from a limit switch contact which blocks HV-854 opening whenever HV-851 is not fully closed. The interlock between these valves in the post-Amendment 38 and 52 plant, however, is from a limit switch contact which blocks HV-854 opening only when HV-851 is fully open.

DISCUSSION: Under normal operating conditions, the condensate suction isolation valves (HV-854 A,B) are open, the condensate and heater drain pumps are running, the safety injection isolation valves (HV-851 A, B) and the safety injection header isolation valves (MOV-850 A, B, C) are closed, and RCS pressure is greater than the shut-off head of the condensate and feedwater system. Since RCS pressure is greater than condensate and feedwater system shut-off head, injection of unborated water cannot occur even if multiple active failures or operator errors were to result in concurrent opening of an HV-854 condensate suction isolation valve, an HV-851 safety injection isolation valve and an MOV-850 safety injection header isolation valve. In accordance with the Technical Specifications, the Safety Injection Signal

(SIS), which provides a concurrent opening signal to the HV-851 and MOV-850 valves, is blocked before RCS pressure is reduced below the shut-off head of the condensate and feedwater system. Additionally, the Technical Specifications require two positive barriers to condensate and feedwater injection to the RCS whenever RCS pressure is below 500 psi. Thus, the interlock from HV-851 position which blocks HV-854 opening has no effect under normal conditions.

Under SIS conditions, the condensate and heater drain pumps are tripped, the MOV-850 and HV-851 safety injection isolation valves receive an open signal, the HV-854 condensate suction isolation valves receive a close signal, HV-851 opening is dependent on full closure of the associated HV-854 valve (via the HV-854 limit switch position to HV-851 controls interlock), and RCS pressure may decrease below the shut-off head of the condensate and feedwater system. Since the Sequencer for each train sends both the pump trip and valve actuation signals on a SIS, and the limit switches for the interlocks operate from valve stem position rather than from the actuator, there is no single active failure which can both leave condensate or heater drain pumps running and result in an open path to the RCS. Because, however, HV-851 opening on SIS is dependent on the interlock from HV-854 position, failure of the interlock (eg. by failure of one an HV-854 limit switches) could result in both valves being partially open, during condensate and heater drain pump coast-down, while the valves are stroking to the SIS positions. As described in FSA Section 4.1.6.5 (which is based on the 10 second pre-Amendment 38 stroke time of the isolation valves rather than the current 5 second nominal stroke time), this interlock failure would result in injection of a volume of unborated water to the RCS less than that contained between the four isolation valves for each main feedwater pump, and hence, bounded by the assumptions of the design basis transient analyses.

Because HV-854 starts in the normally open position and closes on a SIS in the above single failure scenario, the interlock from HV-851 limit switches to block HV-854 opening has no effect. Further, from the preceeding discussion, it is clear that this interlock would only have an effect on the injection of unborated water to the RCS if HV-854 were already closed and RCS pressure was less than condensate and feedwater system shut-off head. As discussed above, positive controls preclude injection of unborated water to the RCS with RCS pressure reduced under normal conditions. Thus, the interlock would only have an effect under SIS conditions, and only after the SIS actuation of the isolation valves.

As shown in the attached Single Failure Response Evaluation for the current plant configuration, the worst single active failure of a Sequencer, DC control power, HV-851, HV-854 or the associated interlocks, in terms of the injection of unborated water to the RCS, is the above discussed case of both valves partially open in one train during pump coast-down, while stroking to the SIS positions. Single active failure of any device, circuit or power source after SIS actuation would be much less severe, since stroke time to the SIS positions (using energy stored in a gas spring) is nominally 5 seconds, whereas stroke time to the pre-SIS positions (using an air-operated hydraulic pump) is on the order of 5 to 10 minutes. The selection of HV-851 open in lieu of HV-851 not closed, for the limit switch interlock to HV-854, would only affect the potential consequences of unborated injection in the event of HV-851 failure partially open post-SIS, with additional failures (or operator errors) to open HV-854 and restart a condensate or heater drain pump. However, multiple failures of this type, post-accident, are outside the SONGS 1 design basis.

CONCLUSION: Based on the above, the change in the HV-851 limit switch position to 854 control interlock from valve not-closed to valve open in the modifications made under Amendments 38 and 52 does not affect the probability or consequences of relevant design basis events, nor create the possibility of a design basis accident or malfunction of a different type than previously evaluated in the FSA.

(FOR INFORMATION)

~~integrated system test was to demonstrate proper functioning of instrumentation and actuation circuits, to evaluate the dynamics of placing the system in operation, and to expose the system to conditions representative of those which can be expected for loss-of-coolant accidents. Flow was established in all parts of the system.~~ AB

~~Injection system operation was initiated by the installed instrumentation and controls. An injection signal was generated by coincident low pressurizer level and low pressurizer pressure. The flow comparator circuits were tested separately rather than to require an injection flow test through the injection lines.~~

~~Design of the Safety Injection System permits periodic testing of components to assure that the system will perform its design function if it should be called on during plant lifetime. In addition, provisions are available to conduct a no-flow system test on a periodic basis during shutdown conditions.~~

4.1.6 SAFEGUARDS AGAINST ACCIDENTAL INJECTION OF UNBORATED WATER

The reactivity control of the core is dependent upon having boric acid present in the reactor coolant to complement the control rods. The dissolved boric acid provides control of the reactivity associated with the cold to hot operating temperature change, for equilibrium xenon, samarium poisons, and fuel depletion during the life of the plant. Therefore, a large dilution of the reactor coolant boric acid concentration might result in an undesirable insertion of reactivity.

4.1.6.1 Feedwater Pumps

The Safety Injection System utilizes the turbine cycle feedwater pumps. These pumps during normal plant operation are in operation as part of the feedwater and condensate system. The volume of the borated safety injection lines is a total of 302 cubic feet. The two branches to the injection header are not equal in volume, being 104 cubic feet and 123 cubic feet. The injection headers contain a total of 75 cubic feet.

The feedwater pumps are operated during plant operation and develop the head necessary to pump the condensate into the shell side of the steam generators. The pumps operate in series with the condensate and reheater drain pumps in the feedwater train and are dependent upon these pumps for adequate flow and suction conditions. The pumps normally will not be operated independently. During normal operation the condensate pumps provide approximately 70 percent and the reheater drain pump 30 percent of the flow delivered to the feedwater pump suction. The condensate pumps take their suction from the condenser hotwells which have a five-minute full flow storage capacity. The reheater drain pumps deliver the drains from the third point heater into the condensate system upstream of the second point heater.

(FOR INFORMATION)

4.1.6.2 Reactor Coolant System Safeguards

The combined shutoff head of the feedwater and condensate pumps is approximately 1,400 psig. During normal operation of the Reactor Coolant System, the pumps could not deliver any water to the system. In addition, for a substantial part of the plant heatup and cooldown period, no water can be delivered to the system through the safety injection lines. During cold shutdowns when Reactor Coolant System pressure is low, protection against injection of unborated condensate is provided by basic design features, protective interlocks, and administrative procedures which require positive shutoff of flow paths from the source of condensate.

The system design also provides an inherent safeguard against accidental injection of unborated condensate. Even without considering protective interlocks and administrative procedures , it is very unlikely that an operator could produce the degree of system maloperation necessary to inject condensate due to the following:

1. Actuation of the safety injection relays will result in closing the flow path for condensate as well as tripping of the condensate and heater drain pumps. This feature alone provides two-fold assurance that significant quantities of unborated water will not be injected.

2. In order to achieve any condensate injection by individual actuation of components, it is necessary to disregard specific operating instructions, align more than one valve, and start at least one pump.

Protective interlocks between the condensate isolation valves at feedwater pump suction and safety injection header isolation valves at pump discharge will normally be in service during cold shutdown conditions. Interlocks prevent the opening of one valve unless the other is closed, and further assure that an effective barrier to the flow of condensate is maintained.

4.1.6.3 Additional Equipment Safeguards

In addition to the above safety features which are inherent in the design of the Safety Injection System, administrative procedures will be followed during periods of cold shutdown. Equipment will be aligned, de-energized, and cleared

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according to written procedures. Standard clearance procedures of the Southern California Edison Company will be used as required for taking equipment out of operation, assuring proper valve positions, racking open breakers, and tagging controls and equipment.

The clearance procedures are based on the requirement that violation of at least two clearances is required to establish flow of unborated condensate. This criterion also applies to test conditions where it is necessary to operate valves or start individual pumps. The clearance procedure for a valve requires checking for closed valve position and removing the fuses from the combination starters. Clearance of a pump capable of delivering unborated condensate requires racking the breakers to the test position where the conductors are physically disconnected and a metal shield inserted between them. The clearance of each item of equipment will be noted in the operator's log book. A prepared checkoff list will be used to ensure proper clearing of all equipment and serve as a guide to the operator taking the clearance. Cleared components will be tagged at all control points. The tags indicate that operation of the component is prohibited without first having the clearance removed by the responsible operator.

The design features of the Safety Injection System provide reasonable assurance that no accidental injection of borated water can occur. When combined with the clearance procedures that will be used to de-activate pumps and valves during periods of cold shutdown, the degree of protection is such as to render the injection of unborated condensate incredible.

4.1.6.4 Safety Injection Operation

For protection during a loss-of-coolant accident or a large steam break, either of which could initiate safety injection, several safeguards are incorporated in the system design to limit the amount of unborated water to the Reactor Coolant System, including the following:

1. Safety injection lines are filled with water borated to refueling concentration.

2. Actuation of all required components is accomplished as programmed through the main actuation relays, thereby eliminating operator error as a source of malfunction.

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3. Isolation valves which open the discharge of a feedwater pump to the injection header are interlocked to prevent opening, unless the corresponding pump suction valve which isolates the condensate system has completely closed. A similar interlock prevents opening the condensate isolation valve unless the corresponding discharge valve to the injection header is completely closed.

4. Condensate and heater drain pumps are tripped automatically upon initiation of the safety injection signal and full open position of the safety injection pump discharge valve.

4.1.6.5 Interlock Failure

Failure of the normally open contacts of the interlock to complete the circuit upon closing of the suction valve will cause the affected discharge valve to remain shut. The associated injection train will deliver no water, but the other safety injection train will fulfill the safety injection design requirements. In the unlikely event that the interlock contacts on the suction valves fail closed, the suction and discharge valves will move simultaneously upon receiving a safety injection signal. With the condensate pumps tripped, only a portion of the approximately 23 cubic feet of unborated condensate trapped between the feedwater pump isolation valves in one injection train can be injected. The remainder will be swept into the feedwater system. The approximately 23 cubic feet trapped between the suction and discharge valves amounts to the maximum quantity of unborated water which can conceivably be injected with any single failure of a component to respond as required. For loss of coolant cases, this quantity of unborated water is insignificant.

4.1.6.6 Reactivity Change

The effect of the reactivity change produced by the injection of this quantity of unborated water has been analyzed as a condition of the steam break accident, specified in Subsection 8.4, Steam Line Break. The occurrence of this malfunction was also considered during the large steam break transient since there is a rapid temperature reduction with the Reactor Coolant System and no corresponding addition of boron to the coolant. The result of this analysis shows that a limiting condition of reactivity insertion would not be reached if the quantity of unborated water injected were up to 20 times as great as the approximately 23 cubic feet which could be injected in the single failure case described.

MAIN FEEDWATER PUMP REALIGNMENT AND INTERLOCKS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

ITEM	DEVICE/FAILURE	FAILURE TIMING	EFFECTS	OPERATOR ACTIONS
1.1	SEQUENCER	BEFORE SIS	ONE TRAIN STAYS IN FW ALIGNMENT AND TWO OF MOV-850A,B,C OPEN. AFFECTED HV-851 REMAINS CLOSED TO PROVIDE POSITIVE BARRIER	NONE REQD
1.2	SEQUENCER	AFTER SIS, BEFORE HV-851 OPEN	NONE. VALVES, INCLUDING HV-854, REPOSITION FOR SI AND STAY IN SI ALIGNMENT DUE TO CONTROL SEAL-IN	NONE REQD
1.3	SEQUENCER	AFTER HV-851 OPEN, BEFORE SIS RESET	(SAME AS 1.2)	NONE REQD
1.4	SEQUENCER	AFTER SIS RESET	NONE	NONE REQD
2.1	125VDC	BEFORE SIS	(SAME AS 1.1)	NONE REQD
2.2	125VDC	AFTER SIS, BEFORE HV-851 OPEN	VALVES, EXCEPT HV-851, REPOSITION FOR SI THEN BACK TO FW ALIGNMENT. FW AND SI PUMPS START, COND AND HTR DR PUMPS COAST DOWN. POTENTIAL INJECTION OF CONDENSATE BOUNDED BY FSA SECTION 4.1.6.5 ANALYSIS	NONE REQD
2.3	125VDC	AFTER HV-851 OPEN, BEFORE SIS RESET	VALVES, INCLUDING HV-851, REPOSITION FOR SI THEN BACK TO FW ALIGNMENT. FW AND SI PUMPS START, COND AND HTR DR PUMPS COAST DOWN. POTENTIAL INJECTION OF CONDENSATE BOUNDED BY FSA SECTION 4.1.6.5 ANALYSIS	NONE REQD

MAIN FEEDWATER PUMP REALIGNMENT AND INTERLOCKS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

ITEM	DEVICE/FAILURE	FAILURE TIMING	EFFECTS	OPERATOR ACTIONS
2.4	125VDC	AFTER SIS RESET	NONE	NONE REQD
3.1.1	HV-854 (AS-IS)	BEFORE SIS	INTERLOCK FROM LIMIT SWITCHES PREVENTS HV-851 FROM OPENING	NONE REQD
3.1.2	HV-854 (AS-IS)	AFTER SIS, BEFORE HV-851 OPEN	IF HV-854 FAILS AFTER CLOSING, NO EFFECT. IF FAILS IN MID-STROKE, SAME AS 3.1.1	NONE REQD
3.1.3	HV-854 (AS-IS)	AFTER HV-851 OPEN, BEFORE SIS RESET	NONE. (HV-854 FAILED IN CLOSED POSITION)	NONE REQD
3.1.4	HV-854 (AS-IS)	AFTER SIS RESET	(SAME AS 3.1.3)	NONE REQD
3.2.1	OPERATOR ERROR (HV-854 C/S TO OPEN)	BEFORE SIS	NONE. (NORMAL POSITION OF HV-854)	NONE REQD
3.2.2	OPERATOR ERROR (HV-854 C/S TO OPEN)	AFTER SIS, BEFORE HV-851 OPEN	NONE. (HV-854 STAYS IN SI ALIGNMENT DUE TO SIS SIGNAL)	NONE REQD
3.2.3	OPERATOR ERROR (HV-854 C/S TO OPEN)	AFTER HV-851 OPEN, BEFORE SIS RESET	NONE. (HV-854 STAYS IN SI ALIGNMENT DUE TO SIS SIGNAL AND HV-851 INTERLOCK)	NONE REQD
3.2.4	OPERATOR ERROR (HV-854 C/S TO OPEN)	AFTER SIS RESET	NONE. (HV-854 STAYS IN SI ALIGNMENT DUE TO HV-851 INTERLOCK)	NONE REQD
3.3.1	OPERATOR ERROR (HV-854 C/S TO CLOSE)	BEFORE SIS	NO EFFECT ON SAFEGUARDS AGAINST INJECTION OF CONDENSATE. REDUCTION OF FW TO 3 S/G RESULTS IN PLANT TRIP	TRIP AFFECTED FWP TO PREVENT PUMP DAMAGE

MAIN FEEDWATER PUMP REALIGNMENT AND INTERLOCKS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

ITEM	DEVICE/FAILURE	FAILURE TIMING	EFFECTS	OPERATOR ACTIONS
3.3.2	OPERATOR ERROR (HV-854 C/S TO CLOSE)	AFTER SIS, BEFORE HV-851 OPEN	NONE. (HV-854 ALREADY CLOSING ON SIS)	NONE REQD
3.3.3	OPERATOR ERROR (HV-854 C/S TO CLOSE)	AFTER HV-851 OPEN, BEFORE SIS RESET	NONE. (HV-854 ALREADY CLOSED ON SIS)	NONE REQD
3.3.4	OPERATOR ERROR (HV-854 C/S TO CLOSE)	AFTER SIS RESET	NONE. (HV-854 ALREADY CLOSED)	NONE REQD
3.4.1	PASSIVE FAILR (HV-854 (RE)OPENS)	BEFORE SIS	(SAME AS 3.1.1)	NONE REQD
3.4.2	PASSIVE FAILR (HV-854 (RE)OPENS)	AFTER SIS, BEFORE HV-851 OPEN	INTERLOCK CAUSES HV-851 TO RECLOSE FROM MID-STROKE. BOUNDED BY 3.4.3. NOT CREDIBLE FOR LOCA, SLB OR SGTR (DOUBLE PASSIVE FAILURE)	NONE REQD
3.4.3	PASSIVE FAILR (HV-854 (RE)OPENS)	AFTER HV-851 OPEN, BEFORE SIS RESET	INTERLOCK CAUSES HV-851 TO RECLOSE FROM FULL STROKE. NOT CREDIBLE FOR LOCA, SLB OR SGTR (DOUBLE PASSIVE FAILURE). FOR WORST CASE ACTIVE FAILURE (PORV OR STM DUMP), INJ OF COND PRECLUDED SINCE RCS PRESS ABOVE FWP S/O HD WHILE COND PP HD ABOVE SI PP HD	NONE REQD

MAIN FEEDWATER PUMP REALIGNMENT AND INTERLOCKS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

ITEM	DEVICE/FAILURE	FAILURE TIMING	EFFECTS	OPERATOR ACTIONS
3.4.4	PASSIVE FAILR (HV-854 (RE)OPENS)	AFTER SIS RESET	INTERLOCK CAUSES HV-851 TO RECLOSE. SINCE COND AND HTR DRAIN PUMPS ALREADY COASTED DOWN, NO POTENTIAL FOR INJECTION OF CONDENSATE	NONE REQD
4.1.1	HV-851 (AS-IS)	BEFORE SIS	NONE. (HV-854 CLOSES NORMALLY TO ISOLATE CONDENSATE AND HTR DR PUMPS)	NONE REQD
4.1.2	HV-851 (AS-IS)	AFTER SIS, BEFORE HV-851 OPEN	(SAME AS 4.1.1)	NONE REQD
4.1.3	HV-851 (AS-IS)	AFTER HV-851 OPEN, BEFORE SIS RESET	NONE. (TRAIN REALIGNS NORMALLY BEFORE FAILURE)	NONE REQD
4.1.4	HV-851 (AS-IS)	AFTER SIS RESET	(SAME AS 4.1.3)	NONE REQD
4.2.1	OPERATOR ERROR (HV-851 C/S TO OPEN)	BEFORE SIS	NONE. (HV-851 STAYS CLOSED DUE TO HV-854 INTERLOCK)	NONE REQD
4.2.2	OPERATOR ERROR (HV-851 C/S TO OPEN)	AFTER SIS, BEFORE HV-851 OPEN	NONE. (HV-851 STAYS CLOSED UNTIL HV-854 INTERLOCK CLEARS. TRAIN REALIGNS NORMALLY)	NONE REQD
4.2.3	OPERATOR ERROR (HV-851 C/S TO OPEN)	AFTER HV-851 OPENS, BEFORE SIS RESET	NONE. (VALVE ALREADY OPEN)	NONE REQD

MAIN FEEDWATER PUMP REALIGNMENT AND INTERLOCKS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

ITEM	DEVICE/FAILURE	FAILURE TIMING	EFFECTS	OPERATOR ACTIONS
4.2.4	OPERATOR ERROR (HV-851 C/S TO OPEN)	AFTER SIS RESET	(SAME AS 4.2.3)	NONE REQD
4.3.1	OPERATOR ERROR (HV-851 C/S TO CLOSE)	BEFORE SIS	NONE	NONE REQD
4.3.2	OPERATOR ERROR (HV-851 C/S TO CLOSE)	AFTER SIS, BEFORE HV-851 OPEN	NONE. (SIS SIGNAL OVERRIDES CONTROL SWITCH)	NONE REQD
4.3.3	OPERATOR ERROR (HV-851 C/S TO CLOSE)	AFTER HV-851 OPEN, BEFORE SIS RESET	NONE. (HV-851 STAYS IN SI ALIGNMENT DUE TO SIS SIGNAL)	NONE REQD
4.3.4	OPERATOR ERROR (HV-851 C/S TO CLOSE)	AFTER SIS RESET	HV-851 RECLOSES ON AFFECTED TRAIN. NO EFFECT ON HV-854	NONE REQD
4.4.1	PASSIVE FAILR (HV-851 OPENS)	BEFORE SIS	COND INJ DURING NORMAL OPS PRECLUDED BY MOV-850A,B,C AND RCS PRESSURE, EVEN IF INTERLOCK DOES NOT CLOSE HV-854. POTENTIAL INJ OF COND DURING SI CONDITIONS BOUNDED BY FSA SECTION 4.1.6.5. NOT CREDIBLE DURING LOCA, SLB OR SGTR (DOUBLE PASSIVE FAILURE)	NONE REQD

MAIN FEEDWATER PUMP REALIGNMENT AND INTERLOCKS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

ITEM	DEVICE/FAILURE	FAILURE TIMING	EFFECTS	OPERATOR ACTIONS
4.4.2	PASSIVE FAILR (HV-851 OPENS)	AFTER SIS, BEFORE HV-851 OPEN	POTENTIAL COND INJ DURING HV-854 STROKE WHILE COND AND HTR DR PUMPS COAST DOWN BOUNDED BY FSA SECTION 4.1.6.5 ANALYSIS. NOT CREDIBLE DURING LOCA, SLB OR SGTR (DOUBLE PASSIVE FAILURE)	NONE REQD
4.4.3	PASSIVE FAILR (HV-851 OPENS)	AFTER HV-851 OPEN, BEFORE SIS RESET	NO EFFECT (HV-851 ALREADY OPEN). EVENT NOT CREDIBLE DURING LOCA, SLB OR SGTR	NONE REQD
4.4.4	PASSIVE FAILR (HV-851 OPENS)	AFTER SIS RESET	(SAME AS 4.4.3)	NONE REQD
5.1.1	HV-854 LIMIT SW (SPURIOUS CLOSED SIGNAL)	BEFORE SIS	INTERLOCK TO HV-851 DEFEATED. HV-851 WILL BEGIN OPENING CONCURRENT WITH HV-854 CLOSURE ON SIS. POTENTIAL INJ OF COND BOUNDED BY FSA SECTION 4.1.6.5 ANALYSIS	NONE REQD
5.1.2	HV-854 LIMIT SW (SPURIOUS CLOSED SIGNAL)	AFTER SIS, BEFORE HV-851 OPEN	(SAME AS 5.1.1)	NONE REQD
5.1.3	HV-854 LIMIT SW (SPURIOUS CLOSED SIGNAL)	AFTER HV-851 OPEN, BEFORE SIS RESET	NONE. (HV-854 ALREADY CLOSED IN RESPONSE TO SIS)	NONE REQD

MAIN FEEDWATER PUMP REALIGNMENT AND INTERLOCKS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

ITEM	DEVICE/FAILURE	FAILURE TIMING	EFFECTS	OPERATOR ACTIONS
5.1.4	HV-854 LIMIT SW (SPURIOUS CLOSED SIGNAL)	AFTER SIS RESET	(SAME AS 5.1.3)	NONE REQD
5.2.1	HV-854 LIMIT SW (SPURIOUS OPEN SIGNAL)	BEFORE SIS	NONE. (VALVE NORMALLY OPEN. REDUNDANT SW WILL PROVIDE PERMISSIVE FOR HV-851 WHEN HV-854 STROKED CLOSED ON SIS)	NONE REQD
5.2.2	HV-854 LIMIT SW (SPURIOUS OPEN SIGNAL)	AFTER SIS, BEFORE HV-851 OPEN	NONE. (REDUNDANT SW PROVIDES PERMISSIVE FOR HV-851 WHEN HV-854 CLOSED ON SIS)	NONE REQD
5.2.3	HV-854 LIMIT SW (SPURIOUS OPEN SIGNAL)	AFTER HV-851 OPEN, BEFORE SIS RESET	NONE. (VALVES ALREADY IN SI POSITIONS. REDUNDANT SWITCH MAINTAINS PERMISSIVE FOR HV-851 WHEN HV-854 STROKED CLOSED ON SIS)	NONE REQD
5.2.4	HV-854 LIMIT SW (SPURIOUS OPEN SIGNAL)	AFTER SIS RESET	(SAME AS 5.2.3)	NONE REQD
6.1.1	HV-851 LIMIT SW (SPURIOUS OPEN SIGNAL)	BEFORE SIS	HV-854 CLOSES DUE TO INTERLOCK. REDUCTION OF FW TO 3 S/G RESULTS IN PLANT TRIP	TRIP AFFECTED FWP TO PREVENT PUMP DAMAGE
6.1.2	HV-851 LIMIT SW (SPURIOUS OPEN SIGNAL)	AFTER SIS, BEFORE HV-851 OPEN	NONE. (HV-854 ALREADY CLOSING ON SIS)	NONE REQD

MAIN FEEDWATER PUMP REALIGNMENT AND INTERLOCKS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

ITEM	DEVICE/FAILURE	FAILURE TIMING	EFFECTS	OPERATOR ACTIONS
6.1.3	HV-851 LIMIT SW (SPURIOUS OPEN SIGNAL)	AFTER HV-851 OPEN, BEFORE SIS RESET	NONE. (HV-854 ALREADY CLOSED)	NONE REQD
6.1.4	HV-851 LIMIT SW (SPURIOUS OPEN SIGNAL)	AFTER SIS RESET	NO EFFECT ON SAFEGUARDS AGAINST INJECTION OF CONDENSATE. HOWEVER, HV-854 CANNOT BE REPOSITIONED AFTER SI SECURED	NONE REQD
6.2.1	HV-851 LIMIT SW (SPURIOUS CLOSED SIGNAL)	BEFORE SIS	NONE. (HV-851 IS NORMALLY CLOSED. INTERLOCK TO HV-854 REMAINS FUNCTIONAL DUE TO REDUNDANT SWITCH)	NONE REQD
6.2.2	HV-851 LIMIT SW (SPURIOUS CLOSED SIGNAL)	AFTER SIS, BEFORE HV-851 OPEN	NONE. (INTERLOCK SW DOES NOT AFFECT HV-854 CLOSURE ON SIS. INTERLOCK REMAINS FUNCTIONAL DUE TO REDUNDANT SWITCH)	NONE REQD
6.2.3	HV-851 LIMIT SW (SPURIOUS CLOSED SIGNAL)	AFTER HV-851 OPEN, BEFORE SIS RESET	(SAME AS 6.2.2)	NONE REQD
6.2.4	HV-851 LIMIT SW (SPURIOUS CLOSED SIGNAL)	AFTER SIS RESET	(SAME AS 6.2.2)	NONE REQD

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

Assumptions:

1. The Main Feedwater (MFW) isolation design following implementation of PFCs 1-88-3501.0, 1-88-3501.1, 1-88-3501.2, 1-88-3364.02 and 1-88-3472 is as follows:

   a. Electrical power alignment, control power and safeguards sequencer assignment for each subsystem or device is as per the attached sketch. (Reference applicable elementary diagrams and P&IDs 5178115, 5178205 and 5178206.)

   b. The MFW pump realignment valves fail to their normal (MFW) positions on loss of control power. Response time for realignment valves HV-852A and HV-852B is less than or equal to 5 seconds following receipt of a SIS. The MFW pumps trip on SIS or SISLOP and restart 11 seconds later.

   c. Motor operated valves MOV-20, MOV-21 and MOV-22 are environmentally qualified and fail as-is on loss of control or motive power. Response time for these valves is less than or equal to 10 seconds following receipt of a SIS and less than or equal to 21 seconds (including diesel generator and sequencer load group delays) following receipt of a SISLOP.

   d. Pneumatically operated valves FCV-456, FCV-457 and FCV-458 fail open on loss of actuator gas pressure. Actuation of the associated environmentally qualified isolation pilot solenoid valves blocks the respective positioner pneumatic signal and applies air or backup nitrogen pressure to the actuator diaphragm. Concurrent actuation of the associated environmentally qualified damper bypass solenoid valve ensures that the closure time for these valves is less than or equal to 10 seconds following receipt of a SIS or SISLOP.

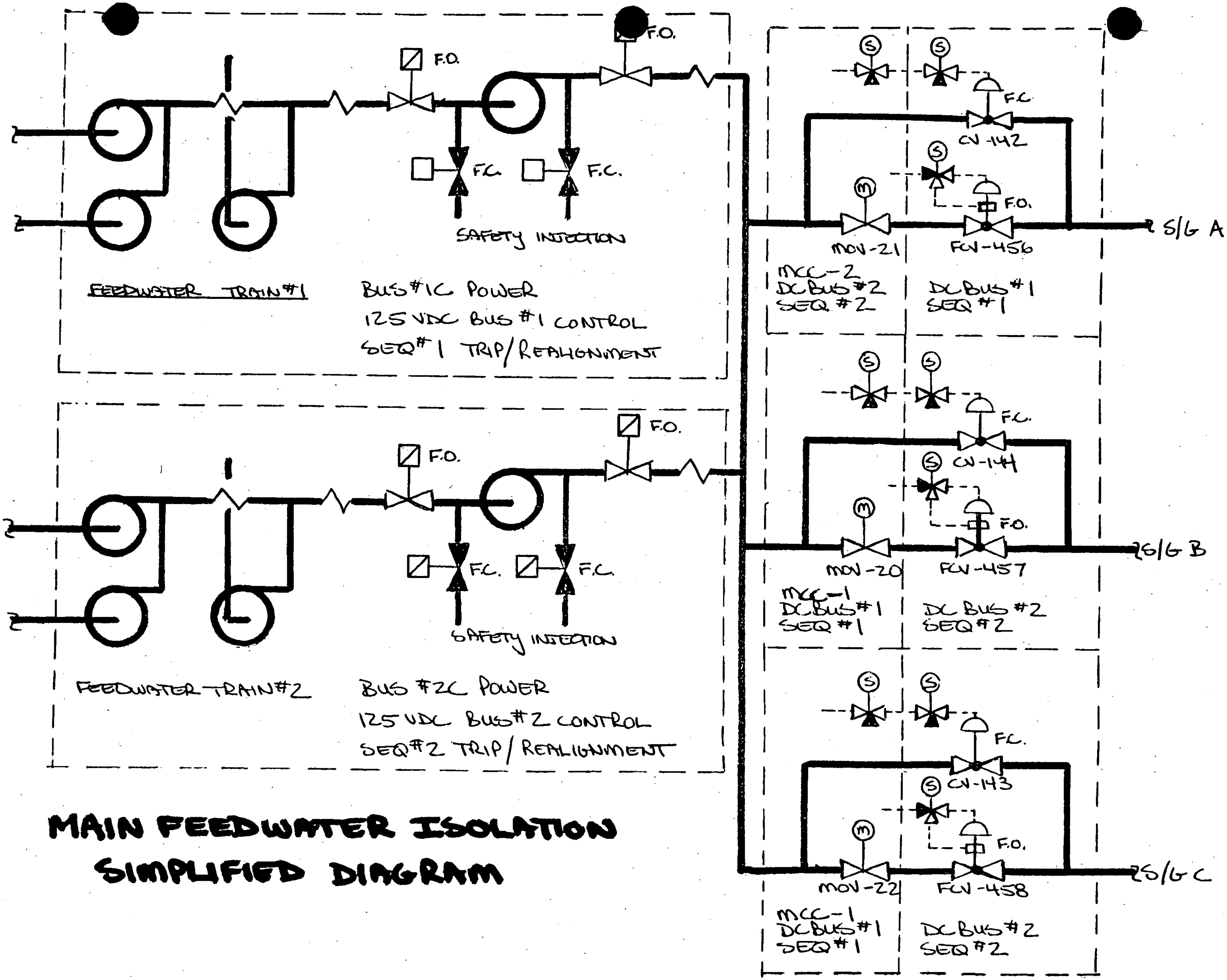
   e. Pneumatically operated valves CV-142, CV-143 and CV-144 fail closed on loss of actuator gas pressure. Actuation of either of the redundant environmentally qualified isolation pilot solenoid valves on each CV isolates and vents the actuator diaphragms. The response time for these valves is less than or equal to 10 seconds following receipt of a SIS or SISLOP.

2. The main steam line break accident analyses assume main feedwater isolation within 10 seconds following receipt of the SIS actuation signal (no loss of off-site power), and that

safety injection flow to the reactor coolant system (RCS) occurs after realignment of either FW/SIS train when RCS pressure decreases below SI system shut-off head. It is assumed that the integrated main feedwater flow for the SIS/10 second isolation case bounds that of the SISLOP/21 second isolation case, due to the pump coastdown which would occur following the loss of off-site power.

3. For postulated loss of 125 VDC control power, the affected 4kV breakers cannot be tripped from the control room; trip of the associated pumps is therefore creditted only after local operator action (in the 4kV room).

4. The applicable events are evaluated both with and without offsite power.



MAIN FEEDWATER ISOLATION
SIMPLIFIED DIAGRAM

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN STEAM LINE BREAK, INSIDE CONTAINMENT
NO LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: UNQUALIFIED LEVEL TRANSMITTERS IN HARSH ENVIRONMENT. ASSUMED FULL OPEN SIGNAL TO FCVs (IN AUTO)
AIR: NO EFFECT. (Unqualified devices outside harsh area; compressor capacity adequate to maintain pressure at FCVs)

	EFFECT ON MAIN FEEDWATER ISOLATION					
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	SI FLOW TO FW HEADER	NONE (Train realigns normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE
HV-852A	NONE (Train realigns normally)	SI FLOW TO FW HEADER	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE
SEQ #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
SEQ #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	NONE
DC BUS #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
DC BUS #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	NONE

*OR FULL OPEN IF IN AUTO

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN STEAM LINE BREAK, INSIDE CONTAINMENT
WITH LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: UNQUALIFIED LEVEL TRANSMITTERS IN HARSH ENVIRONMENT. ASSUMED FULL OPEN SIGNAL TO FCVs (IN AUTO)
AIR: LOST AS A RESULT OF SISLOP/LOP. FCVs FAIL OPEN (UNLESS SV ACTUATED)

	EFFECT ON MAIN FEEDWATER ISOLATION					
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	SI FLOW TO FW HEADER	NONE (Train realigns normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE
HV-852A	NONE (Train realigns normally)	SI FLOW TO FW HEADER	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE
SEQ #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
SEQ #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE
DC BUS #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
DC BUS #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN STEAM LINE BREAK, OUTSIDE CONTAINMENT
NO LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: UNQUALIFIED FCV AND CV POSITIONERS IN HARSH ENVIRONMENT. FCVs ASSUMED TO FAIL OPEN (UNLESS SV ACTUATED)
AIR: UNQUALIFIED COMPRESSORS IN HARSH ENVIRONMENT; AIR LINES ASSUMED IMPACTED. FCVs FAIL OPEN (UNLESS SV ACTUATED)

	EFFECT ON MAIN FEEDWATER ISOLATION					
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	SI FLOW TO FW HEADER	NONE (Train realigns normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE
HV-852A	NONE (Train realigns normally)	SI FLOW TO FW HEADER	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE
SEQ #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
SEQ #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE
DC BUS #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
DC BUS #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN STEAM LINE BREAK, OUTSIDE CONTAINMENT
WITH LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: UNQUALIFIED FCV AND CV POSITIONERS IN HARSH ENVIRONMENT. FCVs ASSUMED TO FAIL OPEN (UNLESS SV ACTUATED)
AIR: LOST AS A RESULT OF SISLOP/LOP. FCVs FAIL OPEN (UNLESS SV ACTUATED)

	EFFECT ON MAIN FEEDWATER ISOLATION					
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	SI FLOW TO FW HEADER	NONE (Train realigns normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE
HV-852A	NONE (Train realigns normally)	SI FLOW TO FW HEADER	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE
SEQ #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
SEQ #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE
DC BUS #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
DC BUS #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: UNQUALIFIED LEVEL TRANSMITTERS IN HARSH ENVIRONMENT. ASSUMED FULL OPEN SIGNAL TO FCVs (IN AUTO)
AIR: NO EFFECT. (Unqualified devices not significantly affected in first 30 minutes; compressor capacity adequate to maintain pressure at FCVs)

	EFFECT ON MAIN FEEDWATER ISOLATION					
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	NONE (RCS less than S/G pressure)	NONE (Train realigns normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE
HV-852A	NONE (Train realigns normally)	NONE (RCS less than S/G pressure)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE
SEQ #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
SEQ #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	NONE
DC BUS #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
DC BUS #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV isolates normally	NONE

*OR FULL OPEN IF IN AUTO

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:

FWCS: UNQUALIFIED LEVEL TRANSMITTERS IN HARSH ENVIRONMENT. ASSUMED FULL OPEN SIGNAL TO FCVs (IN AUTO)

AIR: LOST AS A RESULT OF SISLOP/LOP. FCVs FAIL OPEN (UNLESS SV ACTUATED)

	EFFECT ON MAIN FEEDWATER ISOLATION					
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	NONE (RCS less than S/G pressure)	NONE (Train realigns normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE
HV-852A	NONE (Train realigns normally)	NONE (RCS less than S/G pressure)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE (MOV, FCV, CV isolate normally)	NONE
SEQ #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
SEQ #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE
DC BUS #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	NONE
DC BUS #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

Assumptions:

1. The AFW design, following implementation of PFCs 1-88-3364.00, 1-88-3364.01, 1-88-3364.03 and 1-88-3364.04 has, the following features:

   a. Parallel flow control valves (FCVs) to each steam generator (S/G), one Train A (fail closed on loss of power) and one Train B (fail open on loss of power).

   b. One AFW flow indicator per S/G (Train B).

   c. Pumps G-10 and G-10S on Train A.

   d. Pump G-10W on Train B.

   e. Interlocks prevent auto-start of G-10 or G-10S unless lead pump (G-10W) fails.

   f. Flow restrictions prevent exceeding pump run-out or water hammer limits.

   g. Redundant isolation of steam generator blowdown downstream of sample lines. At least two series sample isolation valves in the safety related portion of each line, one Train A (fail closed on loss of power), and the other manual.

2. The RPS steam/feedwater flow mismatch scram has been modified per PFC 1-88-3496 to preclude common mode failure (eg. PT-459 input) and to have channel trip on both negative and positive mismatch (inadequate or excess feedwater flow). The existing 2 out of 3 steam generator logic for reactor scram is retained. Single failure is thus precluded from preventing early reactor scram except for the loss of main feedwater to a single steam generator event; for this event, mismatch scram will not occur, since only one steam generator is affected.

3. Loss of offsite power and single active failure are assumed in addition to the initiating event; however, scram on the Loss of Power (LOP) signal from the Safeguards Load Sequencers is not creditted.

4. Loss of train power is conservatively assumed to include the associated control power supply.

5. No credit is taken for local manual operation of pump G-10.

6. The applicable RPS/AFW transient analysis references are as follows:

CASE A: Loss of Normal Feedwater to 1 S/G, from 100% power
Reactor trip on high pressurizer water level (50%)
AFW flow of 185 gpm at 30 minutes
[Case 1 of W letter SCE-87-612 to SCE dated 8/7/87]

CASE B: Loss of Normal Feedwater to 3 S/G, from 100% power
Reactor trip on steam/feedwater flow mismatch
AFW flow of 165 gpm at 30 minutes
[Case 1 of SCE letter to NRC dated 5/1/1986]

CASE C: Loss of Normal Feedwater to 3 S/G, from 50% power
Reactor trip on high pressurizer water level (50%)
AFW flow of 185 gpm at 30 minutes
[Case 2 of W letter SCE-87-612 to SCE dated 8/7/87]

CASE D: Main Feed Line Break (upstream), from 100% power
Reactor trip on steam/feedwater flow mismatch
AFW flow of 125 gpm at 30 minutes
[Case 3 of W letter SCE-87-612 to SCE dated 8/7/87]

CASE E: Main Feed Line Break (upstream), from 50% power
Reactor trip on high pressurizer water level (50%)
AFW flow of 125 gpm at 15 minutes
[Case 4 of W letter SCE-87-612 to SCE dated 8/7/87]

CASE F: Main Feed Line Break (downstream), from 100% power
Reactor trip on steam/feedwater flow mismatch
AFW flow of 250 gpm at 15 min (+ 5 min to refill lines)
[Case 2 of SCE letter to NRC dated 5/1/87]

CASE G: Main Feed Line Break (downstream), from 50% power
Reactor trip on high pressurizer pressure
AFW flow of 250 gpm at 15 min (+ 5 min to refill lines)
[Case 5 of W letter SCE-87-612 to SCE dated 8/7/87]

(FOR INFORMATION)

SUMMARY TABLE OF HYDRAULIC CALCULATION(1) SUPPLEMENT RESULTS FOR AFWS MODIFICATIONS UNDER DCP 3364.00TJ

A CASE NO.	B PUMP OPERATING	C STEAM S/G1A	D GEN S/G1B	E PRESS(PSIG) S/G1C	F AFWS S/G1A	G FLOW(GPM) S/G1B	H TO S/G1C	I TOTAL GPM TO S/Gs (4)	J TOTAL(3) AFWS FLOW	K FLOW REQ'D W/O MARGIN(2)	L AFWS FLOW REQ'D/7% MARG AT PUMP	
1	G10S	---------ATMOSPHERIC---------			130	130	130	372 (MSLB)	401	250 (1.3.5.6)	267	ACCEPTABLE
								248* + 12 GPM (FWLB) w/SAMPLES ISOL		405 (1.3.5.8)		ACCEPTABLE
										150/SG (1.3.5.9)		ACCEPTABLE
3	G10W	---------ATMOSPHERIC---------			134	134	134	384 (MSLB)	443	250 (1.3.5.6)	267	ACCEPTABLE
								256 + 12 GPM (FWLB) w/SAMPLES ISOL		150/SG (1.3.5.9)		ACCEPTABLE
6	G10W	1015	1015	1015	83	83	83	231 +18 w/SAMPLES ISOL	291	185 (1.3.5.1)	198	ACCEPTABLE
7	G10+G10S	1015	1015	1015	85	85	85	237	311	185 (1.3.5.1)	198	ACCEPTABLE
8	G10S	1015	1015	1015	68	68	68	186	225	165 (1.3.5.2)	176.6	ACCEPTABLE
9	G10	1015	1015	1015	79	79	79	219	275	165 (1.3.5.3)	176	ACCEPTABLE
10	G10+G10S	1015	1015	BREAK TO ATMOS	65	65	189	118* +12 w/SAMPLES ISOL	374	125 (1.3.5.5)	133	ACCEPTABLE *
11	G10W	BREAK TO AMOS	1015	1015	184	46	46	80	319	125	133	N/A
		OPERATOR EQUALIZES FLOW			83	83	83	154 +12 w/SAMPLES ISOL	291	125 (1.3.5.4)	133	ACCEPTABLE
OTHER CASES NOT INCLUDED IN HYDRAULIC CALCULATIONS:												
9B	G10	1015	1015	BREAK TO AMOS	44	44	182	76	308			
		OPERATOR EQUALIZES FLOW			79	79	79	146	275	125 (1.3.5.3)	133.75	ACCEPTABLE

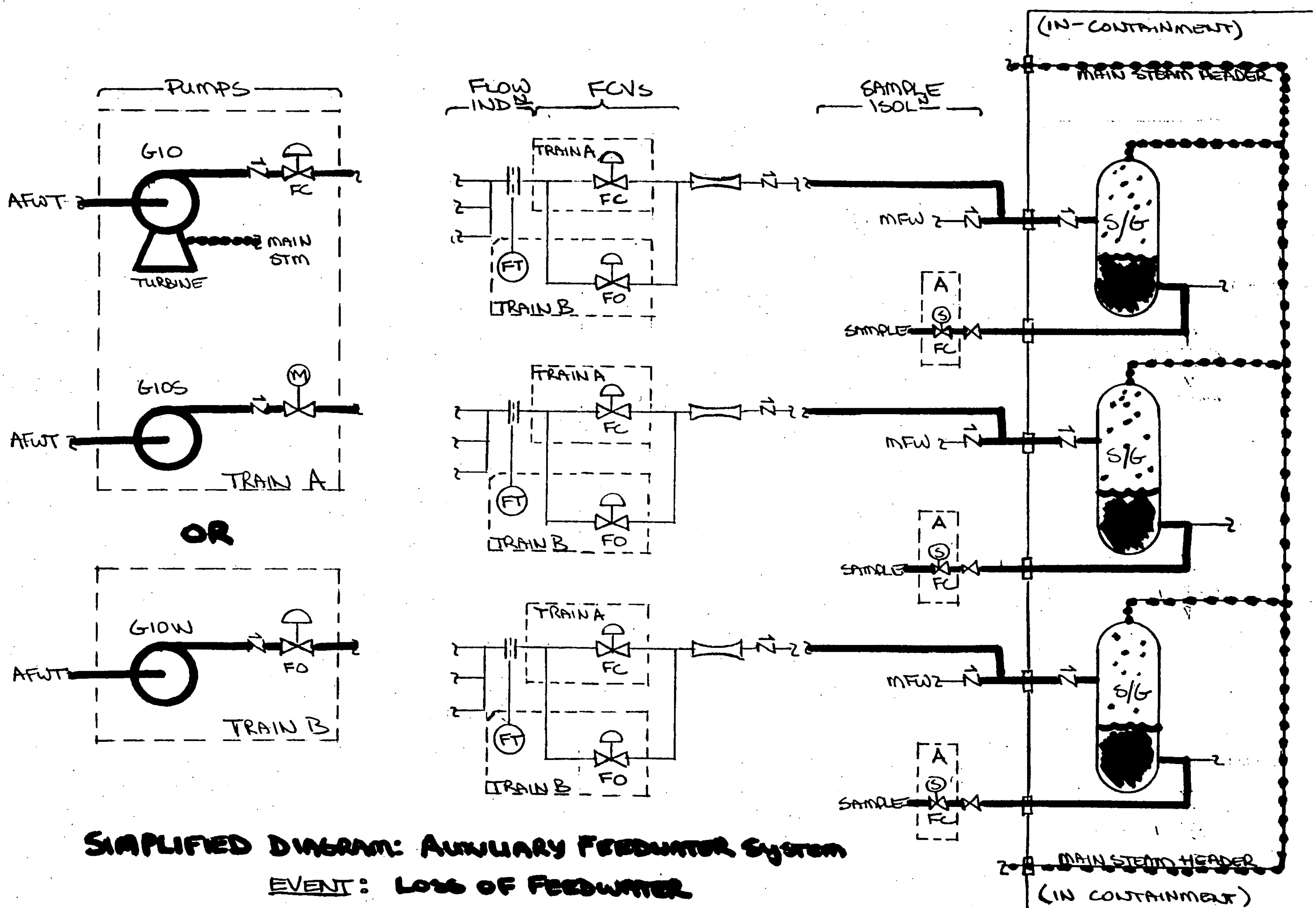
* REMOTE ISOLATION OF SAMPLE LINES ARE REQUIRED

(1) DC2836 AFWS HYDRAULIC CALCULATION

(2) M86315 DESIGN CRITERIA, AFWS MODIFICATIONS

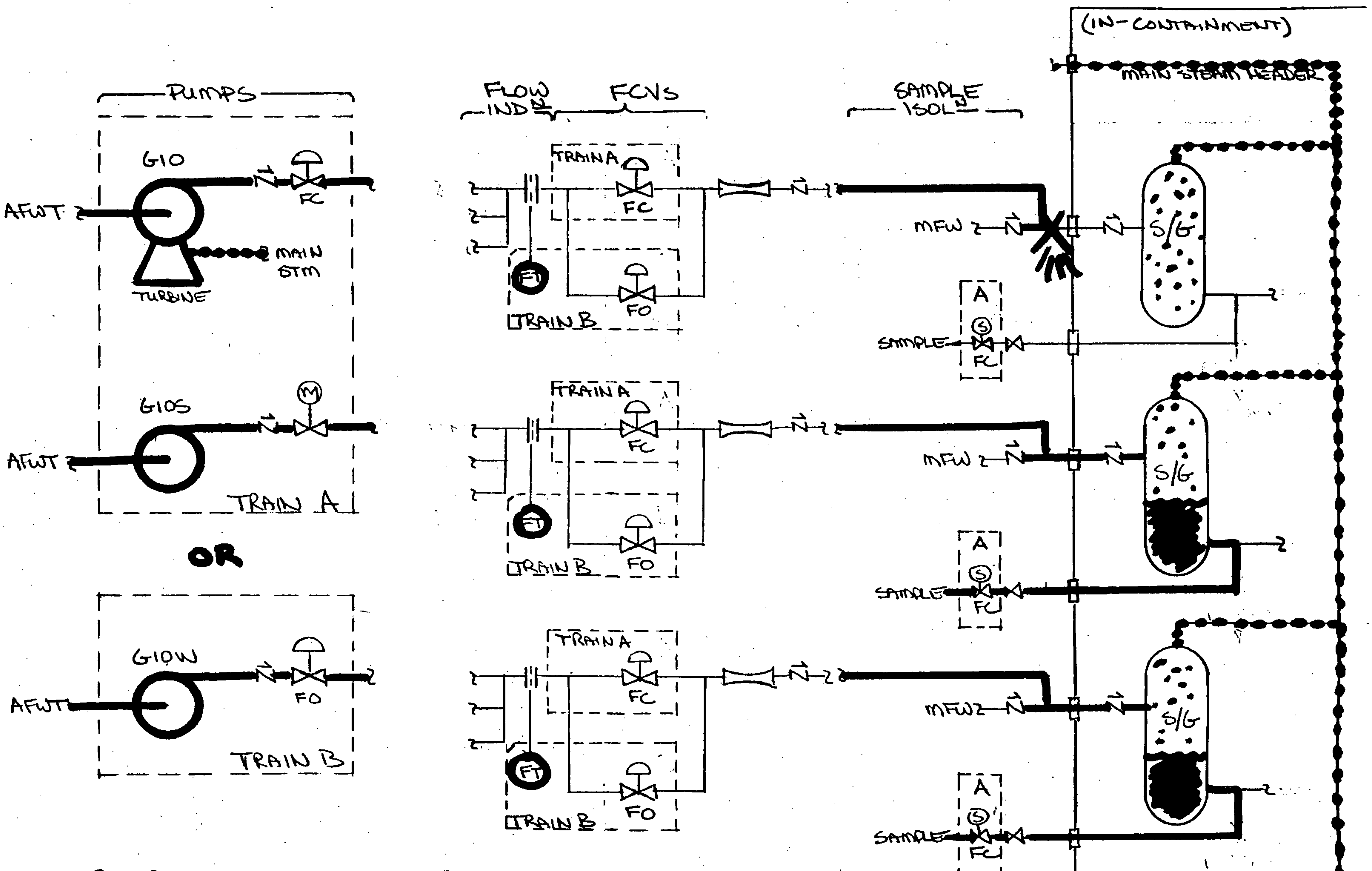
(3) INCLUDING MINI-FLOW RETURN

(4) INCLUDING THE CHEMISTRY SAMPLE LOSSES (6 GPM PER EACH UNAFFECTED STEAM GENERATOR)



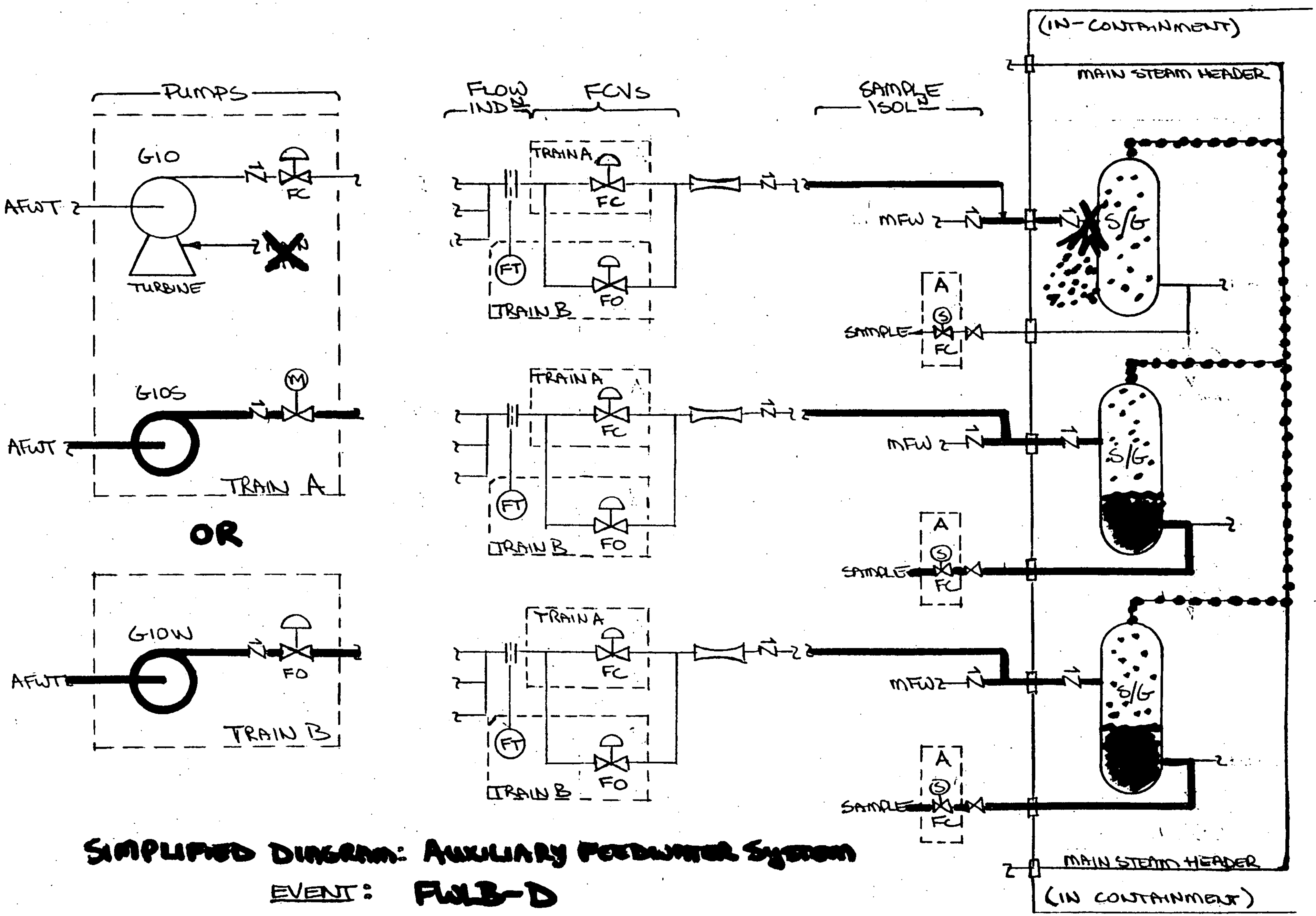
SIMPLIFIED DIAGRAM: AUXILIARY FEEDWATER SYSTEM

EVENT: LOSS OF FEEDWATER



SIMPLIFIED DIAGRAM: AUXILIARY FEEDWATER SYSTEM

EVENT: FWLB-U



SIMPLIFIED DIAGRAM: AUXILIARY FEEDWATER SYSTEM

EVENT: **FWLB-D**

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: SINGLE STEAM GENERATOR LOSS OF FEEDWATER
FROM 100% POWER

COMMON CAUSE FAILURES: NONE
STM/FW MISMATCH SCRAM: AVAILABLE
ACCEPTANCE CRITERION: NO PRESSURIZER FILL

SINGLE FAILURE	{---- REACTOR SCRAM	G-10	G-10S	EFFECT ON RPS/AFWS G-10W	FLOW INDICATION	FCVS / SAMPLE ISOL	ACTION (AFW FLOW) ----}	APPLICABLE ANALY (REQUIRED AFW FL
G-10	HI PZR LEVEL (50%)	FAILED	AVAILABLE @30 MIN	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	CLOSE DG-2 BRKR (231 @ 30 MIN)	CASE A (185 @ 30 MIN)
G-10S	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (185 @ 30 MIN)
TRAIN A POWER	HI PZR LEVEL (50%)	FAILED	FAILED	AVAILABLE @30 MIN	AVAILABLE	1/LOOP FAILED SHUT SMPLS FAILED SHUT	CLOSE DG-2 BRKR (249 @ 30 MIN)	CASE A (185 @ 30 MIN)
G-10W	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (185 @ 30 MIN)
FLOW INDICATION	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	AVAILABLE @30 MIN	FAILED	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (185 @ 30 MIN)
TRAIN B POWER	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	FAILED	1/LOOP FAILED OPEN SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (185 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: SINGLE STEAM GENERATOR LOSS OF FEEDWATER FROM 50% POWER

COMMON CAUSE FAILURES: NONE
STM/FW MISMATCH SCRAM: BYPASSED
ACCEPTANCE CRITERION: NO PRESSURIZER FILL

SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FCVS / SAMPLE ISOL	ACTION (AFW FLOW)	APPLICABLE ANALYS (REQUIRED AFW FLO
	{---------- EFFECT ON RPS/AFWS ----------							
G-10	HI PZR LEVEL (50%)	FAILED	AVAILABLE @30 MIN	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	CLOSE DG-2 BRKR (231 @ 30 MIN)	BOUNDED BY CASE ((185 @ 30 MIN)
G-10S	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (213 @ 3.5 MIN)	BOUNDED BY CASE ((185 @ 30 MIN)
TRAIN A POWER	HI PZR LEVEL (50%)	FAILED	FAILED	AVAILABLE @30 MIN	AVAILABLE	1/LOOP FAILED SHUT SMPLS FAILED SHUT	CLOSE DG-2 BRKR (249 @ 30 MIN)	BOUNDED BY CASE ((185 @ 30 MIN)
G-10W	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (213 @ 3.5 MIN)	BOUNDED BY CASE ((185 @ 30 MIN)
FLOW INDICATION	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	AVAILABLE @30 MIN	FAILED	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (213 @ 3.5 MIN)	BOUNDED BY CASE ((185 @ 30 MIN)
TRAIN B POWER	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	FAILED	1/LOOP FAILED OPEN SMPL ISOL OK	NONE REQUIRED (213 @ 3.5 MIN)	BOUNDED BY CASE ((185 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: COMPLETE LOSS OF MAIN FEEDWATER
FROM 100% POWER

COMMON CAUSE FAILURES: NONE
STM/FW MISMATCH SCRAM: AVAILABLE
ACCEPTANCE CRITERION: NO PRESSURIZER FILL

	{----------	----------	---------- EFFECT ON RPS/AFWS	----------	----------	----------	----------}	APPLICABLE ANALY.
SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FCVS / SAMPLE ISOL	ACTION (AFW FLOW)	(REQUIRED AFW FL
G-10	STM/FW MISMATCH	FAILED	AVAILABLE @30 MIN	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	CLOSE DG-1 BRKR (166 @ 30 MIN) OR CLOSE DG-2 BRKR (231 @ 30 MIN)	CASE B (165 @ 30 MIN)
G-10S	STM/FW MISMATCH	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (165 @ 30 MIN)
TRAIN A POWER	STM/FW MISMATCH	FAILED	FAILED	AVAILABLE @30 MIN	AVAILABLE	1/LOOP FAILED SHUT SMPLS FAILED SHUT	CLOSE DG-2 BRKR (249 @ 30 MIN)	CASE B (165 @ 30 MIN)
G-10W	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (165 @ 30 MIN)
FLOW INDICATION	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	AVAILABLE @30 MIN	FAILED	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (165 @ 30 MIN)
TRAIN B POWER	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	FAILED	1/LOOP FAILED OPEN SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (165 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: COMPLETE LOSS OF MAIN FEEDWATER
FROM 50% POWER

COMMON CAUSE FAILURES: NONE
STM/FW MISMATCH SCRAM: BYPASSED
ACCEPTANCE CRITERION: NO PRESSURIZER FILL

SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FCVS / SAMPLE ISOL	ACTION (AFW FLOW)	APPLICABLE ANALY (REQUIRED AFW FL
	←——— EFFECT ON RPS/AFWS ———→							
G-10	HI PZR LEVEL (50%)	FAILED	AVAILABLE @30 MIN	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	CLOSE DG-2 BRKR (231 @ 30 MIN)	CASE C (185 @ 30 MIN)
G-10S	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (185 @ 30 MIN)
TRAIN A POWER	HI PZR LEVEL (50%)	FAILED	FAILED	AVAILABLE @30 MIN	AVAILABLE	1/LOOP FAILED SHUT SMPLS FAILED SHUT	CLOSE DG-2 BRKR (249 @ 30 MIN)	CASE C (185 @ 30 MIN)
G-10W	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (185 @ 30 MIN)
FLOW INDICATION	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	AVAILABLE @30 MIN	FAILED	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (185 @ 30 MIN)
TRAIN B POWER	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	FAILED	1/LOOP FAILED OPEN SMPL ISOL OK	NONE REQUIRED (219 @ 3.5 MIN)	BOUNDED BY CASE (185 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN FEEDWATER LINE BREAK, UPSTREAM OF S/G CHECK VALVES
FROM 100% POWER

COMMON CAUSE FAILURES: ONE FEEDWATER LINE RUPTURED. ALL AFW TO THE AFFECTED LINE ASSUMED LOST
STM/FW MISMATCH SCRAM: AVAILABLE
ACCEPTANCE CRITERION: NO CORE UNCOVERY

	{------ EFFECT ON RPS/AFWS						------}	APPLICABLE ANALYS
SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FCVS / SAMPLE ISOL	ACTION (AFW FLOW)	(REQUIRED AFW FLO
G-10	STM/FW MISMATCH	FAILED	AVAILABLE @15 MIN	AVAILABLE @15 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	CLOSE DG-2 BRKR AND EQUALIZE FLOW (154 @ 15 MIN)	CASE D (125 @ 30 MIN)
G-10S	STM/FW MISMATCH	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @15 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	(76 @ 3.5 MIN) EQUALIZE FLOW (146 @ 15 MIN)	BOUNDED BY CASE D (125 @ 30 MIN)
TRAIN A POWER	STM/FW MISMATCH	FAILED	FAILED	AVAILABLE @15 MIN	AVAILABLE	1/LOOP FAILED SHUT SMPLS FAILED SHUT	CLOSE DG-2 BRKR AND EQUALIZE FLOW (166 @ 15 MIN)	CASE D (125 @ 30 MIN)
G-10W	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	FAILED	AVAILABLE	2/LOOP OK SMPL ISOL OK	(76 @ 3.5 MIN) EQUALIZE FLOW (146 @ 15 MIN)	BOUNDED BY CASE D (125 @ 30 MIN)
FLOW INDICATION	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	AVAILABLE @15 MIN	FAILED	2/LOOP OK SMPL ISOL OK	(76 @ 3.5 MIN) CLOSE DG-1 BRKR AND ISOL SMPLS (130 @ 15 MIN)	BOUNDED BY CASE D (125 @ 30 MIN)
TRAIN B POWER	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	FAILED	FAILED	1/LOOP FAILED OPEN SMPL ISOL OK	(76 @ 3.5 MIN) CLOSE DG-1 BRKR AND ISOL SMPLS (130 @ 15 MIN)	BOUNDED BY CASE D (125 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN FEEDWATER LINE BREAK, UPSTREAM OF S/G CHECK VALVES FROM 50% POWER

COMMON CAUSE FAILURES: ONE FEEDWATER LINE RUPTURED. ALL AFW TO THE AFFECTED LINE ASSUMED LOST
STM/FW MISMATCH SCRAM: BYPASSED
ACCEPTANCE CRITERION: NO CORE UNCOVERY

SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FCVS / SAMPLE ISOL	ACTION (AFW FLOW)	APPLICABLE ANALYS (REQUIRED AFW FL
	←EFFECT ON RPS/AFWS						→	
G-10	HI PZR LEVEL (50%)	FAILED	AVAILABLE @15 MIN	AVAILABLE @15 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	CLOSE DG-2 BRKR AND EQUALIZE FLOW (154 @ 15 MIN)	CASE E (125 @ 15 MIN)
G-10S	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @15 MIN	AVAILABLE	2/LOOP OK SMPL ISOL OK	(76 @ 3.5 MIN) EQUALIZE FLOW (146 @ 15 MIN)	BOUNDED BY CASE E (125 @ 15 MIN)
TRAIN A POWER	HI PZR LEVEL (50%)	FAILED	FAILED	AVAILABLE @15 MIN	AVAILABLE	1/LOOP FAILED SHUT SMPLS FAILED SHUT	CLOSE DG-2 BRKR AND EQUALIZE FLOW (166 @ 15 MIN)	CASE E (125 @ 15 MIN)
G-10W	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	FAILED	AVAILABLE	2/LOOP OK SMPL ISOL OK	(76 @ 3.5 MIN) EQUALIZE FLOW (146 @ 15 MIN)	BOUNDED BY CASE E (125 @ 15 MIN)
FLOW INDICATION	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	AVAILABLE @15 MIN	FAILED	2/LOOP OK SMPL ISOL OK	(76 @ 3.5 MIN) CLOSE DG-1 BRKR AND ISOL SMPLS (130 @ 15 MIN)	BOUNDED BY CASE E (125 @ 15 MIN)
TRAIN B POWER	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	FAILED	FAILED	1/LOOP FAILED OPEN SMPL ISOL OK	(76 @ 3.5 MIN) CLOSE DG-1 BRKR AND ISOL SMPLS (130 @ 15 MIN)	BOUNDED BY CASE E (125 @ 15 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN FEEDWATER LINE BREAK, DOWNSTREAM OF S/G CHECK VALVES
FROM 100% POWER

COMMON CAUSE FAILURES: ONE LINE RUPTURED AT STEAM GENERATOR. AFW TO AFFECTED LINE AND STEAM TO G-10 TURBINE ASSUMED LOST
STM/FW MISMATCH SCRAM: AVAILABLE
ACCEPTANCE CRITERION: NO CORE UNCOVERY

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	{------ EFFECT ON RPS/AFWS						------}	APPLICABLE ANALYSI
SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FCVS / SAMPLE ISOL	ACTION (AFW FLOW)	(REQUIRED AFW FLOW
G-10		NO STEAM						
G-10S	STM/FW MISMATCH	NO STEAM	FAILED	AVAILABLE @1 MIN*	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (256 @ 1 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)
TRAIN A POWER	STM/FW MISMATCH	NO STEAM	FAILED	AVAILABLE @1 MIN*	AVAILABLE	1/LOOP FAILED SHUT SMPLS FAILED SHUT	NONE REQUIRED (268 @ 1 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)
G-10W	STM/FW MISMATCH	NO STEAM	AVAILABLE @1 MIN*	FAILED	AVAILABLE	2/LOOP OK SMPL ISOL OK	(248 @ 1 MIN+) ISOL SMPLS (260 @ 15 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)
FLOW INDICATION	STM/FW MISMATCH	NO STEAM	AVAILABLE @15 MIN#	AVAILABLE @1 MIN*	FAILED	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (256 @ 1 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)
TRAIN B POWER	STM/FW MISMATCH	NO STEAM	AVAILABLE @1 MIN*	FAILED	FAILED	1/LOOP FAILED OPEN SMPL ISOL OK	(248 @ 1 MIN+) ISOL SMPLS (260 @ 15 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)

INTERLOCK BLOCKS AUTO-START

* SISLOP/DG/PUMP START

+ PLUS 5 MIN FOR REFILL OF INTACT FW LINES

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN FEEDWATER LINE BREAK, DOWNSTREAM OF S/G CHECK VALVES FROM 50% POWER

COMMON CAUSE FAILURES: ONE LINE RUPTURED AT STEAM GENERATOR. AFW TO AFFECTED LINE AND STEAM TO G-10 TURBINE ASSUMED LOST
STM/FW MISMATCH SCRAM: BYPASSED
ACCEPTANCE CRITERION: NO CORE UNCOVERY

SINGLE FAILURE	{------ REACTOR SCRAM	G-10	G-10S	EFFECT ON RPS/AFWS G-10W	FLOW INDICATION	FCVS / SAMPLE ISOL	ACTION (AFW FLOW) ------}	APPLICABLE ANALY (REQUIRED AFW FL
G-10		NO STEAM						
G-10S	HI PZR PRESSURE	NO STEAM	FAILED	AVAILABLE @1 MIN*	AVAILABLE	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (256 @ 1 MIN+)	BOUNDED BY CASE (250 @ 15 MIN+)
TRAIN A POWER	HI PZR PRESSURE	NO STEAM	FAILED	AVAILABLE @1 MIN*	AVAILABLE	1/LOOP FAILED SHUT SMPLS FAILED SHUT	NONE REQUIRED (268 @ 1 MIN+)	BOUNDED BY CASE (250 @ 15 MIN+)
G-10W	HI PZR PRESSURE	NO STEAM	AVAILABLE @1 MIN*	FAILED	AVAILABLE	2/LOOP OK SMPL ISOL OK	(248 @ 1 MIN+) ISOL SMPLS (260 @ 15 MIN+)	BOUNDED BY CASE (250 @ 15 MIN+)
FLOW INDICATION	HI PZR PRESSURE	NO STEAM	AVAILABLE @15 MIN#	AVAILABLE @1 MIN*	FAILED	2/LOOP OK SMPL ISOL OK	NONE REQUIRED (256 @ 1 MIN+)	BOUNDED BY CASE (250 @ 15 MIN+)
TRAIN B POWER	HI PZR PRESSURE	NO STEAM	AVAILABLE @1 MIN*	FAILED	FAILED	1/LOOP FAILED OPEN SMPL ISOL OK	(248 @ 1 MIN+) ISOL SMPLS (260 @ 15 MIN+)	BOUNDED BY CASE (250 @ 15 MIN+)

INTERLOCK BLOCKS AUTO-START

* SISLOP/DG/PUMP START

+ PLUS 5 MIN FOR REFILL OF INTACT FW LINES

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS INCLUDING DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECTS UPON AFWS	REMARKS AND OTHER EFFECTS
1	A	S/G Water Level Instrumentation (Part of Loop 2400)	Level High (Output High)	2-out-of-3 S/G logic reduced to 2-out-of-2 on remaining S/G's	Control Room Indication; Periodic Testing	Redundant Train, Manual Initiation	Train A initiation may not be provided automatically when 2 S/G's at low level condition.	Actuation Devices include: LT2400A, B, C; LYV2400A, B, C; LYB2400A, B, C; LYC2400A, B, C (Ref. 451775 and 5159842)
			Level Low (Output Low)	2-out-of-3 S/G logic reduced to 1-out-of-2 on remaining S/G's	Control Room Alarm Indication; Periodic Testing	None required, Manual Mode and Redundant Train	Train A flow may be provided automatically when only 1 S/G at low level condition.	Operator can place train in manual mode and prevent start. Train B is still available.
2	A	AFW Initiation Logic (Part of Loop 2400)	Untripped (Output High)	Loss of capability to provide automatic initiation of AFW Train A	Periodic Testing; Control Room Status at Redundant Train Initiation	Redundant Train, possible Manual Initiation, Manual Mode and operation	Train A initiation not provided automatically when S.G's at low level condition.	Initiation Devices include: LYY2400A, B; HS2400A, B; LYL2400A, B; LYC2400D through I. (Ref. 451775 and 5159842)
			Tripped (Output Low)	Initiates G10S and G10 pumps in "lag" mode; if G10W is not delivering flow, G10 and G10S will start, and their discharge valves will open.	Control Room Alarm, Status	None required, Manual Mode and Redundant Train	Train A flow provided to S/G's (represents less than 5% of normal feedwater flow).	Operator can place train in manual mode and then stop, or prevent start if still in "lag" period. Train B is still available.
3	A	G10S Pump Suction Pressure Instrumentation (Loop 2010)	Pressure Low (Output Low)	Inoperability of Train A automatic (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves.)	Control Room Alarm, Indication; Periodic Testing	Redundant Train, Manual Mode and Operation	Inoperability of Train A automatic (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves).	Automatic Protection Interlock Devices include: PT2010, PYV2010, PYB2010, PYI2010, PYY2010, PYC2010A, PYC2010B, (Ref: 451791, 5180611, 5159842). NOTE: EQ is required.
			Pressure High (Output High)	Inoperability of Train A motor-driven pump automatic protection.	Periodic Testing; Control Room Indication	None required, Manual Mode and Redundant Train	Inoperability of Train A motor-driven pump automatic protection.	For equipment protection only; Train B is still available.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS INCLUDING DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECTS UPON AFWS	REMARKS AND OTHER EFFECTS
4	A	Motor-driven AFW Pump (G10S)	Fails to Start	Inoperability of Train A (motor-driven) pumping capabilitiy for MSLB or FWLB (downstream of check valves)	Periodic Testing; Control Room Alarm, Status, Indication	Redundant Train	Inperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves).	Operation Devices include: HS2200A, B; HS2201A, B; Circuit Breaker 52-1125 Ref. 5180611.
			Starts with G10W running	G10S pump starts and operates at minimum flow. Discharge valve does not open due to compensating provision.	Control Room Alarm Status Indication	G10W Pump Discharge Manifold 2nd flow switch pair for Train A operation.	G10S pump starts and operates at minimum flow. Discharge valve does not open due to compensating provision.	Train B is still available.
5	A	G10S Pump Discharge Pressure Instrumentation (Loop 2011)	Pressure Low (Output High)	Inoperability of Train A automatic (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	Periodic Testing; Control Room Indication	Redundant Train Manual Mode and Operation	Inperability of Train A automatic (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves).	Automatic Interlock Devices include: PT2011, PYV2011, PYB2011, PYC2011A, (Ref. 451666, 5180611, 5159842). NOTE: EQ is required
			Pressure High (Output High)	Inoperability of G10S pump discharge pressure indication and discharge valve interlock.	Control Room Indication; Periodic Testing	None required, Manual Mode and Redundant Train	Inoperability of G10S pump discharge pressure indication and discharge valve interlock.	Train B is still available.
6	A	G10S Cross-Tie to 1st Point Heater (MOV1204)	Fails in the closed position	No AFW effect	Periodic Testing; Control Room Alarm, Status, Indication	None Required	None	Operation Devices include: HS1204A, B. (Ref. 5159559, 5180611.
			Fails to close	Inoperability of Train A (motor-driven) pumping capability of MSLB or FWLB (downstream of check valves).	Periodic Testing Control Room Alarm, Status, Indication	Redundant Train, possible Manual Operation	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves).	MOV1204 can be closed by manual operation from Control Room or locally at valve. Train B is still available.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS INCLUDING DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECTS UPON AFWS	REMARKS AND OTHER EFFECTS
7	A	G10S Pump Discharge Valve (MOV1202)	Fails to the open position with G10W running	Discharge valve opens. G10S pump does not start due to compensating provisions.	Control Room Alarm, Status	G10W Pump Discharge Manifold 1st Flow switch pair for Train A operation.	Discharge valve opens. G10S pump does not start due to compensating provision.	Operation Devices include: HS2200A, B; HS2202A, B; (Ref. 5159842, 5180611).
			Fails to open.	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	Periodic Testing; Control Room Alarm, Status, Indication	Redundant Train, possible Manual operation	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves).	MOV1202 can be opened by manual operation from Control Room or locally at valve. Train B is still available.
8	A	AFW Flow Control Valve (FCV) 2300A, 2300B, 2300C	Fails closed (F.C.)	FCV closes	Control Room Alarm, Indication	FCV 3300A, 3300B, or 3300C Redundant Train	None (full flow available through Train B parallel FCV).	Control Devices include: FCV2300A, FCV2300B, FCV2300C, FY2300A1, FY2300B1, FY2300C1, FY12300A, FY12300B, FY12300C, FC2300A, FC2300B, FC2300C, HC2300A, HC2300B, HC2300C, FY2300A2, FY2300B2, FY2300C2, PCV2300A1, PCV2300A2, PCV2300B1, PCV2300B2, PCV2300C1, PCV2300C2, ZS02300A, ZS02300B, ZS02300C (Ref. 451874, 5159842).
			Fails to close	FCV remains open	Periodic Testing; Control Room Indication	Combined G10 and G10S pump capability	Loss of flow equalization capability for FWLB	Combined G10 and G10S pumps capacity provides minimum flow through at least 2 intact feedwater lines without flow equalization.
9	A	Vital Bus No. 3A	Fails to Supply power	In Train A AFW: - Loss of S/G water level instrumentation - Loss of status indication - Loss of AFW initiation logic - G10S and G10 pumps suction pressure automatic protection tripped - Loss of G10S and G10 pumps discharge pressure automatic operation interlocks - Loss of FCVs control (F.C.) - Loss of G10 pump control - G10 pump goes into "warmup" condition - Loss of G10 pump discharge valve (CV 2620) control (F.O.)	Periodic Testing; Control Room Alarm, Indication	Redundant Train	Train A initiation not provided automatically when S/G's at low level condition; Train A FCVs fail closed preserve Train B equalization capability	G10S pump MOV1202 and MOV1204 are still available by manual operation from Control Room; G10 pump can be started locally (Ref. 5102174, 5159794, 5159842. Train B is still available.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS INCLUDING DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECTS UPON AFWS	REMARKS AND OTHER EFFECTS
10	A	125 Vdc Bus No.1	Fails to supply power	Same as Vital Bus No. 3A above plus: - Loss of G10S pump control - Loss of G10S pump discharge valve (MOV1202) control (Power Failure Interlock closes valve.)	Control Room Alarm, Indication	Redundant Train	Train A Controls inoperable.	G10 pump can be started locally; G10S pump can be started from 480V Swgr breaker, since its electrical fault protection does not require external control power; MOV1202 can be operated locally at valve. (Ref. 5146828, 5180611). Train B is still available.
11	A	480V MCC No. 1	Fails to supply power	In Train A AFW: - Loss of MOV1202 control - Loss of MOV1204 control (both failed locked - as is)	Control Room Alarm, Status	Redundant Train	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	MOV1202 and MOV1204 can be operated locally at each valve. G10 pump is still available (Ref. 5102165, 5146828, 5159559, 5159842). Train B is still available.
12	A	480V Swgr No. 1	Fails to supply power	Same as 480V MCC No. 1 above plus: - Loss of G10S Pump	Control Room Alarm, Status, Indication	Redundant Train	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	G10 pump is still available (Ref. 5146828, 5102162, 5150885). Train B is still available.
13	A	4160 Bus No. 1C	Fails to supply power	Same as 480V MCC No. 1 above	Control Room Alarm, Status, Indication	Redundant Train	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	G10 pump is still available (Ref. 5146828, 5102162, 5130351, 5150876). Train B is still available.
14	A	G10 Pump Suction Pressure Instrumentation Loop 2610	Pressure Low (Output Low)	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via Operator Control Room action.	Control Room Alarm, Indication; Periodic Testing	Redundant Train and manual loading of Diesel Generator, Manual Mode and Operation	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action.	Automatic Protection Interlock Devices include: PT2610, PYV2610, PYB2610, PYT2610, PYY2610, PYC2610A, PYC2610B (Ref. 5202912, 5159842, 5159794). NOTE: EQ is required.
			Pressure High (Output High)	Inoperability of steam turbine-driven pump automatic protection.	Periodic Testing; Control Room Indication	None Required, Manual Mode and Redundant Train with manual loading of Diesel Generator	Inoperability of steam turbine-driven pump automatic protection.	For equipment protection only; Train B is still available.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS INCLUDING DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECTS UPON AFWS	REMARKS AND OTHER EFFECTS
15	A	Steam turbine-driven AFW pump (G10)	Fails to start	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action.	Periodic Testing; Control Room Alarm, Status, Indication	Redundant Train and Manual loading of Diesel Generator	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action.	Failure to start could also be "warmup" failure; Operation Devices include: HS2602A, B; HS2612A, B. (Ref. 5159794).
			Starts with G10 running	G10 pump starts and operates at minimum flow. Discharge valve does not open due to compensating provision.	Control Room Alarm, Status, Indication	G10 Pump Discharge Manifold 1st flow switch pair for Train A operation.	G10 pumps start and operates at minimum flow. Discharge valve does not open due to compensating provision.	Train B is still available.
16	A	G10 Pump Discharge Pressure Instrumentation (Loop 2601)	Pressure Low (Output Low)	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action.	Periodic Testing; Control Room Indication	Redundant Train and Manual loading of Diesel Generator, Manual Mode and Operation.	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action.	Automatic Interlock Devices include: PT2611, PYV2611, PYB2611, PYC2611A. (Ref. 5202913, 5159794, 5159842). NOTE: EQ is required.
			Pressure High (Output High)	Inoperability of G10 pump discharge pressure indication and discharge valve interlock.	Control Room Indication; Periodic Testing	None required, Manual Mode and Redundant Train	Inoperability of G10 pump discharge pressure indication and discharge valve interlock.	Train B is still available.
17	A	G10 Pump Discharge Valve CV 2620	Fails Open (F.O.) with G10W running	Discharge valve opens, G10 pump does not start due to compensating provision.	Control Room Alarm, Status	G10W Pump Discharge Manifold 2nd flow switch pair for Train A operation.	Discharge valve opens. G10W pump does not start due to compensating provision.	Operation Devices include: HS2602A, B; HS2620A, B. (Ref. 5159794).
			Fails to open	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action.	Periodic Testing; Control Room Alarm, Status, Indication	Redundant Train and manual loading of Diesel Generator	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action.	CV 2620 can be opened by Manual operation from Control Room or locally at valve. Train B is still available.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS INCLUDING DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECTS UPON AFWS	REMARKS AND OTHER EFFECTS
18	A	G10W Pump Discharge Manifold flow switch (first pair) (Loops 2306 or 2307)	Flow Low (Output High)	G10S pump starts and operates at minimum flow (assume auto initiation previously given) Discharge valve does not open and G10 pump does not start due to compensating provision.	Periodic Testing; Control Room Alarm, Status	G10W Pump Discharge Manifold 2nd flow switch for Train A operation	G10S pump starts and operates at minimum flow (assume auto initiation previously given). Discharge valve does not open and G10 pump does not start due to compensating provision.	Design precludes concurrent operation of Trains A and B (in auto mode); Train B will act as lead pump train and Train A as lag pump train; (Ref. 5159842, 5159794, 5180611) NOTE: EQ is required.
			Flow High Output Low	Inoperability of Train A automatic pumping capability.	Periodic Testing; Control Room Status	Redundant Train, Manual Mode and operation	Inoperability of Train A automatic pumping capability.	Train B is still available.
19	A	G10W Pump Discharge Manifold flow switch (second pair) (Loop 2308 or 2309	Flow Low (Output High)	G10 pump starts and operates at minimum flow (assume auto initiation previously given). Discharge valve does not open and G10S pump does not start due to compensating provision.	Periodic Testing; Control Room Alarm, Status	G10W Pump Discharge Manifold 1st flow switch pair for Train A operation	G10 pump starts and operates at minimum flow (assume auto initiation previously given). Discharge valve does not open and G10S pump does not start due to compensating provision.	Design precludes concurrent operation of Trains A and B (in auto mode); Train B will act as lead pump train and Train A as lag pump train; (Ref. 5159842, 5159794, 5180611). NOTE: EQ is required.
			Flow High Output Low	Inoperability of Train A automatic pumping capability.	Periodic Testing; Control Room Status	Redundant Train Manual Mode and operation	Inoperability of Train A automatic pumping capability.	Train B is still available.
20	B	S/G Water Level Instrumentation (Part of Loop 3400)	Level High (Output High)	2-out-of-3 S/G logic reduced to 2-out-of-2 on remaining S/G's	Control Room Indication; Periodic Testing	Redundant Train, Manual Initiation	Train B initiation may not be provided automatically when 2 S/G's at low level condition.	Actuation Devices include: LT3400A, B, C; LYV3400A, B, C; LYB3400A, B, C; LYC3400A, B, C (Ref. 451776 and 5159843)
			Level Low (Output Low)	2-out-of-3 S/G logic reduced to 1-out-of-2 on remaining S/G's	Control Room Alarm, Indication; Periodic Testing	None required, Manual Mode and Redundant Train	Train B flow may be provided automatically when only 1 S/G at low level condition.	Operator can place train in manual mode and prevent start. Train A is still available.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS INCLUDING DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECTS UPON AFWS	REMARKS AND OTHER EFFECTS
21	B	AFW Initiation Logic (Part of Loop 3400)	Untripped (Output High)	Loss of capability to provide automatic initiation of AFW Train B	Periodic Testing; Control Room Status at Redundant Train Initiation	Redundant Train, possible Manual Initiation Manual Mode and operation	Train B initiation not provided automatically when S/G's at low level condition.	Initiation Devices include: LYY3400A, B; HS3400A, B; LYL3400A, B; LYC3400D through J (Ref. 451776 and 5159843)
			Tripped (Output Low)	Initiates G10W pump and discharge valve will open.	Control Room Alarm, Status	None required, Manual Mode and Redundant Train	Train B flow provided to S/G's (represents less than 5% of normal feedwater flow)	Operator can place train in manual mode and then stop. Train A is still available.
22	B	G10W Pump Suction Pressure Instrumentation (Loop 3010)	Pressure Low (Output Low)	Inoperability of Train B automatic pumping capability.	Control Room Alarm, Indication, Periodic Testing	Redundant Train, Manual Mode and Operation	Inoperability of Train B automatic pumping capability.	Automatic Protection Interlock Devices include: PI3010, PYV3010, PYB3010, PYT3010, PYY3010, PYC3010A, PYC3010B, (Ref: 451869, 5159843. NOTE: EQ is required.
			Pressure High (Output High)	Inoperability of Train B pump automatic protection.	Periodic Testing; Control Room Indication	None required, Manual Mode and Redundant Train	Inoperability of Train B pump automatic protection.	For equipment protection only; Train A is still available.
23	B	Motor-driven AFW Pump (G10W)	Fails to Start, stops	Inoperability of Train B automatic pumping capability.	Periodic Testing; Control Room Alarm, Status, Indication	Redundant Train	Inoperability of Train B pumping capability.	Operation Devices include: HS3219A, B; HS3215A, B; Circuit Breaker A2C14. G10S and G10 pumps start based on G10W pump discharge manifold low flow signal, assume auto initiation previously given. (Ref. 5151027)

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS INCLUDING DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECTS UPON AFWS	REMARKS AND OTHER EFFECTS
24	B	G10W Pump Discharge Pressure Instrumentation (Loop 3011)	Pressure Low (Output Low)	Inoperability of Train B automatic pumping capability.	Periodic Testing Control Room Indication	Redundant Train Manual Mode and Operation	Inoperability of Train B pump discharge pressure indication and discharge valve interlocks.	Automatic Interlock Devices include: PT3011, PYV3011, PYB3011, PYC3011, (Ref. 451666, 5180611, 5159842). NOTE: EQ is required
			Pressure High (Output High)	Inoperability of Train B pump discharge pressure indication and discharge valve interlock.	Control Room Indication; Periodic Testing	None required, Manual Mode and Redundant Train	Inoperability Train B pump discharge pressure indication and discharge valve interlock.	Train A is still available.
25	B	G10W Pump Discharge Valve (CV 3110)	Fails open (F.O.)	If F.O. before G10W Pump at normal operating speed, will cause insignificant delay in pump providing full flow.	Control Room Alarm, Status	None required	If F.O. before G10W pump at normal operating speed, will cause insignificant delay in providing full flow.	Operation Device include: HS3219A, B; HS3110A, B. (Ref. 5151027)
			Fails to opens	Inoperability of Train B pumping capability.	Periodic Testing; Control Room Alarm, Status, Indication	Redundant Train possible Manual Operation	Inoperability of Train B pumping capability.	CV3110 can be opened by manual operation from Control Room or locally at valve. Train A is still available.
26	B	AFW Flow Control Valve FCV-3300A 3300B, or 3300C	Fails to the closed position	FCV closes.	Control Room Alarm, Indication	FCV2300A, 2300B or 2300C (Redundant Train)	None (full flow available through Train A parallel FCV)	Control Devices include: FCV3300C, FCV-3300B, FCV3300A, FY3300A1, FY3300B1, FY3300C1, FY13300A, FY13300B, FY13300C, HC3300A, HC3300B, HC3300C, FC3300A, FC3300B, FC3300C, FY3300A2, FY3300B2, FY3300C2, PCV3300A1, PCV3300A2, PCV3300B1, PCV3300B2, PCV3300C1, PCV3300C2, ZS03300B, ZS03300C, ZS03300A
			Fails open (F.O.)	FCV remains open	Periodic Testing Control Room Indication	Combine G10 and G10S capacity.	Loss of flow equalization capability for FWLB.	Combined G10 and G10S pumps capacity provides minimum flow through at least 2 intact feedwater lines without flow equalization.

APPENDIX B

CONTAINMENT ISOLATION
FAILURE MODE AND EFFECTS ANALYSIS

1. Instrument connections, instrument valves and the instruments themselves are considered extensions of the piping and were not explicitly analyzed in this SFA.

2. Drain and vent valves which are normally closed and which are not part of the process system were not analyzed in this SFA.

3. In-line strainers are considered as part of the pipe and were not analyzed in this SFA.

4. Where electrical failure modes affect tagged mechanical items, then the failure mode or position of the mechanical item was cited.

5. The solenoid valves, pressure control valves and other block valves in the instrument air system and the gaseous nitrogen system were not analyzed in this SFA since the failure modes of the valves which these gas sources actuate would encompass any failure mode of the valves in the actuating supply lines.

6. The following failure mode codes were used in this SFA:

Code	Failure Mode Description
1	Fail open
2	Fail closed
3	Input open
4	Input short
5	Input high
6	Input low or input lost
7	Output open
8	Output short
9	Output high
10	Output low or output lost
11	Tripped (bistable, circuit breaker)
12	As-is (un-tripped, last position maintained)
13	Output volts high (instrument power supply)
14	Output volts low, grounded (power supply)
15	All contact open (switch, relay, breaker)
16	All contacts closed (switch, relay, breaker)
17	All contacts grounded (switch, relay, breaker)
18	All contact shorted (paralleling of switch or relay contacts)

7. The containment pressure sensors which input the sequencer were analyzed as distinct instruments (since they were not covered in previous studies). The sequencer and the Containment Isolation System (CIS) panel were considered as "black boxes" and their outputs to the final controlled devices considered to have only two failure modes; no signal and good signal.

8. The CIS panel for Train A and the CIS panel for Train B are independent and each has been considered as a single entity which fails safe, that is, loss of power to either train's logic will generate a signal to isolate containment.

9. Each CIS panel is interlocked with, and overrides, any process signals that may interface with the CIS. Thus, any failure in the process instrumentation or control has no effect on CIS function.

10. The CIS is not affected by loss of offsite power alone, as all instruments and controls are supplied by the 125 vDC or 125 vAC vital busses, and the containment isolation valves are powered by safety related gas supplies, stored energy (accumulators or springs) or the emergency diesel generators.

11. The Main Steam System containment isolation was addressed in the Systematic Evaluation Program and SCE modified procedures to manually close valves. Therefore, the main steam lines through penetrations 1-N-1 and 2-J-1 up to the main steam stop valves are not analyzed in this SFA. Reference SEP Topic VI-4 and SEP paragraph 4.23.7.2.

12. Penetration B-11 and its associated lines CRS-728, CRS-729 and CRS-737 are considered to be part of the containment; therefore, none of these lines, their interconnecting lines, their valves, etc., are included in this study.

13. The notation for the containment isolation FEMA is as follows:

section|	Containment isolation is numbered as Section 1
group|	Penetrations and sub-systems in which like functions are grouped
train|	Redundant functions and/or different functions will be given unique train numbers
device|	All tag numbered devices will be uniquely numbered in functional order from the final actuated device toward the electrical power source or sequencer.
failure mode|	As defined in item 6, above.

Index of Groups

Group	Penetration(s)	Service
00	None	Initiating Pressure Signal
01	B-12	Feedwater Sampling
02	B-7A, B, C	Seal Water
03	B-8	RCP Seal Water Return
04	B-1A, B, C B-17A, E-15	Safety Injection System
05	B-3, B-18A	Containment Spray
06	B-6	Letdown Demineralizer
07	B-5	Pressurizer Aux Spray
08	B-12, A-15	Sampling
09	A-8, 11, B-2, 10 C-2A, C	Radwaste
10	C-1A, B, C C-3A, B, C	Feedwater
11	A-9A, B, A-14	Cooling Water
12	A-5, 6, B-16B	Nitrogen Gas
13	A-12, 13	Instrument Air
14	B-17B, 18B, E-1	Ventilation

CONTAINMENT ISOLATION

The findings for each group relative to containment isolation redundancy criteria (GDC 55, 56, 57) are as follows:

Group 0. No electrical failure mode was found which would prevent containment isolation signals from actuating both trains. No single failure susceptibility was found.

Group 1. The main steam sample lines meet GDC 57. Each line has one automatic isolation valve outside containment, and the secondary system piping inside containment meets the criteria for a closed system.

Group 2. The seal water lines to the main coolant pumps via penetrations B-7A,B,C do not meet GDC 55. Inside containment, each line has a check valve in the branch to the main coolant pump, and a normally closed remote manual valve in the branch to the safety injection header. Outside containment, each line has two remote manual valves in parallel branches, one of which (FCV 1115A, B, C) fails open on loss of instrument air. However, because these valves must be opened for post-LOCA charging/recirculation, the NRC accepted this configuration, under SEP Topic VI-4, on the basis of greater safety function (NRC letter to SCE dated March 3, 1982).

Group 3. Seal water return through penetration B-8 meets GDC 55 for safe shutdown systems. There are remote manual valves inside and outside containment at this penetration. While single failures reduce isolation redundancy, no single failure will violate containment isolation provided credit is taken for the normally closed nitrogen valves (SEP 4.23.1.1).

Group 4. Safety injection system meets the design criteria of GDC 55. The feedwater pump bypasses and the overpressure relief to the hold tank reduce the isolation redundancy. While single failures reduce isolation redundancy, no single failure will violate containment isolation.

Group 5. Containment spray and recirculation system penetrations connect to containment atmosphere. Neither spray penetration B-18A nor recirculation penetration B-3 meet GDC 56 in that there are no automatic isolation valves inside or outside containment. For penetration B-18A, there are remote manual valves inside containment (CV 82, CV 92, CV 114) and simple check valves outside containment (CRS 304, CRS 305). CV 82 and CV 114 fail open on loss of the non-safety grade instrument air system. There are also several normally closed valves on branch lines between the penetrations and the check valves (MOV 880, CRS 382, CRS 338, CRS 361, CRS 321). The NRC accepted the configuration for these two penetrations, based on their post-accident safety functions and administrative control of the normally closed valves, in SEP paragraph 4.23.7.1.

Group 6. The letdown demineralizer penetration isolation meets the design requirements of GDC 55. The isolation valves are Paul Munroe and they fail closed on loss of instrument air. While single failures reduce isolation redundancy, no single failure will violate containment isolation.

Group 7. Penetration B-5 meets the design requirements of GDC 55 in that there are remote manual isolation valves in an ESF system with leak detection on the valves outside containment. While single failures reduce isolation redundancy, no single failure will violate containment isolation.

Group 8. Penetration B-12 meets the design requirements of GDC 55 as amended by SEP paragraph 4.23.2 in which the NRC accepts remote manual isolation valves within containment. While single failures reduce isolation redundancy, no single failure will violate containment isolation provided credit is taken for the normally closed nitrogen valves (SEP 4.23.1.1).

Group 9. Penetration A-8, A-11, B-2, B-10, C-2A and C-2C have automatic isolation valves both inside and outside containment and they fail closed on loss of actuating power. They meet GDC 55. While single failures reduce isolation redundancy, no single failure will violate containment isolation.

Group 10. The feedwater lines do not meet GDC 57. Although the secondary system piping inside containment meets the criteria for a closed system, each of the chemical feed connections outside containment is isolated only by a check valve. Each main and bypass control branch is isolated by a check valve, backed up by automatic isolation valves which close on a SIS (a flow control valve and motor operated isolation valve in the main path, and a bypass flow control valve in the bypass path). The NRC accepted the above configuration, in SEP paragraph 4.23.3. It is noted that the safety-related boundaries include all of the above valves. Additionally, the NRC has reviewed the main steam lines from penetrations 1-J-1 and 2-J-1 to the main steam stop valves (SEP paragraph 4.23.7.2) and has accepted the existing configuration.

Group 11. The NRC has reviewed penetrations A-9A, A-9B and A-14 as part of SEP. IPSAR paragraph 4.23.6 states that the configuration satisfies the requirements of GDC 57. However, for GDC 57 to apply the closed system inside containment should be of safety-grade design. The seimic design of safety related systems was reviewed as part of the Seismic Reevaluation Program under SEP Topic III-6. In this program system boundaries were established up to a single valve. Therefore, these lines were evaluated from the containment boundary to the single isolation valve.

Group 12. Penetration B-16B meets the design requirements of GDC 57. Penetration A-6 is acceptable provided credit is taken for the normally closed nitrogen valves (SEP 4.23.1.1). Penetration A-5, which supplies safety-related backup nitrogen to the PORV and block valve actuators, has a check valve inside containment and a normally open remote manual valve outside containment. This configuration does not meet GDC requirements. However, the nitrogen system outside containment meets the criteria for a closed system, ensuring that containment isolation is maintained. In addition, the normally open position of the remote manual isolation valve is the one required for the post-accident safety function of the PORVs and block valves.

Group 13. Penetration A-12 meets the design requirements of GDC 57. Penetration A-13 has been reviewed by the NRC in SEP paragraph 4.23.3 and the NRC considers that PCV 40 and check valve ISA 955 outside containment coupled with check valve ISA 001 inside containment is acceptable. While single failures reduce isolation redundancy, no single failure will violate containment isolation provided credit is taken for the normally closed nitrogen valves (SEP 4.23.1.1).

Group 14. Penetrations B-17B and B-18B meet the design requirements of GDC 56 with automatic isolation valves both inside and outside containment. Penetration E-1 has both isolation valves outside containment; one is an automatic isolation valve and one is locked closed whenever the plant is in operation. This arrangement is acceptable per SEP paragraph 4.23.4. While single failures reduce isolation redundancy, no single failure will violate containment isolation provided credit is taken for the normally closed nitrogen valves (SEP 4.23.1.1).

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 0. INITIATING PRESSURE SIGNAL FILE:CI-CIS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.1.01.09	PT 1120A	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.01.10	PT 1120A	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.02.03	PY 1120A	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.02.04	PY 1120A	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.02.05	PY 1120A	INPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.02.06	PY 1120A	INPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.02.07	PY 1120A	OUTPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.02.08	PY 1120A	OUTPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.02.09	PY 1120A	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.02.10	PY 1120A	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 0. INITIATING PRESSURE SIGNAL FILE:CI-CIS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.1.03.03	PA 1120A	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	OUTPUT OF THE PA INSTRUMENT IS BOTH TO CIS PANEL 2/3 LOGIC AND TO THE PC INSTRUMENTS. REF ELEM DIAG 451355
1.0.1.03.04	PA 1120A	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.03.15	PA 1120A	CONTACT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.03.16	PA 1120A	CONTACT CLOSED	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.03.17	PA 1120A	CONTACT GROUNDED	INSTRUMENT FUSE OPENS AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.04.03	PC 1120A	INPUT OPEN	NO EFFECT ON CIS OPERATION	PERIODIC TESTING	NONE REQUIRED	NONE	OUTPUT OF PC INSTRUMENTS IS NOT CIS. REF ELEM DIAG 451355
1.0.1.04.04	PC 1120A	INPUT SHORT	AFFECTS THE INPUT TO THE CIS 2/3 LOGIC AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.05.09	PT 1120B	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.05.10	PT 1120B	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.06.03	PY 1120B	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 0. INITIATING PRESSURE SIGNAL FILE:CI-CIS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.1.06.04	PY 1120B	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.06.05	PY 1120B	INPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.06.06	PY 1120B	INPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.06.07	PY 1120B	OUTPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.06.08	PY 1120B	OUTPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.06.09	PY 1120B	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.06.10	PY 1120B	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.07.03	PA 1120B	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	OUTPUT OF THE PA INSTRUMENT IS BOTH TO CIS PANEL 2/3 LOGIC AND TO THE PC INSTRUMENTS. REF ELEM DIAG 451355
1.0.1.07.04	PA 1120B	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.07.15	PA 1120B	CONTACT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 0. INITIATING PRESSURE SIGNAL FILE:CI-CIS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.1.07.16	PA 1120B	CONTACT CLOSED	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.07.17	PA 1120B	CONTACT GROUNDED	INSTRUMENT FUSE OPENS AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.08.03	PC 1120B	INPUT OPEN	NO EFFECT ON CIS OPERATION	PERIODIC TESTING	NONE REQUIRED	NONE	OUTPUT OF PC INSTRUMENTS IS NOT CIS. REF ELEM DIAG 451355
1.0.1.08.04	PC 1120B	INPUT SHORT	AFFECTS THE INPUT TO THE CIS 2/3 LOGIC AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.09.09	PT 1120C	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.09.10	PT 1120C	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.10.03	PY 1120C	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.10.04	PY 1120C	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.10.05	PY 1120C	INPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.10.06	PY 1120C	INPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
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ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.1.10.07	PY 1120C	OUTPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.10.08	PY 1120C	OUTPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.10.09	PY 1120C	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.10.10	PY 1120C	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.11.03	PA 1120C	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	OUTPUT OF THE PA INSTRUMENT IS BOTH TO CIS PANEL 2/3 LOGIC AND TO THE PC INSTRUMENTS. REF ELEM DIAG 451355
1.0.1.11.04	PA 1120C	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.11.15	PA 1120C	CONTACT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.11.16	PA 1120C	CONTACT CLOSED	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.11.17	PA 1120C	CONTACT GROUNDED	INSTRUMENT FUSE OPENS AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.1.12.03	PC 1120C	INPUT OPEN	NO EFFECT ON CIS OPERATION	PERIODIC TESTING	NONE REQUIRED	NONE	OUTPUT OF PC INSTRUMENTS IS NOT CIS. REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 0. INITIATING PRESSURE SIGNAL FILE:CI-CIS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.1.12.04	PC 1120C	INPUT SHORT	AFFECTS THE INPUT TO THE CIS 2/3 LOGIC AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.01.09	PT 1121A	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.01.10	PT 1121A	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.02.03	PY 1121A	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.02.04	PY 1121A	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.02.05	PY 1121A	INPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.02.06	PY 1121A	INPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.02.07	PY 1121A	OUTPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.02.08	PY 1121A	OUTPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.02.09	PY 1121A	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
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ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.2.02.10	PY 1121A	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.03.03	PA 1121A	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	OUTPUT OF THE PA INSTRUMENT IS BOTH TO CIS PANEL 2/3 LOGIC AND TO THE PC INSTRUMENTS. REF ELEM DIAG 451355
1.0.2.03.04	PA 1121A	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.03.15	PA 1121A	CONTACT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.03.16	PA 1121A	CONTACT CLOSED	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.03.17	PA 1121A	CONTACT GROUNDED	INSTRUMENT FUSE OPENS AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.04.03	PC 1121A	INPUT OPEN	NO EFFECT ON CIS OPERATION	PERIODIC TESTING	NONE REQUIRED	NONE	OUTPUT OF PC INSTRUMENTS IS NOT CIS. REF ELEM DIAG 451355
1.0.2.04.04	PC 1121A	INPUT SHORT	AFFECTS THE INPUT TO THE CIS 2/3 LOGIC AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.05.09	PT 1121B	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.05.10	PT 1121B	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
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GROUP 0. INITIATING PRESSURE SIGNAL FILE:CI-CIS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.2.06.03	PY 1121B	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.06.04	PY 1121B	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.06.05	PY 1121B	INPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.06.06	PY 1121B	INPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.06.07	PY 1121B	OUTPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.06.08	PY 1121B	OUTPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.06.09	PY 1121B	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.06.10	PY 1121B	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.07.03	PA 1121B	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	OUTPUT OF THE PA INSTRUMENT IS BOTH TO CIS PANEL 2/3 LOGIC AND TO THE PC INSTRUMENTS. REF ELEM DIAG 451355
1.0.2.07.04	PA 1121B	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 0. INITIATING PRESSURE SIGNAL FILE:CI-CIS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.2.07.15	PA 1121B	CONTACT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.07.16	PA 1121B	CONTACT CLOSED	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.07.17	PA 1121B	CONTACT GROUNDED	INSTRUMENT FUSE OPENS AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.08.03	PC 1121B	INPUT OPEN	NO EFFECT ON CIS OPERATION	PERIODIC TESTING	NONE REQUIRED	NONE	OUTPUT OF PC INSTRUMENTS IS NOT CIS. REF ELEM DIAG 451355
1.0.2.08.04	PC 1121B	INPUT SHORT	AFFECTS THE INPUT TO THE CIS 2/3 LOGIC AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.09.09	PT 1121C	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.09.10	PT 1121C	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.10.03	PY 1121C	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.10.04	PY 1121C	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.10.05	PY 1121C	INPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 0. INITIATING PRESSURE SIGNAL FILE:CI-CIS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.2.10.06	PY 1121C	INPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.10.07	PY 1121C	OUTPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.10.08	PY 1121C	OUTPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.10.09	PY 1121C	OUTPUT HIGH	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.10.10	PY 1121C	OUTPUT LOW	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.11.03	PA 1121C	INPUT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	OUTPUT OF THE PA INSTRUMENT IS BOTH TO CIS PANEL 2/3 LOGIC AND TO THE PC INSTRUMENTS. REF ELEM DIAG 451355
1.0.2.11.04	PA 1121C	INPUT SHORT	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.11.15	PA 1121C	CONTACT OPEN	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.11.16	PA 1121C	CONTACT CLOSED	HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355
1.0.2.11.17	PA 1121C	CONTACT GROUNDED	INSTRUMENT FUSE OPENS AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE LOST ONE OF THE 2/3 LOGIC INPUTS AND ANY RESULTING ISOLATION WILL HAVE TO BE DERIVED FROM 2/2 OF THE REMAINING INSTRUMENTS	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 0. INITIATING PRESSURE SIGNAL FILE:CI-CIS

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.0.2.12.03	PC 1121C	INPUT OPEN	NO EFFECT ON CIS OPERATION	PERIODIC TESTING	NONE REQUIRED	NONE	OUTPUT OF PC INSTRUMENTS IS NOT CIS. REF ELEM DIAG 451355
1.0.2.12.04	PC 1121C	INPUT SHORT	AFFECTS THE INPUT TO THE CIS 2/3 LOGIC AND HIGH CONTAINMENT PRESSURE SIGNAL WILL HAVE ONE ERRONEOUS INPUT INTO THE 2/3 LOGIC AND CONTAINMENT ISOLATION WILL BE INITIATED IF ONE MORE SIGNAL IS RECEIVED	PERIODIC TESTING	THIS TRAIN REMAINS AVAILABLE FOR AUTOMATIC ISOLATION AND THE REDUNDANT TRAIN IS UNAFFECTED	NONE	REF ELEM DIAG 451355

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 1. PENETRATION B-12 FEEDWATER SAMPLING FILE: CI-260

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.01.1.01.1	SV 119	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	TWO MANUAL SR VALVES IN SERIES CAN BE CLOSED	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	REF P&I 5178260
1.01.1.01.2	SV 119	FAIL CLOSED	NONE, NORMALLY CLOSED, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.1.02.1	FSS 303	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.1.02.2	FSS 303	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.1.03.1	FSS 301	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.1.03.2	FSS 301	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.2.01.1	SV 120	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	TWO MANUAL SR VALVES IN SERIES CAN BE CLOSED	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	REF P&I 5178260
1.01.2.01.2	SV 120	FAIL CLOSED	NONE, NORMALLY CLOSED, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.2.02.1	FSS 306	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.2.02.2	FSS 306	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.2.03.1	FSS 302	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.2.03.2	FSS 302	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.3.01.1	SV 121	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	TWO MANUAL SR VALVES IN SERIES CAN BE CLOSED	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	REF P&I 5178260
1.01.3.01.2	SV 121	FAIL CLOSED	NONE, NORMALLY CLOSED, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.3.02.1	FSS 308	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.3.02.2	FSS 308	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.3.03.1	FSS 304	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.3.03.2	FSS 304	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.4.01.1	SV 122	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	TWO MANUAL SR VALVES IN SERIES CAN BE CLOSED	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	REF P&I 5178260
1.01.4.01.2	SV 122	FAIL CLOSED	NONE, NORMALLY CLOSED, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.4.02.1	FSS 338	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.4.02.2	FSS 338	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.4.03.1	FSS 334	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.4.03.2	FSS 334	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.5.01.1	SV 123	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	TWO MANUAL SR VALVES IN SERIES CAN BE CLOSED	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	REF P&I 5178260
1.01.5.01.2	SV 123	FAIL CLOSED	NONE, NORMALLY CLOSED, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.5.02.1	FSS 329	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.5.02.2	FSS 329	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 1. PENETRATION B-12 FEEDWATER SAMPLING FILE: CI-260

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.01.5.03.1	FSS 327	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.5.03.2	FSS 327	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.6.01.1	SV 124	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	TWO MANUAL SR VALVES IN SERIES CAN BE CLOSED	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	REF P&I 5178260
1.01.6.01.2	SV 124	FAIL CLOSED	NONE, NORMALLY CLOSED, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.6.02.1	FSS 340	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.6.02.2	FSS 340	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260
1.01.6.03.1	FSS 336	FAIL OPEN	NONE, NORMAL POSITION	NONE	SOLENOID VALVE WILL ISOLATE	NONE	REF P&I 5178260
1.01.6.03.2	FSS 336	FAIL CLOSED	NONE, SAMPLE LINE ISOLATED	NONE	NONE REQUIRED	NONE	REF P&I 5178260

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 2: PENETRATION B-7A,B,C SEAL WATER FILE: CI-110

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.02.1.01.1	FCV 1115A	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVES INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B7-C.	CHECK VALVE RCP 005 AND MOV 358 IN CONTAINMENT. REF P&I 5178110
1.02.1.01.2	FCV 1115A	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178110. FC WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE WOULD FO.
1.02.1.02.1	FCV 1115D	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVES INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B7-C	REF P&I 5178110. FO WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE WOULD FC.
1.02.1.02.2	FCV 1115D	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178110
1.02.1.03.1	SV 1115AD	FAIL OPEN	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178110. BACKUP N2 NOT AVAILABLE AND ON LOSS OF INSTRUMENT AIR FCV 1115D FAILS CLOSED
1.02.1.03.2	SV 1115AD	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	BACKUP NITROGEN AVAILABLE. REF P&I 5178110
1.02.2.01.1	FCV 1115B	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVES INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B7-B.	CHECK VALVE RCP 006 AND MOV 357 IN CONTAINMENT. REF P&I 5178110
1.02.2.01.2	FCV 1115B	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178110. FC WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE WOULD FO.
1.02.2.02.1	FCV 1115E	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVES INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B7-B	REF P&I 5178110. FO WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE WOULD FC.
1.02.2.02.2	FCV 1115E	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178110
1.02.2.03.1	SV 1115BE	FAIL OPEN	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178110. BACKUP N2 NOT AVAILABLE AND ON LOSS OF INSTRUMENT AIR FCV 1115E FAILS CLOSED
1.02.2.03.2	SV 1115BE	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	BACKUP NITROGEN AVAILABLE. REF P&I 5178110
1.02.3.01.1	FCV 1115C	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVES INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B7-A.	CHECK VALVE RCP 104 AND MOV 358 IN CONTAINMENT. REF P&I 5178110
1.02.3.01.2	FCV 1115C	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178110. FC WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE WOULD FO.
1.02.3.02.1	FCV 1115F	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVES INSIDE CONTAINMENT	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B7-A	REF P&I 5178110. FO WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE WOULD FC.
1.02.3.02.2	FCV 1115F	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178110
1.02.3.03.1	SV 1115CF	FAIL OPEN	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178110. BACKUP N2 NOT AVAILABLE AND ON LOSS OF INSTRUMENT AIR FCV 1115F FAILS CLOSED
1.02.3.03.2	SV 1115CF	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	BACKUP NITROGEN AVAILABLE. REF P&I 5178110

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 3: PENETRATION B-8 RCP SEAL WATER RETURN FILE:CI-111

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.03.1.01.1	CV 527	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-8	REF P&I 5178111. FO WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE WOULD FC.
1.03.1.01.2	CV 527	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178111
1.03.1.02.1	CV 528	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-8	REF P&I 5178136. FO WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE WOULD FC.
1.03.1.02.2	CV 528	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178136
1.03.1.03.1	VCC 345	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-8	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178136
1.03.1.03.2	VCC 345	FAIL CLOSED	NONE, NORMALLY CLOSED	NONE	NONE	NONE	REF P&I 5178136

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 4: PENETRATION B-1A,B,C,E-15,B-17A SIS FILE: CI-115

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.04.1.01.1	HV 851A	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B1-A,B,C	FO WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE IS BACKED UP BY BOTTLED N2. VALVE FAILURE MODE IS NOT PREDICTABLE BUT FO IS THE WORST CASE. REF P&I 5178115
1.04.1.01.2	HV 851A	FAIL CLOSED	NONE, NORMALLY CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178115
1.04.1.02.1	SIS 320	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B1-A,B,C	REF P&I 5178115
1.04.1.02.2	SIS 320	FAIL CLOSED	NONE, NORMAL POSITION	NONE	NONE REQUIRED	NONE	REF P&I 5178115
1.04.1.03.1	SV 702A	FAIL OPEN	ISOLATION OUTSIDE CONTAINMENT IS LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-15	REF P&I 5178115
1.04.1.03.2	SV 702A	FAIL CLOSED	NONE, NORMAL OPERATION	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178115
1.04.1.04.1	SV 702B	FAIL OPEN	ISOLATION INSIDE CONTAINMENT IS LOST	POSITION INDICATION IN CONTROL ROOM	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-15	REF P&I 5178115
1.04.1.04.2	SV 702B	FAIL CLOSED	NONE, NORMAL POSITION	POSITION INDICATION IN CONTROL ROOM	NONE REQUIRED	NONE	REF P&I 5178115
1.04.1.05.1	MOV 850C	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT ON PEN. B1-A,B,C. NONE FOR PEN. B17-A	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B1-A,B,C AND E-15. REDUCED ISOLATION REDUNDANCY FOR PENETRATION B17-A	VALVE IS FAI. FO IS WORST CASE. REF P&I 5178115
1.04.1.05.2	MOV 850C	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	VALVE IS FAI. FC IS NORMAL POSITION. REF P&I 5178115
1.04.2.01.1	HV 851B	FAIL OPEN	ISOLATION OUTSIDE CONTAINMENT IS LOST	POSITION INDICATION IN CONTROL ROOM	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B1-A,B,C	FO WOULD BE DUE TO CONTROLLER FAILURE ON LOSS OF INSTRUMENT AIR THE VALVE IS BACKED UP BY BOTTLED N2. VALVE FAILURE MODE IS NOT PREDICTABLE BUT FO IS THE WORST CASE. P&I 5178115
1.04.2.01.2	HV 851B	FAIL CLOSED	NONE, NORMALLY CLOSED	POSITION INDICATION IN CONTROL ROOM	NONE REQUIRED	NONE	REF P&I 5178115
1.04.2.02.1	SIS 319	FAIL OPEN	ISOLATION OUTSIDE CONTAINMENT IS LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B1-A,B,C	REF P&I 5178115
1.04.2.02.2	SIS 319	FAIL CLOSED	NONE, NORMAL POSITION	NONE	NONE REQUIRED	NONE	REF P&I 5178115
1.04.2.03.1	SV 702C	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-15	REF P&I 5178115
1.04.2.03.2	SV 702C	FAIL CLOSED	NONE, NORMAL POSITION	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178115
1.04.2.04.1	SV 702D	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-15	REF P&I 5178115
1.04.2.04.2	SV 702D	FAIL CLOSED	NONE, NORMAL POSITION	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178115
1.04.2.05.1	MOV 850B	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT ON PEN. B1-A,B,C. NONE FOR PEN. B17-A	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B1-A,B,C AND E-15. REDUCED ISOLATION REDUNDANCY FOR PENETRATION B17-A	VALVE IS FAI. FO IS WORST CASE. REF P&I 5178115
1.04.2.05.2	MOV 850B	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	VALVE IS FAI. FC IS NORMAL POSITION. REF P&I 5178115

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 4: PENETRATION B-1A,B,C,E-15,B-17A SIS FILE: CI-115

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.04.3.01.1	SIS 385	FAIL OPEN	NOT APPLICABLE, SEE REMARKS	NONE	NONE REQUIRED	NONE	THIS VALVE IS LOCKED CLOSED SUBJECT TO THE VALVE LOCKING PROGRAM. REF P&I 5178115
1.04.3.01.2	SIS 385	FAIL CLOSED	NONE, LOCKED CLOSED	NONE	NONE REQUIRED	NONE	THIS VALVE IS LOCKED CLOSED SUBJECT TO THE VALVE LOCKING PROGRAM. REF P&I 5178115
1.04.3.02.1	SIS 386	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B17-A	REF P&I 5178115
1.04.3.02.2	SIS 386	FAIL CLOSED	NONE, NORMAL SPRING LOADED CHECK VALVE POSITION	NONE	NONE REQUIRED	NONE	REF P&I 5178115
1.04.3.03.1	SIS 390	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B17-A	REF P&I 5178115
1.04.3.03.2	SIS 390	FAIL CLOSED	NONE, NORMAL POSITION	NONE	NONE REQUIRED	NONE	REF P&I 5178115
1.04.3.04.1	RV 868	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B17-A	REF P&I 5178115
1.04.3.04.2	RV 868	FAIL CLOSED	NONE, NORMAL RELIEF VALVE POSITION	NONE	NONE REQUIRED	NONE	REF P&I 5178115
1.04.3.05.1	MOV 850A	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT ON PEN. B1-A,B,C. NONE FOR PEN. B17-A	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B1-A,B,C AND E-15. REDUCED ISOLATION REDUNDANCY FOR PENETRATION B17-A	VALVE IS FAI. FO IS WORST CASE. REF P&I 5178115
1.04.3.05.2	MOV 850A	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	VALVE IS FAI. FC IS NORMAL POSITION. REF P&I 5178115

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 5: PENETRATION B-18A,3 CONTAINMENT SPRAY FILE:CI-120

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.05.1.01.1	CV 82	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B18-A	REF P&I 5178120. NRC WILL ACCEPT CHECK VALVES CRS 304 AND CRS 305 AS ACCEPTABLE PER SEP PARAGRAPH 4.23.7.1
1.05.1.01.2	CV 82	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
1.05.1.02.1	CRS 021	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B18-A	REF P&I 5178120. NRC WILL ACCEPT CHECK VALVES CRS 304 AND CRS 305 AS ACCEPTABLE PER SEP PARAGRAPH 4.23.7.1
1.05.1.02.2	CRS 021	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178120
1.05.2.01.1	CV 114	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B18-A	REF P&I 5178120. NRC WILL ACCEPT CHECK VALVES CRS 304 AND CRS 305 AS ACCEPTABLE PER SEP PARAGRAPH 4.23.7.1
1.05.2.01.2	CV 114	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178120
1.05.3.01.1	CV 92	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B18-A	REF P&I 5178120. NRC WILL ACCEPT CHECK VALVES CRS 304 AND CRS 305 AS ACCEPTABLE PER SEP PARAGRAPH 4.23.7.1
1.05.3.01.2	CV 92	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178120.
1.05.4.01.1	CRS 020	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-3	REF P&I 5178120. NRC WILL ACCEPT CHECK VALVES CRS 304 AND CRS 305 AS ACCEPTABLE PER SEP PARAGRAPH 4.23.7.1
1.05.4.01.2	CRS 020	FAIL CLOSED	INSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-3	REF P&I 5178120. NO CREDIT CAN BE TAKEN FOR CHECK VALVE CRS 020
1.05.4.02.1	CRS 341	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-3	REF P&I 5178120. NRC WILL ACCEPT CHECK VALVES CRS 304 AND CRS 305 AS ACCEPTABLE PER SEP PARAGRAPH 4.23.7.1
1.05.4.02.2	CRS 341	FAIL CLOSED	NONE, NORMALLY CLOSED	NONE	NONE REQUIRED	NONE	REF P&I 5178120
1.05.4.03.1	CRS 342	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-3. SEE REMARKS	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178120
1.05.4.03.2	CRS 342	FAIL CLOSED	NONE, NORMALLY CLOSED	NONE	NONE REQUIRED	NONE	REF P&I 5178120
1.05.4.04.1	CRS 304	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-3, 18-A	
1.05.4.04.2	CRS 304	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	
1.05.4.05.1	CRS 305	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-3, 18-A	
1.05.4.05.2	CRS 305	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 6: PENETRATION B-6 LETDOWN DEMINERALIZER FILE:CI-130

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.06.1.01.1	CV 525	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-6	REF P&I 5178130. FO WOULD BE DUE TO A VALVE MECHANICAL FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.06.1.01.2	CV 525	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178130
1.06.1.02.1	CV 526	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-6	REF P&I 5178140. FO WOULD BE DUE TO A VALVE MECHANICAL FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.06.1.02.2	CV 526	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178140
1.06.1.03.1	LDS 312	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-6	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178140
1.06.1.03.2	LDS 312	FAIL CLOSED	NONE, NORMAL POSITION	NONE	NONE REQUIRED	NONE	REF P&I 5178140

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 7: PENETRATION B-5 PRESSURIZER SPRAY AUX FILE:CI-135

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.07.1.01.1	FCV 1112	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-5	REF P&I 5178135
1.07.1.01.2	FCV 1112	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178135
1.07.1.02.1	CV 304	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-5	REF P&I 5178135
1.07.1.02.2	CV 304	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178135
1.07.2.01.1	CV 305	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-5	REF P&I 5178135
1.07.2.01.2	CV 305	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178135

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 8: PENETRATION B-12,A-15 SAMPLING FILE: CI-150

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.08.1.01.1	CV 948	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.1.01.2	CV 948	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.1.02.1	CV 949	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.1.02.2	CV 949	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.1.03.1	GNI 440	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	NITROGEN SYSTEM VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178400
1.08.1.03.2	GNI 440	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178400
1.08.2.01.1	CV 962	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.2.01.2	CV 962	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.2.02.1	CV 957	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.2.02.2	CV 957	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.2.03.1	RSS 310	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178150
1.08.2.03.2	RSS 310	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178150
1.08.3.01.1	CV 955	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.3.01.2	CV 955	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.3.02.1	CV 956	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.3.02.2	CV 956	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.3.03.1	SV 3302	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.3.03.2	SV 3302	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.3.04.1	RSS 315	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178150
1.08.3.04.2	RSS 315	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178150
1.08.3.05.1	RSS 345	FAIL OPEN	NONE, SEE REMARKS	NONE	NONE REQUIRED	NONE, SEE REMARKS	VALVE LOCKED CLOSED AS PART OF THE VALVE LOCKING PROGRAM. REF P&I 5178150
1.08.3.05.2	RSS 345	FAIL CLOSED	NONE, NORMAL POSITION	NONE	NONE REQUIRED	NONE, SEE REMARKS	VALVE LOCKED CLOSED AS PART OF THE VALVE LOCKING PROGRAM. REF P&I 5178150
1.08.3.06.1	RSS 018	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-15	
1.08.3.06.2	RSS 018	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178150
1.08.3.07.1	RSS 020	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-6	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178150

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 8: PENETRATION B-12,A-15 SAMPLING FILE: CI-150

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.08.3.07.2	RSS 020	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178150
1.08.3.08.1	RSS 344	FAIL OPEN	NONE, SEE REMARKS	NONE	NONE REQUIRED	NONE, SEE REMARKS	VALVE LOCKED CLOSED AS PART OF THE VALVE LOCKING PROGRAM. REF P&I 5178150
1.08.3.09.2	RSS 344	FAIL CLOSED	NONE, NORMAL POSITION	NONE	NONE REQUIRED	NONE, SEE REMARKS	VALVE LOCKED CLOSED AS PART OF THE VALVE LOCKING PROGRAM. REF P&I 5178150
1.08.3.10.1	RSS 347	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION A-15	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178150
1.08.3.10.2	RSS 347	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178150
1.08.4.01.1	CV 953	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.4.01.2	CV 953	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.4.02.1	CV 951	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.4.02.2	CV 951	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.4.03.1	CV 992	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	PASS ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-12	REF P&I 5178150
1.08.4.03.2	CV 992	FAIL CLOSED	NONE	PASS ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178150
1.08.4.04.1	RSS 331	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION B-12	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178150
1.08.4.04.2	RSS 331	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178150
1.08.5.01.1	CV 2145	FAIL OPEN	NONE	NONE	NONE REQUIRED	NONE	THIS SAMPLE LINE DOES NOT PENETRATE CONTAINMENT. REF P&I 5178150
1.08.5.01.2	CV 2145	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	THIS SAMPLE LINE DOES NOT PENETRATE CONTAINMENT. REF P&I 5178150

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 9: PENETRATION A-8,11,B-2,10,C-2A,C RAD WASTE F:CI-158

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.09.1.01.1	CV 102	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-8	REF P&I 5178158. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.1.01.2	CV 102	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178158
1.09.1.02.1	CV 103	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-8	REF P&I 5178158. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.1.02.2	CV 103	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178158
1.09.1.03.1	RLC 525	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-8	REF P&I 5178158. NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1.
1.09.1.03.2	RLC 525	FAIL CLOSED	NONE, NORMAL POSITION	NONE	NONE REQUIRED	NONE	REF P&I 5178158
1.09.2.01.1	CV 104	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-10	REF P&I 5178158. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.2.01.2	CV 104	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178158
1.09.2.02.1	CV 105	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-10	REF P&I 5178158. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.2.02.2	CV 105	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178158
1.09.2.03.1	RLC 522	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-10	REF P&I 5178158. NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1.
1.09.2.03.2	RLC 522	FAIL CLOSED	NONE, NORMAL POSITION	NONE	NONE REQUIRED	NONE	REF P&I 5178158
1.09.3.01.1	CV 106	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C2-C	REF P&I 5178158. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.3.01.2	CV 106	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178158
1.09.3.02.1	CV 107	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C2-C	REF P&I 5178158. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.3.02.2	CV 107	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178158
1.09.3.03.1	RLC 520	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C2-C	REF P&I 5178158. NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1.

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 9: PENETRATION A-8,11,B-2,10,C-2A,C RAD WASTE F:CI-158

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.09.3.03.2	RLC 520	FAIL CLOSED	NONE, NORMAL POSITION	NONE	NONE REQUIRED	NONE	REF P&I 5178158
1.09.4.01.1	CV 536	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C2-A	REF P&I 5178158. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.4.01.2	CV 536	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178158
1.09.4.02.1	CV 535	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C2-A	REF P&I 5178158. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.4.02.2	CV 535	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178158
1.09.4.03.1	GNI 595	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C2-A	REF P&I 5178158. NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1.
1.09.4.03.2	GNI 595	FAIL CLOSED	NONE, NORMAL POSITON	NONE	NONE REQUIRED	NONE	REF P&I 5178158
1.09.5.01.1	CV 533	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-2	REF P&I 5178370. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.5.01.2	CV 533	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178370
1.09.5.02.1	CV 534	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-2	REF P&I 5178370. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.5.02.2	CV 534	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178370
1.09.5.03.1	PMU 364	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-2	VALVE LOCKED CLOSED, PART OF VALVE LOCKING PROGRAM. REF P&I 5178370. NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1.
1.09.5.03.2	PMU 364	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	VALVE LOCKED CLOSED, PART OF VALVE LOCKING PROGRAM. REF P&I 5178370
1.09.6.01.1	CV 537	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-11	REF P&I 5178381. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.09.6.01.2	CV 537	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178381
1.09.6.02.1	CV 115	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-11	REF P&I 5178381. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 9: PENETRATION A-8,11,B-2,10,C-2A,C RAD WASTE F:CI-158

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.09.6.02.2	CV 115	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178381
1.09.6.03.1	SDW 416	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-11	REF P&I 5178381. NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1.
1.09.6.03.2	SDW 416	FAIL CLOSED	NONE, NORMAL POSITON	NONE	NONE REQUIRED	NONE	REF P&I 5178381

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 10. PENETRATION C-1A,B,C,C-3A,B,C FEEDWATER F:CI-206

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.10.1.01.1	FCV 456	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-A	REF P&I 5178206. THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3.
1.10.1.01.2	FCV 456	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206. FC DUE TO MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR FO.
1.10.1.02.1	MOV 21	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-A	THIS IS THE ANTICIPATED "FAIL AS-IS" POSITION FOR THIS MOV. REF P&I 5178206. THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3.
1.10.1.02.2	MOV 21	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.1.03.1	FWS 345	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-A	REF P&I 5178206. THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3.
1.10.1.03.2	FWS 345	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.1.04.1	CV 142	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-A	REF P&I 5178206. THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3.
1.10.1.04.2	CV 142	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.1.05.1	FWS 379	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-A	REF P&I 5178206. THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3.
1.10.1.05.2	FWS 379	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.1.06.1	FWS 369	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT. FWS 373 STILL CLOSED TO BLOCK BYPASS	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-A	REF P&I 5178206
1.10.1.06.2	FWS 369	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178206
1.10.1.07.1	AFW 321	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	NONE	REDUCED ISOLATION CAPACITY FOR PENETRATION C3-A. OTHER CHECK VALVES (AFW 309, AFW 320, AFW 399) BACKUP AFW 321	FOLLOWING A LOCA, AUX FEEDWATER WOULD BE INJECTED VIA THIS LINE. REF P&I 5178220
1.10.1.07.2	AFW 321	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178220
1.10.1.08.1	SCF 359	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION C3-A	REF P&I 5178270. CHECK VALVE CONSIDERED ADEQUATE FOR ISOLATION IN THIS SERVICE, SEE SEP PARAGRAPH 4.23.3
1.10.1.08.2	SCF 359	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178270
1.10.2.01.1	FCV 457	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-C	THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3. REF P&I 5178206
1.10.2.01.2	FCV 457	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206. FC DUE TO MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR FO.
1.10.2.02.1	MOV 20	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-C	THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3. THIS IS THE ANTICIPATED "FAIL AS-IS" POSITION FOR THIS MOV. REF P&I 5178206

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 10. PENETRATION C-1A,B,C,C-3A,B,C FEEDWATER F:CI-206

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.10.2.02.2	MOV 20	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.2.03.1	FWS 346	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-C	REF P&I 5178206. THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3.
1.10.2.03.2	FWS 346	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.2.04.1	CV 144	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-C	REF P&I 5178206. THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3.
1.10.2.04.2	CV 144	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.2.05.1	FWS 378	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-C	REF P&I 5178206. THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3.
1.10.2.05.2	FWS 378	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.2.06.1	FWS 384	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT. FWS 388 STILL CLOSED TO BLOCK BYPASS	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-C	REF P&I 5178206
1.10.2.06.2	FWS 384	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178206
1.10.2.07.1	AFW 322	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	NONE	REDUCED ISOLATION CAPACITY FOR PENETRATION C3-C. OTHER CHECK VALVES (AFW 310, AFW 318, AFW 384) BACKUP AFW 322	FOLLOWING A LOCA, AUX FEEDWATER WOULD BE INJECTED VIA THIS LINE. REF P&I 5178220
1.10.2.07.2	AFW 322	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178220
1.10.2.08.1	SCF 368	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION C3-C	CHECK VALVE CONSIDERED ADEQUATE FOR ISOLATION IN THIS SERVICE, SEE SEP PARAGRAPH 4.23.3. REF P&I 5178270
1.10.2.08.2	SCF 368	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178270
1.10.3.01.1	FCV 458	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-B	REF P&I 5178206. THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3.
1.10.3.01.2	FCV 458	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206. FC DUE TO MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR FO.
1.10.3.02.1	MOV 22	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-B	THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3. FOR THESE MOV'S FAIL OPEN IS THE ANTICIPATED FAIL AS-IS POSITION. REF P&I 5178206
1.10.3.02.2	MOV 22	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.3.03.1	FWS 398	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-B	THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3. REF P&I 5178206
1.10.3.03.2	FWS 398	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.3.04.1	CV 143	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-B	THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3. REF P&I 5178206
1.10.3.04.2	CV 143	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206

ENGINEERED SAFETY FEA[illegible] SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 10. PENETRATION C-1A,B,C,C-3A,B,C FEEDWATER F:CI-206

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.10.3.05.1	FWS 417	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM SYSTEM INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-B	THE NRC CREDITS THE CHECK VALVE IN CONJUNCTION WITH THE MOV, SEE SEP PARAGRAPH 4.23.3. REF P&I 5178206
1.10.3.05.2	FWS 417	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.3.06.1	FWS 408	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT. FWS 412 STILL CLOSED TO BLOCK BYPASS	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C3-B	REF P&I 5178206
1.10.3.06.2	FWS 408	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178206
1.10.3.07.1	AFW 324	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM SYSTEM INDICATION	NONE	REDUCED ISOLATION CAPACITY FOR PENETRATION C3-B. OTHER CHECK VALVES (AFW 312, AFW 317, AFW 388) BACKUP AFW 324	FOLLOWING A LOCA, AUX FEEDWATER WOULD BE INJECTED VIA THIS LINE. REF P&I 5178220
1.10.3.07.2	AFW 324	FAIL CLOSED	NONE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	REF P&I 5178220
1.10.3.08.1	SCF 398	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION C3-B	CHECK VALVE CONSIDERED ADEQUATE FOR ISOLATION IN THIS SERVICE, SEE SEP PARAGRAPH 4.23.3. REF P&I 5178270
1.10.3.08.2	SCF 398	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178270
1.10.4.01.1	CV 100	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	CLOSED SYSTEM IN CONTAINMENT	LOSS OF ISOLATION CAPABILITY FOR PENETRATION C1-A,B,C	REF P&I 5178206. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC. FWS 380 IS NORMALLY CLOSED TO BLOCK INSTRUMENT AIR FLOW
1.10.4.01.2	CV 100	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.4.02.1	FWS 580	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	CLOSED SYSTEM IN CONTAINMENT	LOSS OF ISOLATION CAPABILITY FOR PENETRATION C1-A,B,C	REF P&I 5178206. CLOSED MANUAL VALVE, REQUIRES OPERATOR ACTION TO OPEN
1.10.4.02.2	FWS 580	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.4.03.1	CV 100B	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C1-A,B,C	REF P&I 5178206. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.10.4.03.2	CV 100B	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178206
1.10.4.04.1	FWS 581	FAIL OPEN	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178206
1.10.4.04.2	FWS 581	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178206
1.10.4.05.1	CV 100A	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION C1-A,B,C	REF P&I 5178206. FO WOULD BE DUE TO A VALVE MECHANICAL OR CONTROLLER FAILURE. ON LOSS OF INSTRUMENT AIR THE VALVE WILL FC.
1.10.4.05.2	CV 100A	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178206

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 11: PENETRATION A-9A,B,A-14 COOLING WATER FILE:CI-320

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.11.1.01.1	CV 515	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION A-9B, A-14	PIPING INSIDE CONTAINMENT IS NON-SEISMIC. TCW 516 CAN BE MANUALLY CLOSED TO ISOLATE PENETRATION A-14. REF P&I 5178320
1.11.1.01.2	CV 515	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178320
1.11.2.01.1	CV 516	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION A-9A	PIPING INSIDE CONTAINMENT IS NON-SEISMIC. REF P&I 5178320
1.11.2.01.2	CV 516	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178320

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 12: PENETRATION A-5,6,B-16B GAS NITROGEN FILE:CI-402

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.12.1.01.1	SV 2004	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	PERIODIC TESTING	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-16B	REF P&I 5178402
1.12.1.01.2	SV 2004	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178402
1.12.1.02.1	SV 3004	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	PERIODIC TESTING	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-16B	REF P&I 5178405
1.12.1.02.2	SV 3004	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178405
1.12.2.01.1	CV 532	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-5	REF P&I 5178404
1.12.2.01.2	CV 532	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178404
1.12.2.02.1	GNI 732	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	PERIODIC TESTING	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNCANCY FOR PENETRATION A-5	LOCKED CLOSED AS PART OF VALVE LOCKING PROGRAM. REF P&I 5178404
1.12.2.02.2	GNI 732	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	LOCKED CLOSED AS PART OF THE VALVE LOCKING PROGRAM. REF P&I 5178404
1.12.2.03.1	GNI 736	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	PERIODIC TESTING	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-5	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178404
1.12.2.03.2	GNI 736	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178404
1.12.2.04.1	GNI 102	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	PERIODIC TESTING	CLOSED SYSTEM OUTSIDE CONTAINMENT, REMOTE MANUAL VALVE	LOSS OF AUTOMATIC ISOLATION CAPABILITY FOR PENETRATION A-5	REF P&I 5178405
1.12.2.04.2	GNI 102	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178405
1.12.3.01.1	GNI 336	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	PERIODIC TESTING	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-6	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178400
1.12.3.01.2	GNI 336	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178400
1.12.3.02.1	GNI 362	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	PERIODIC TESTING	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-6	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178400
1.12.3.02.2	GNI 362	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178400
1.12.3.03.1	GNI 001	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	PERIODIC TESTING	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-6	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178405
1.12.3.03.2	GNI 001	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178405

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 13: PENETRATION A-12,13 INSTRUMENT AIR FILE: CI-442

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.13.1.01.1	SV 125A	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION A-12	REF P&I 5178442
1.13.1.01.2	SV 125A	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178442
1.13.1.02.1	ISA 539	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION A-12	LOCKED CLOSED AS PART OF THE VALVE LOCKING PROGRAM. REF P&I 5178442
1.13.1.02.2	ISA 539	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	LOCKED CLOSED AS PART OF VALVE LOCKING PROGRAM. REF P&I 5178442
1.13.1.03.1	ISA 540	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION A-12	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178442.
1.13.1.03.2	ISA 540	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178442
1.13.2.01.1	PCV 40	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT. REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-13	SEE SEP PARAGRAPH 4.23.3. REF P&I 5178444
1.13.2.01.2	PCV 40	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178444
1.13.2.02.1	ISA 538	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT. REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-13	SEE SEP PARAGRAPH 4.23.3. REF P&I 5178442
1.13.2.02.2	ISA 538	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178442
1.13.2.03.1	ISA 955	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT. REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-13	SEE SEP PARAGRAPH 4.23.3. REF P&I 5178444
1.13.2.03.2	ISA 955	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178444
1.13.2.04.1	ISA 959	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-13	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178444
1.13.2.04.2	ISA 959	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178444
1.13.2.05.1	ISA 001	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION A-13	SEE SEP PARAGRAPH 4.23.3. REF P&I 5178449
1.13.2.05.2	ISA 001	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178449

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 14: PENETRATION B-17B, 18B, E-1 VENTILATION FILE:CI-600

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.14.1.01.1	CV 146	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-18B	REF P&I 5178600
1.14.1.01.2	CV 146	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178600
1.14.1.02.1	SV 1212-8	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-18B	REF P&I 5178601
1.14.1.02.2	SV 1212-8	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.1.03.1	CVS 333	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-18B	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178601
1.14.1.03.2	CVS 333	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.2.01.1	CV 147	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-18B	REF P&I 5178600
1.14.2.01.2	CV 147	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178600
1.14.2.02.1	CVS 335	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-18B	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178601
1.14.2.02.2	CVS 335	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.2.03.1	SV 1212-9	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-18B	REF P&I 5178601
1.14.2.03.2	SV 1212-9	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.3.01.1	CV 40	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-17B	REF P&I 5178600
1.14.3.01.2	CV 40	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178600
1.14.3.02.1	CV 116	FAIL OPEN	INSIDE ISOLATION CAPABILITY LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-17B	REF P&I 5178600
1.14.3.02.2	CV 116	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178600
1.14.3.03.1	CVS 328	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-17B	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178601
1.14.3.03.2	CVS 328	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.3.04.1	CV 10	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE INSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION B-17B	REF P&I 5178601
1.14.3.04.2	CV 10	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.4.01.1	POV 10	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-1	CVS 313 IS LOCKED CLOSED DURING PLANT OPERATION. SEE SEP PARAGRAPH 4.23.4. REF P&I 5178601
1.14.4.01.2	POV 10	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178601
1.14.4.02.1	GNI 374	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION E-1	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178601

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
CONTAINMENT ISOLATION
GROUP 14: PENETRATION B-17B, 18B, E-1 VENTILATION FILE:CI-600

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
1.14.4.02.2	GNI 374	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.4.03.1	GNI 373	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-1	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178601
1.14.4.03.2	GNI 373	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.4.04.1	CVS 313	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-1	CVS 313 IS LOCKED CLOSED DURING PLANT OPERATION. SEE SEP PARAGRAPH 4.23.4. REF P&I 5178601
1.14.4.04.2	CVS 313	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.5.01.1	POV 9	FAIL OPEN	ONE REDUNDANT ISOLATION VALVE LOST	CONTROL ROOM POSITION INDICATION	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-1	CVS 301 IS LOCKED CLOSED DURING PLANT OPERATION. SEE SEP PARAGRAPH 4.23.4. REF P&I 5178601
1.14.5.01.2	POV 9	FAIL CLOSED	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	REF P&I 5178601
1.14.5.02.1	GNI 378	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	NONE	LOSS OF ISOLATION CAPABILITY FOR PENETRATION E-1	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178601
1.14.5.02.2	GNI 378	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.5.03.1	GNI 377	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-1	NITROGEN SYSTEM SR VALVE NORMALLY CLOSED AND ACCEPTED AS ADEQUATE ISOLATION BY THE NRC, SEE SEP PARAGRAPH 4.23.1.1. REF P&I 5178601
1.14.5.03.2	GNI 377	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601
1.14.5.04.1	CVS 301	FAIL OPEN	OUTSIDE ISOLATION CAPABILITY LOST	NONE	REDUNDANT VALVE OUTSIDE CONTAINMENT	REDUCED ISOLATION REDUNDANCY FOR PENETRATION E-1	CVS 301 IS LOCKED CLOSED DURING PLANT OPERATION. SEE SEP PARAGRAPH 4.23.4. REF P&I 5178601
1.14.5.04.1	CVS 301	FAIL CLOSED	NONE	NONE	NONE REQUIRED	NONE	REF P&I 5178601

V.C MAIN FEEDWATER ISOLATION FUNCTION OF THE ECCS

The evaluation of the Main Feedwater Isolation function of the Emergency Core Cooling System (ECCS) was performed by way of a failure modes and effects analysis (FMEA) and, based on the FMEA results, an event-specific single failure response evaluation which explicitly accounted for common cause effects and the event-dependent alignment of 480 V MCC #3 (which powers one of the isolation valves). The event-specific evaluation is provided in Appendix V.C.1, and the FMEA in Appendix V.C.2.

These analyses identified event-related single failure susceptibilities which could result in:

a. Failure to isolate main feedwater to one or more steam generators in the time assumed in the existing design basis transient analyses for Main Steam Line Break (MSLB) and Loss of Coolant Accident. Such failure could result in more adverse core and containment consequences for MSLB, and in the potential for steam generator overfill concurrent with a LOCA.

b. Diversion of both trains of safety injection to the steam generators during an MSLB. Such failure could result in more adverse core and containment consequences than previously analysed for this event.

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

Assumptions:

1. The existing Main Feedwater (MFW) isolation design is as follows:

   a. Electrical power alignment, control power and safeguards sequencer assignment for each subsystem or device is as per the attached sketch. (Reference applicable elementary diagrams and P&IDs 5178115, 5178205 and 5178206.) MCC-3 power and control are aligned to Train 1 under normal and SIS conditions, and to Train 2 under SISLOP conditions.

   b. The MFW pump realignment valves fail to their normal (MFW) positions on loss of control power. Response time for realignment valves HV-852A and HV-852B is less than or equal to 5 seconds following receipt of a SIS.

   c. Motor operated valves MOV-20, MOV-21 and MOV-22 fail as-is on loss of control or motive power. Response time for these valves is less than or equal to 60 seconds following receipt of a SIS.

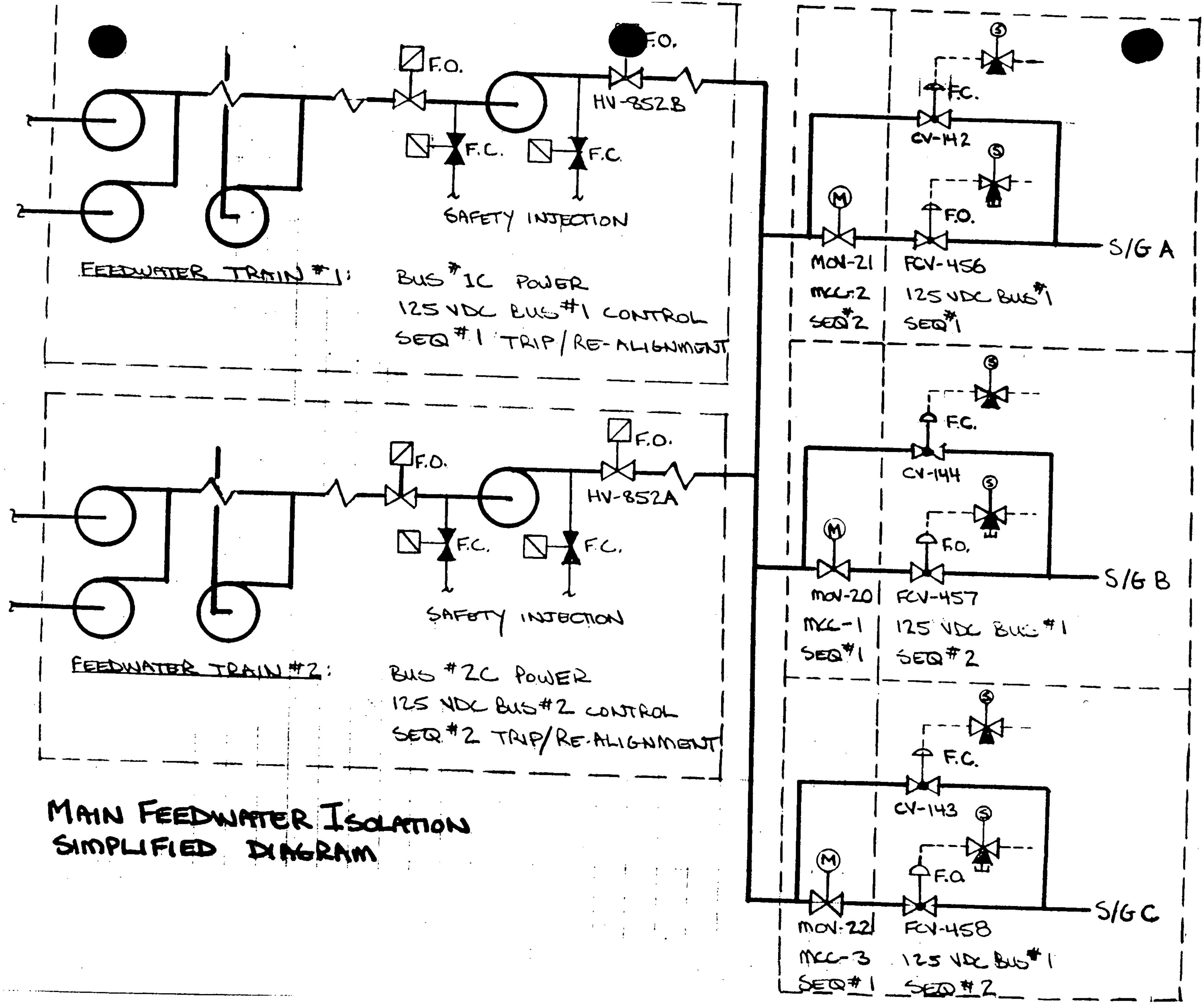
   d. Pneumatically operated valves FCV-456, FCV-457 and FCV-458 fail open on loss of instrument air pressure. Actuation of the associated isolation pilot solenoid valves bypasses the respective positioners and applies instrument air pressure to the actuator diaphragms as permitted by the positioner bleed rate. The response time for these valves is less than or equal to 60 seconds following receipt of a SIS.

   e. Pneumatically operated valves CV-142, CV-143 and CV-144 fail closed on loss of instrument air pressure. Actuation of the associated isolation pilot solenoid valves isolates and vents the actuator diaphragms. The response time for these valves is less than or equal to 30 seconds following receipt of a SIS.

2. The main steam line break accident analyses assume main feedwater isolation within 5 seconds following receipt of the SIS actuation signal, and that safety injection flow to the reactor coolant system (RCS) occurs after realignment of either FW/SIS train when RCS pressure decreases below SI system shut-off head.

3. For postulated loss of 125 VDC control power, the affected 4kV breakers cannot be tripped from the control room; trip of the associated pumps is therefore creditted only after local operator action (in the 4kV room).

4. The applicable events are evaluated both with and without offsite power.



MAIN FEEDWATER ISOLATION
SIMPLIFIED DIAGRAM

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN STEAM LINE BREAK, INSIDE CONTAINMENT
NO LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: NO EFFECT. (Unqualified devices outside harsh area)
INST AIR: NO EFFECT. (Unqualified devices outside harsh area; compressor capacity adequate to maintain pressure at FCVs)
EQ: NO EFFECT. (FCVs, CVs, MOVs and MCCs outside harsh area)
MCC-3 ALIGNED TO: TRAIN 1

SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
	{------	------	------EFFECT ON MAIN FEEDWATER ISOLATION	------	------	------}
HV-852B	SI FLOW TO FW HEADER	NONE (Train realigns normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	SI DIVERTED TO 3 S/G FOR 1 MIN
HV-852A	NONE (Train realigns normally)	SI FLOW TO FW HEADER	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	SI DIVERTED TO 3 S/G FOR 1 MIN
SEQ #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	FW ISOLATED TO 2 S/G IN 1 MIN, FW TO 1 S/G UNISOLATED
SEQ #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	FW TO 1 S/G ISOLATED IN 1 MIN, FW TO 2 S/G UNISOLATED
DC BUS #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	MOV FAILS OPEN FCV FAILS AS-IS* CV FAILS AS-IS	MOV FAILS OPEN FCV FAILS AS-IS* CV FAILS AS-IS	FW TO 3 S/G UNISOLATED
DC BUS #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	FW TO 1 S/G ISOLATED IN 1 MIN, FW TO 2 S/G UNISOLATED

*OR TO 5% IF IN AUTO

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN STEAM LINE BREAK, INSIDE CONTAINMENT
WITH LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:

FWCS: NO EFFECT. (Unqualified devices outside harsh area)
INST AIR: LOST AS A RESULT OF SISLOP/LOP. FCVs FAIL OPEN, CVs FAIL SHUT
EQ: NO EFFECT. (FCVs, CVs, MOVs and MCCs outside harsh area)
MCC-3 ALIGNED TO: TRAIN 2

	EFFECT ON MAIN FEEDWATER ISOLATION					
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	SI FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	SI DIVERTED TO 3 S/G FOR 1 MIN
HV-852A	NONE (Train realigns normally)	SI FLOW TO FW HEADER	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	SI DIVERTED TO 3 S/G FOR 1 MIN
SEQ #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV FAILS OPEN CV isolates normally	NONE
SEQ #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE
DC BUS #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE
DC BUS #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN STEAM LINE BREAK, OUTSIDE CONTAINMENT
NO LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: FCV AND CV POSITIONERS AFFECTED BY HARSH ENVIRONMENT. FCVs ASSUMED TO FAIL OPEN
INST AIR: COMPRESSORS AFFECTED BY HARSH ENVIRONMENT; AIR LINES ASSUMED IMPACTED. FCVs ASSUMED TO FAIL OPEN, CVs TO FAIL SHUT
EQ: FCV AND CV SOLENOIDS, MOVs AND MCC-3 AFFECTED BY HARSH ENVIRONMENT
MCC-3 ALIGNED TO: TRAIN 1

	{-------------------------	-------------------------	----------EFFECT ON MAIN FEEDWATER ISOLATION------	-------------------------	-------------------------	-------------------------}
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	SI FLOW TO FW HEADER	NONE (Train realigns normally)	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	SI DIVERTED/UNISOLATED TO 3 S/G
HV-852A	NONE (Train realigns normally)	SI FLOW TO FW HEADER	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	SI DIVERTED/UNISOLATED TO 3 S/G
SEQ #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	FW TO 3 S/G UNISOLATED
SEQ #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	FW TO 3 S/G UNISOLATED
DC BUS #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	FW TO 3 S/G UNISOLATED
DC BUS #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	FW TO 3 S/G UNISOLATED

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN STEAM LINE BREAK, OUTSIDE CONTAINMENT
WITH LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: FCV AND CV POSITIONERS AFFECTED BY HARSH ENVIRONMENT. FCVs ASSUMED TO FAIL OPEN
INST AIR: LOST AS A RESULT OF SISLOP/LOP. FCVs FAIL OPEN, CVs FAIL SHUT
EQ: FCV AND CV SOLENOIDS, MOVs AND MCC-3 AFFECTED BY HARSH ENVIRONMENT
MCC-3 ALIGNED TO: TRAIN 2

SINGLE FAILURE	EFFECT ON MAIN FEEDWATER ISOLATION: FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	SI FLOW TO FW HEADER	NONE (Train realigns normally)	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	SI DIVERTED/UNISOLATED TO 3 S/G
HV-852A	NONE (Train realigns normally)	SI FLOW TO FW HEADER	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	SI DIVERTED/UNISOLATED TO 3 S/G
SEQ #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE
SEQ #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE
DC BUS #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE
DC BUS #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
NO LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: NO EFFECT. (Unqualified devices not significantly affected in first 30 minutes)
INST AIR: NO EFFECT. (Unqualified devices not significantly affected in first 30 minutes; compressor capacity adequate to maintain pressure at FCVs)
EQ: NO EFFECT. (MCCs outside harsh area; FCV and CV solenoids, MOVs not significantly affected in first 30 minutes)
MCC-3 ALIGNED TO: TRAIN 1

	EFFECT ON MAIN FEEDWATER ISOLATION					
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	NONE (RCS less than S/G pressure)	NONE (Train realigns normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (RCS less than S/G pressure)
HV-852A	NONE (Train realigns normally)	NONE (RCS less than S/G pressure)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (MOV, FCV and CV isolate normally)	NONE (RCS less than S/G pressure)
SEQ #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV FAILS OPEN FCV isolates normally CV isolates normally	FW TO 2 S/G ISOLATED IN 1 MIN, FW TO 1 S/G UNISOLATED
SEQ #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	FW TO 1 S/G ISOLATED IN 1 MIN, FW TO 2 S/G UNISOLATED
DC BUS #1	FW FLOW TO FW HEADER	NONE (Train realigns normally)	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	MOV FAILS OPEN FCV FAILS AS-IS* CV FAILS AS-IS	MOV FAILS OPEN FCV FAILS AS-IS* CV FAILS AS-IS	FW TO 3 S/G UNISOLATED
DC BUS #2	NONE (Train realigns normally)	FW FLOW TO FW HEADER	MOV FAILS OPEN FCV isolates normally CV isolates normally	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	MOV isolates normally FCV FAILS AS-IS* CV FAILS AS-IS	FW TO 1 S/G ISOLATED IN 1 MIN, FW TO 2 S/G UNISOLATED

*OR TO 5% IF IN AUTO

MAIN FEEDWATER ISOLATION FUNCTION OF ECCS
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: LOSS OF COOLANT ACCIDENT
WITH LOSS OF OFFSITE POWER

COMMON CAUSE FAILURES:
FWCS: NO EFFECT. (Unqualified devices not significantly affected in first 30 minutes)
INST AIR: LOST AS A RESULT OF SISLOP/LOP. FCVs FAIL OPEN, CVs FAIL SHUT
EQ: NO EFFECT. (MCCs outside harsh area; FCV and CV solenoids, MOVs not significantly affected in first 30 minutes)
MCC-3 ALIGNED TO: TRAIN 2

	EFFECT ON MAIN FEEDWATER ISOLATION					
SINGLE FAILURE	FW TRAIN 1	FW TRAIN 2	STEAM GENERATOR A	STEAM GENERATOR B	STEAM GENERATOR C	NET EFFECT
HV-852B	NONE (RCS less than S/G pressure)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE (RCS less than S/G pressure)
HV-852A	NONE (Train realigns normally)	NONE (RCS less than S/G pressure)	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV isolates normally	NONE (RCS less than S/G pressure)
SEQ #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV isolates normally	MOV FAILS OPEN FCV FAILS OPEN CV isolates normally	NONE
SEQ #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE
DC BUS #1	NONE (Pumps stop due to loss of power)	NONE (Train realigns normally)	MOV isolates normally FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE
DC BUS #2	NONE (Train realigns normally)	NONE (Pumps stop due to loss of power)	MOV FAILS OPEN FCV FAILS OPEN CV isolates normally	MOV isolates normally FCV FAILS OPEN CV fails shut	MOV FAILS OPEN FCV FAILS OPEN CV fails shut	NONE

APPENDIX C.2

MAIN FEEDWATER ISOLATION (ECCS) FUNCTION
FAILURE MODE AND EFFECTS ANALYSIS

1. Electric circuits were traced back to tagged items which were covered in previous studies such as the RPS-SFA study. There was no duplicate analysis.

2. Where electrical failure modes would affect tagged mechanical items, then the failure mode or position of the mechanical item was cited.

3. The pressure control valves and other block valves in the instrument air system were not analyzed in this SFA since the failure modes of the valves which these gas sources actuate would encompass any failure mode of the valves in the actuating supply lines.

4. The following failure mode codes were used in this SFA.

Code	Failure Mode Description
1	Fail open
2	Fail closed
3	Input open
4	Input short
5	Input high
6	Input low or input lost
7	Output open
8	Output short
9	Output high
10	Output low or output lost
11	Tripped (bistable, circuit breaker)
12	As-is (un-tripped, last position maintained)
13	Output volts high (instrument power supply)
14	Output volts low, grounded (power supply)
15	All contact open (switch, relay, breaker)
16	All contacts closed (switch, relay, breaker)
17	All contacts grounded (switch, relay, breaker)
18	All contact shorted (paralleling of switch or relay contacts)

APPENDIX D

OVERPRESSURE MITIGATION SYSTEM
FAILURE MODE AND EFFECTS ANALYSIS

1. Electric circuits were traced back to tagged items which were covered in previous studies such as the RPS-SFA study. There was no duplicate analysis.

2. Where electrical failure modes would affect tagged mechanical items, then the failure mode or position of the mechanical item was cited.

3. The solenoid valves, pressure control valves and other block valves in the instrument air system and the gaseous nitrogen system were not analyzed in this SFA since the failure modes of the valves which these gas sources actuate would encompass any failure mode of the valves in the actuating supply lines.

4. The following failure mode codes were used in this SFA.

Code	Failure Mode Description
1	Fail open
2	Fail closed
3	Input open
4	Input short
5	Input high
6	Input low or input lost
7	Output open
8	Output short
9	Output high
10	Output low or output lost
11	Tripped (bistable, circuit breaker)
12	As-is (un-tripped, last position maintained)
13	Output volts high (instrument power supply)
14	Output volts low, grounded (power supply)
15	All contact open (switch, relay, breaker)
16	All contacts closed (switch, relay, breaker)
17	All contacts grounded (switch, relay, breaker)
18	All contact shorted (paralleling of switch or relay contacts)

OVER-PRESSURE MITIGATION

For all single failures analyzed, at least one OMS train will function as designed. However, this study indicated that one redundant loop is frequently disabled. Some failures caused unplanned depressurization of the pressurizer to begin, which require operator action to terminate.

In one failure mode of the handswitch HS 320 or HS 321, (fail as-is, OM enabled) the pressurizer cannot be operated above the OM mode setpoint without opening the valves which allow the pressurizer to vent to the pressurizer relief tank.

The fail closed and fail shorted failure modes of HS 5546 cause loss of control of one OMS block valve and one power operated relief valve. This is caused by using the exhaust ports of PY 2530 and PY 2546 as supply ports during HS 5546 operation from the Safe Shutdown Room.

These failures of HS 5546, which is located in the Safe Shutdown Room, do not prevent operation of the OMS from the control room however the failure is undetectable and it does remove one of the redundant overpressure mitigation paths from service and prevents operation of the OMS from the Safe Shutdown Room. SCE will open breakers 8-Y4606 and 8-Y4608, thus de-energizing HS 5546, PY 5530 and PY 5546. This removes the effect of any safe shutdown room equipment failures on the OMS.

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
OVERPRESSURE MITIGATION SYSTEM
FILES: OMS REF P&I 5178105

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
3.1.01.09	PT 425-X1	OUTPUT HIGH	TRAIN "A" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.01.10	PT 425-X1	OUTPUT LOW	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.02.03	PSC 425-X1(A)	INPUT OPEN	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.02.04	PSC 425-X1(A)	INPUT SHORT	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.02.05	PSC 425-X1(A)	INPUT HIGH	TRAIN "A" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.02.06	PSC 425-X1(A)	INPUT LOW	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.02.07	PSC 425-X1(A)	OUTPUT OPEN	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.02.08	PSC 421-X1(A)	OUTPUT SHORT	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.02.09	PSC 425-X1(A)	OUTPUT HIGH	TRAIN "A" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.02.10	PSC 425-X1(A)	OUTPUT LOW	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.03.03	PC 425-X1(B)	INPUT OPEN	TRAIN "A" PORV REMAINS CLOSED OM OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT LOOP AVAILABLE	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.03.04	PC 425-X1(B)	INPUT SHORT	TRAIN "A" PORV REMAINS CLOSED OM OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.03.05	PC 425-X1(B)	INPUT HIGH	TRAIN "A" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.03.06	PC 425-X1(B)	INPUT LOW	TRAIN "A" PORV REMAINS CLOSED OM OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.03.07	PC 425-X1(B)	OUTPUT OPEN	TRAIN "A" PORV REMAINS CLOSED OM OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.03.08	PC 425-X1(B)	OUTPUT SHORT	TRAIN "A" PORV REMAINS CLOSED OM OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.03.09	PC 425-X1(B)	OUTPUT HIGH	TRAIN "A" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.03.10	PC 425-X1(B)	OUTPUT LOW	TRAIN "A" PORV REMAINS CLOSED OM OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
OVERPRESSURE MITIGATION SYSTEM
FILES: OMS REF P&I 5178105

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
3.1.04.03	PRD 425-X1(C,D)	INPUT OPEN	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.04.04	PRD 425-X1(C,D)	INPUT SHORT	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.04.15	PRD 425-X1(C,D)	CONTACTS OPEN	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.04.16	PRD 425-X1(C,D)	CONTACTS CLOSED	TRAIN "A" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.04.17	PRD 425-X1(C,D)	CONTACTS GROUNDED	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.04.18	PRD 425-X1(C,D)	CONTACTS SHORTED	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.05.12	HS 320	AS-IS (OM DISABLE POSITION)	OPERATOR UNABLE TO PLACE TRAIN "A" IN THE OM ENABLE MODE	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.05.12	HS 320	AS-IS (OM ENABLE POSITION)	OPERATOR UNABLE TO PLACE TRAIN "A" IN THE OM DISABLE MODE	PERIODIC TESTING	NONE REQUIRED	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.05.15	HS 320	CONTACTS OPEN	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.05.16	HS 320	CONTACTS CLOSED	OPERATOR UNABLE TO REMOVE TRAIN "A" FROM OM ENABLE MODE	PERIODIC TESTING	NONE REQUIRED	NONE	
3.1.05.17	HS 320	CONTACTS GROUNDED	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.05.18	HS 320	CONTACTS SHORTED	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.06.01	PY 3545	FAIL OPEN	TRAIN "A" PORV OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "A" PORV INOPERABLE, REDUCED REDUNDANCY	
3.1.06.02	PY 3545	FAILS CLOSED	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "A" PORV INOPERABLE, REDUCED REDUNDANCY	
3.1.07.01	CV 545	FAIL OPEN	TRAIN "A" PORV OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "A" PORV INOPERABLE, REDUCED REDUNDANCY	
3.1.07.02	CV 545	FAIL CLOSED	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "A" PORV INOPERABLE, REDUCED REDUNDANCY	
3.1.08.03	PC 425-X1(A)	INPUT OPEN	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.08.04	PC 425-X1(A)	INPUT SHORT	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.08.11	PC 425-X1(A)	TRIPPED	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	
3.1.08.12	PC 425-X1(A)	AS-IS (UNTRIPPED)	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.09.03	PRD 425-X1(A,B)	INPUT OPEN	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
OVERPRESSURE MITIGATION SYSTEM
FILES: OMS REF P&I 5178105

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
3.1.09.04	PRD 425-X1(A,B)	INPUT SHORT	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.09.15	PRD 425-X1(A,B)	CONTACTS OPEN	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.09.16	PRD 425-X1(A,B)	CONTACTS CLOSED	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	
3.1.09.17	PRD 425-X1(A,B)	CONTACTS GROUNDED	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.09.18	PRD 425-X1(A,B)	CONTACTS SHORTED	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.10.03	PC 425-X3(A)	INPUT OPEN	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.10.04	PC 425-X3(A)	INPUT SHORT	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.10.11	PC 425-X3(A)	TRIPPED	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.10.12	PC 425-X3(A)	AS-IS (UNTRIPPED)	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.1.11.01	PCV 1531R	FAIL OPEN	NONE	NONE	NONE REQUIRED	NONE	
3.1.11.02	PCV 1531R	FAIL CLOSED	TRAIN "A" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.1.12.12	HS 131	FAIL AS IS (CLOSE VALVE POSITION)	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	NONE	
3.1.12.12	HS 131	FAIL AS-IS (AUTO POSITION)	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.12.12	HS 131	FAIL AS-IS (OPEN VALVE POSITION)	TRAIN "A" PORV OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.12.15	HS 131	CONTACTS OPEN	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.12.16	HS 131	CONTACTS CLOSED	TRAIN "A" PORV OPENS, CANNOT BE CLOSED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.12.17	HS 131	CONTACTS GROUNDED	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.12.18	HS 131	CONTACTS SHORT	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.13.12	HS 127	AS-IS (CLOSE VALVE POSITION)	TRAIN "A" ISOLATION VALVE CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.13.12	HS 127	AS-IS (NEUTRAL POSITION)	TRAIN "A" ISOLATION VALVE FAILS AS-IS	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.13.12	HS 127	AS-IS (OPEN VALVE POSITION)	TRAIN "A" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.1.13.15	HS 127	CONTACTS OPEN	TRAIN "A" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.1.13.16	HS 127	CONTACTS CLOSED	TRAIN "A" ISOLATION VALVE CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.13.17	HS 127	CONTACTS GROUNDED	TRAIN "A" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	NONE	
3.1.13.18	HS 127	CONTACTS SHORTED	TRAIN "A" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	NONE	
3.1.14.01	PY 3531	FAIL OPEN	TRAIN "A" ISOLATION VALVE CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "A" PORV INOPERABLE, REDUCED REDUNDANCY	

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3.1.14.02	PY 3531	FAIL CLOSED	TRAIN "A" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.1.15.01	CV 531	FAIL OPEN	TRAIN "A" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.1.15.02	CV 531	FAIL CLOSED	TRAIN "A" ISOLATION VALVE CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "A" PORV INOPERABLE, REDUCED REDUNDANCY	
3.1.16.15	ZY 3531	CONTACTS OPEN	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	NONE REQUIRED	NONE	
3.1.16.16	ZY 3531	CONTACTS CLOSED	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	
3.1.16.17	ZY 3531	CONTACTS GROUNDED	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.16.18	ZY 3531	CONTACTS SHORTED	TRAIN "A" CONTROL ROOM SYSTEM INDICATION FAILURE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	
3.1.17.13	YE 425-X1	OUTPUT VOLTS HIGH	TRAIN "A" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.17.14	YE 425-X1	OUTPUT VOLTS ZERO	TRAIN "A" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.18.11	8-1215V BREAKER	CONTACTS OPEN (TRIPPED)	TRAIN "A" PORV CLOSES, CANNOT BE OPENED. TRAIN "A" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.1.19.01	PCV 1545R	FAIL OPEN	NONE	NONE	NONE REQUIRED	NONE	
3.1.19.02	PCV 1545R	FAIL CLOSED	TRAIN "A" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "A" PORV INOPERABLE, REDUCED REDUNDANCY	
3.1.20.14	120 VAC BUS-2	OUTPUT VOLTS ZERO OR GROUNDED	TRAIN "A" PORV CLOSES, CANNOT BE OPENED. TRAIN "A" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "A" INOPERABLE, REDUCED REDUNDANCY	
3.2.01.09	PT 425-X2	OUTPUT HIGH	TRAIN "B" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.01.10	PT 425-X2	OUTPUT LOW	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.02.03	PSC 425-X2(A)	INPUT OPEN	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.02.04	PSC 425-X2(A)	INPUT SHORT	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.02.05	PSC 425-X2(A)	INPUT HIGH	TRAIN "B" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.02.06	PSC 425-X2(A)	INPUT LOW	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.02.07	PSC 425-X2(A)	OUTPUT OPEN	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.02.08	PSC 421-X2(A)	OUTPUT SHORT	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	

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3.2.02.09	PSC 425-X2(A)	OUTPUT HIGH	TRAIN "B" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.02.10	PSC 425-X2(A)	OUTPUT LOW	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.03.03	PC 425-X2(B)	INPUT OPEN	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.03.04	PC 425-X2(B)	INPUT SHORT	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.03.05	PC 425-X2(B)	INPUT HIGH	TRAIN "B" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.03.06	PC 425-X2(B)	INPUT LOW	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.03.07	PC 425-X2(B)	OUTPUT OPEN	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.03.08	PC 425-X2(B)	OUTPUT SHORT	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.03.09	PC 425-X2(B)	OUTPUT HIGH	TRAIN "B" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.03.10	PC 425-X2(B)	OUTPUT LOW	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.04.03	PRD 425-X2(C,D)	INPUT OPEN	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.04.04	PRD 425-X2(C,D)	INPUT SHORT	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.04.15	PRD 425-X2(C,D)	CONTACTS OPEN	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.04.16	PRD 425-X2(C,D)	CONTACTS CLOSED	TRAIN "B" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.04.17	PRD 425-X2(C,D)	CONTACTS GROUNDED	TRAIN "B PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.04.18	PRD 425-X2(C,D)	CONTACTS SHORTED	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.05.12	HS 321	AS-IS (OM DISABLE POSITION)	OPERATOR UNABLE TO PLACE TRAIN "B IN THE OM ENABLE MODE	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.05.12	HS 321	AS-IS (OM ENABLE POSITION)	OPERATOR UNABLE TO PLACE TRAIN "B IN THE OM DISABLE MODE	PERIODIC TESTING	NONE REQUIRED	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.05.15	HS 321	CONTACTS OPEN	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	

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3.2.05.16	HS 321	CONTACTS CLOSED	OPERATOR UNABLE TO REMOVE TRAIN "B FROM OM ENABLE MODE	PERIODIC TESTING	NONE REQUIRED	NONE	
3.2.05.17	HS 321	CONTACTS GROUNDED	TRAIN "B PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.05.18	HS 321	CONTACTS SHORTED	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.06.01	PY 2546	FAIL OPEN	TRAIN "B" PORV OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "B" PORV INOPERABLE, REDUCED REDUNDANCY	
3.2.06.02	PY 2546	FAIL CLOSED	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "B" PORV INOPERABLE, REDUCED REDUNDANCY	
3.2.07.01	CV 546	FAIL OPEN	TRAIN "B" PORV OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "B" PORV INOPERABLE, REDUCED REDUNDANCY	
3.2.07.02	CV 546	FAIL CLOSED	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "B" PORV INOPERABLE, REDUCED REDUNDANCY	
3.2.08.03	PC 425-X2(A)	INPUT OPEN	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.08.04	PC 425-X2(A)	INPUT SHORT	TRAIN "B PORV REMAINS CLOSED OM OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.08.11	PC 425-X2(A)	TRIPPED	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	
3.2.08.12	PC 425-X2(A)	AS-IS (UNTRIPPED)	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.09.03	PRD 425-X2(A,B)	INPUT OPEN	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.09.04	PRD 425-X2(A,B)	INPUT SHORT	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.09.15	PRD 425-X2(A,B)	CONTACTS OPEN.	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.09.16	PRD 425-X2(A,B)	CONTACTS CLOSED	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	
3.2.09.17	PRD 425-X2(A,B)	CONTACTS GROUNDED	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.09.18	PRD 425-X2(A,B)	CONTACTS SHORTED	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.10.03	PC 425-X4(A)	INPUT OPEN	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.10.04	PC 425-X4(A)	INPUT SHORT	TRAIN "B" PORV REMAINS CLOSED OM OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.10.11	PC 425-X4(A)	TRIPPED	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.10.12	PC 425-X4(A)	AS-IS (UNTRIPPED)	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	REDUNDANT TRAIN	NONE	
3.2.11.01	PCV 1530R	FAIL OPEN	NONE	NONE	NONE REQUIRED	NONE	
3.2.11.02	PCV 1530R	FAIL CLOSED	TRAIN "B" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.2.12.12	HS 132	FAIL AS IS (CLOSE VALVE POSITION)	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	NONE	

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3.2.12.12	HS 132	FAIL AS-IS (AUTO POSITION)	NONE	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.12.12	HS 132	FAIL AS-IS (OPEN VALVE POSITION)	TRAIN "B" PORV OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.12.15	HS 132	CONTACTS OPEN	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.12.16	HS 132	CONTACTS CLOSED	TRAIN "B" PORV OPENS, CANNOT BE CLOSED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.12.17	HS 132	CONTACTS GROUNDED	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.12.18	HS 132	CONTACTS SHORT	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.13.12	HS 128	AS-IS (CLOSE VALVE POSITION)	TRAIN "B" ISOLATION VALVE CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.13.12	HS 128	AS-IS (NEUTRAL POSITION)	TRAIN "B" ISOLATION VALVE FAILS AS-IS	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.13.12	HS 128	AS-IS (OPEN VALVE POSITION)	TRAIN "B" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.2.13.15	HS 128	CONTACTS OPEN	TRAIN "B" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.2.13.16	HS 128	CONTACTS CLOSED	TRAIN "B" ISOLATION VALVE CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.13.17	HS 128	CONTACTS GROUNDED	TRAIN "B" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	NONE	
3.2.13.18	HS 128	CONTACTS SHORTED	TRAIN "B" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	REDUNDANT TRAIN	NONE	
3.2.14.01	PY 2530	FAIL OPEN	TRAIN "B" ISOLATION VALVE CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "B" PORV INOPERABLE, REDUCED REDUNDANCY	
3.2.14.02	PY 2530	FAIL CLOSED	TRAIN "B" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.2.15.01	CV 530	FAIL OPEN	TRAIN "B" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM POSITION INDICATION	NONE REQUIRED	NONE	
3.2.15.02	CV 530	FAIL CLOSED	TRAIN "B" ISOLATION VALVE CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "B" PORV INOPERABLE, REDUCED REDUNDANCY	
3.2.16.15	ZY 2546	CONTACTS OPEN	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	PERIODIC TESTING	NONE REQUIRED	NONE	
3.2.16.16	ZY 2546	CONTACTS CLOSED	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	
3.2.16.17	ZY 2546	CONTACTS GROUNDED	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.16.18	ZY 2546	CONTACTS SHORTED	TRAIN "B" CONTROL ROOM SYSTEM INDICATION FAILURE	CONTROL ROOM SYSTEM INDICATION	NONE REQUIRED	NONE	
3.2.17.13	YE 425-X2	OUTPUT VOLTS HIGH	TRAIN "B" PORV OPENS, PORV MANUALLY OPERABLE, INDICATION FAILURES	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.17.14	YE 425-X2	OUTPUT VOLTS ZERO	TRAIN "B" PORV REMAINS CLOSED ON OM OVERPRESSURE, PORV MANUALLY OPERABLE, INDICATION FAILURES	PERIODIC TESTING	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.18.11	8-1112V BREAKER	CONTACTS OPEN (TRIPPED)	TRAIN "B" PORV CLOSES, CANNOT BE OPENED. TRAIN "B" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.19.01	PY 5546	FAIL OPEN	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS ARE UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 4563!

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
OVERPRESSURE MITIGATION SYSTEM
FILES: OMS REF P&I 5178105

ITEM NO. DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
3.2.19.02 PY 5546	FAIL CLOSED	NONE	NONE	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS ARE UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.20.14 VITAL BUS 1	OUTPUT VOLTS ZERO OR GROUNDED	TRAIN "B" PORV CLOSES, CANNOT BE OPENED. TRAIN "B" ISOLATION VALVE OPENS, CANNOT BE CLOSED	CONTROL ROOM SYSTEM INDICATION	REDUNDANT TRAIN	TRAIN "B" INOPERABLE, REDUCED REDUNDANCY	
3.2.21.01 PY 5530	FAIL OPEN	TRAIN "B" ISOLATION VALVE CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS ARE UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.21.02 PY 5530	FAIL CLOSED	NONE	NONE	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS ARE UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.22.12 HS 5546	AS-IS (CLOSE VALVES POSITION)	CV 530 AND CV 546 REMAIN CLOSED ON OPERATOR'S ATTEMPT TO OPEN THEM FROM THE SAFE SHUTDOWN ROOM	PERIODIC TESTING	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.22.12 HS 5546	AS-IS (SWITCH NEUTRAL POSITION)	CV 530 AND CV 546 REMAIN AS-IS ON OPERATOR'S ATTEMPT TO OPEN OR CLOSE THEM FROM THE SAFE SHUTDOWN ROOM	PERIODIC TESTING	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.22.12 HS 5546	AS-IS (VALVES OPEN POSITION)	CV 530 AND CV 546 REMAIN OPEN ON OPERATOR'S ATTEMPT TO CLOSE FROM THE SAFE SHUTDOWN ROOM	PERIODIC TESTING	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.22.15 HS 5546	CONTACTS OPEN	CV 546 CAN NOT BE OPENED AND CV 530 CAN NOT BE CLOSED FROM THE SAFE SHUTDOWN ROOM	PERIODIC TESTING	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631

ENGINEERED SAFETY FEATURES SINGLE FAILURE ANALYSIS
SAN ONOFRE UNIT 1
OVERPRESSURE MITIGATION SYSTEM
FILES: OMS REF P&I 5178105

ITEM NO.	DEVICE ID	FAILURE MODE	EFFECT-LOC	METHOD OF DETECTION	INHERENT COMPENSATING PROVISIONS	EFFECT ON ESF FUNCTION	REMARKS
3.2.22.16	HS 5546	CONTACTS CLOSED	CV 530 CLOSES AND CV 546 OPENS. OPERATOR WILL BE UNABLE TO CHANGE VALVES' POSITION FROM EITHER THE SAFE SHUTDOWN ROOM OR THE CONTROL ROOM	CONTROL ROOM SYSTEM INDICATION	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, HOWEVER ONE REDUNDANT LOOP IS BLOCKED AND THE OMS CANNOT BE OPERATED FROM THE SAFE SHUTDOWN ROOM	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.22.17	HS 5546	CONTACTS GROUNDED	BREAKERS 8-Y4608 & 8-Y4606 OPEN AND OPERATOR WILL BE UNABLE TO RE-POSITION THE VALVES FROM THE SAFE SHUTDOWN ROOM	PERIODIC TESTING	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.22.18	HS 5546	CONTACTS SHORTED	CV 530 WILL CLOSE AND CV 546 WILL OPEN. OPERATOR WILL BE UNABLE TO CHANGE VALVES' POSITION FROM EITHER THE CONTROL ROOM OR THE SAFE SHUTDOWN ROOM	CONTROL ROOM SYSTEM INDICATION	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS ARE UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.23.01	PCV 1546R	FAIL OPEN	NONE	NONE	NONE REQUIRED	NONE	
3.2.23.02	PCV 1546R	FAIL CLOSED	TRAIN "B" PORV CLOSES, CANNOT BE OPENED	CONTROL ROOM POSITION INDICATION	REDUNDANT PORV	TRAIN "B" PORV INOPERABLE, REDUCED REDUNDANCY	
3.2.24.11	8-Y4606 BREAKER	CONTACTS OPEN (TRIPPED)	NO POWER AVAILABLE TO OPERATE PY 5546 (PORV CV 546)	PERIODIC TESTING	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631
3.2.25.11	8-Y4608 BREAKER	CONTACTS OPEN (TRIPPED)	NO POWER AVAILABLE TO OPERATE PY 5530 (BLOCK VALVE CV 530)	PERIODIC TESTING	BREAKERS 8-Y4606, 8-Y4608 WILL BE OPENED, NEGATING ANY HS 5546, PY 5530 & PY 5546 FAILURES, THUS ELIMINATING ANY EFFECT OF HS 5546 CIRCUITRY ON THE OMS	NONE, BOTH LOOPS ARE UNAFFECTED AND ARE AVAILABLE FOR OMS OPERATION	REF ONE LINE 5196033, ELEMENTARY 45631

V.E AUXILIARY FEEDWATER / REACTOR PROTECTION SYSTEMS

In Revision 0 of this report, the proposed Cycle 10 configuration of the AFWS and RPS (based on scoping studies completed at the time) was evaluated with both a failure modes and effects analysis and an event-specific single failure response evaluation.

In Revision 1 of this report, the plant configuration following completion of final engineering and implementation of the actual design changes was evaluated, including the interlocks which were added to the AFWS design to prevent exceeding water hammer flow limits.

The single failure response of the AFWS and RPS was found to be acceptable subject to the specified operator actions in the control room (to close a diesel generator breaker, equalize flow to the three steam generators, or isolate the blowdown sample lines).

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
(POST-CYCLE 10 CONFIGURATION)
EVENT-SPECIFIC SINGLE FAILURE RESPONSE EVALUATION
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

Assumptions:

1. The AFW design to be implemented in Cycle 10 will have the following features:

   a. Parallel flow control valves (FCVs) to each steam generator (S/G), one Train A (fail closed on loss of power) and one Train B (fail open on loss of power).

   b. One wide range level indicator per S/G (Train A).

   c. One AFW flow indicator per S/G (Train B).

   d. Pumps G-10 and G-10S on Train A.

   e. Pump G-10W on Train B.

   f. Interlocks prevent auto-start of G-10 or G-10S unless lead pump (G-10W) fails.

   g. Flow restrictions prevent exceeding pump run-out or water hammer limits.

2. The RPS steam/feedwater flow mismatch scram is modified to preclude common mode failure (eg. PT-459 input) and to have channel trip on both negative and positive mismatch (inadequate or excess feedwater flow). The existing 2 out of 3 steam generator logic for reactor scram is retained. Single failure is thus precluded from preventing early reactor scram except for the loss of main feedwater to a single steam generator event; for this event, mismatch scram will not occur, since only one steam generator is affected.

3. Loss of offsite power and single active failure are assumed in addition to the initiating event; however, scram on the Loss of Power (LOP) signal from the Safeguards Load Sequencers is not creditted.

4. Loss of train power is conservatively assumed to include the associated control power supply.

5. No credit is taken for local manual operation of pump G-10.

6. The applicable RPS/AFW transient analysis references are as follows:

CASE A: Loss of Normal Feedwater to 1 S/G, from 100% power
Reactor trip on high pressurizer water level (50%)
AFW flow of 185 gpm at 30 minutes

CASE B: Loss of Normal Feedwater to 3 S/G, from 100% power
Reactor trip on steam/feedwater flow mismatch
AFW flow of 165 gpm at 30 minutes

CASE C: Loss of Normal Feedwater to 3 S/G, from 50% power
Reactor trip on high pressurizer water level (50%)
AFW flow of 185 gpm at 30 minutes

CASE D: Main Feed Line Break (upstream), from 100% power
Reactor trip on steam/feedwater flow mismatch
AFW flow of 125 gpm at 30 minutes

CASE E: Main Feed Line Break (upstream), from 50% power
Reactor trip on high pressurizer water level (50%)
AFW flow of 125 gpm at 15 minutes

CASE F: Main Feed Line Break (downstream), from 100% power
Reactor trip on steam/feedwater flow mismatch
AFW flow of 250 gpm at 15 min (+ 5 min to refill lines)

CASE G: Main Feed Line Break (downstream), from 50% power
Reactor trip on high pressurizer pressure
AFW flow of 250 gpm at 15 min (+ 5 min to refill lines)

7. AFW flow applicable to each event/condition is provided in the following table of hydraulic calculation results.

SOUTHERN CALIFORNIA EDISON CO.
SONGS, UNIT 1
3rd AFW Pump G-10W Automation Study

(FOR INFORMATION)

SUMMARY TABLE OF HYDRAULIC CALCULATION RESULTS (FOR AFW FLOW CONTROL)

STEAM GENERATOR PRESSURE (PSIG) SEEN BY PUMPS	S/G 1A	S/G 1B	S/G 1C	AFW TOTAL FLOW (GPM) TO STEAM GEN. (b)	AFWS TOTAL FLOW (GPM)
G10	1015	1015	1015	218	218
G10	1015	Break to Atmosphere	1015	97	295
G10	1015	1015	Blocked (c)	169	169
G10S	1015	1015	1015	184.5	184.5
G10S	1015	1015	Break to Atmosphere	40.8	230
G10S	1015	1015	Blocked (c)	165	165
G10S	Atmosphere	Atmosphere	Atmosphere	405	405
G10S	Atmosphere	Atmosphere	Break to Atmosphere	270	405
G10W (a)	1015	1015	1015	210	210
G10W (a)	Break to Atmosphere	1015	1015	71.6	263
G10W (a)	Blocked (c)	1015	1015	169	169
G10W (a)	Atmosphere	Atmosphere	Atmosphere	420	420
G10W (a)	Atmosphere	Atmosphere	Break to Atmosphere	280	420
G10 + G10S	1015	1015	Break to Atmosphere	146.6	351.5
G10W (d)	Break to Atmosphere	1015	1015	136.1	336.4

(a) Restriction orifice in pump discharge.
(b) Each AFW line with same venturi/orifice downstream of FCV's and before AFW-MFW boundary check valve.
(c) By operator action to close off line break to atmosphere.
(d) Flow through bypass around restriction orifice in discharge.

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
(POST-CYCLE 10 CONFIGURATION)
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: SINGLE STEAM GENERATOR LOSS OF FEEDWATER FROM 100% POWER

COMMON CAUSE FAILURES: NONE
STM/FW MISMATCH SCRAM: AVAILABLE

ACCEPTANCE CRITERION: NO PRESSURIZER FILL

SINGLE FAILURE	{------- EFFECT ON RPS/AFWS						------}	APPLICABLE ANALYSIS
	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FLOW CONTROL VLVS	ACTION (AFW FLOW)	(REQUIRED AFW FLOW)
G-10	HI PZR LEVEL (50%)	FAILED	AVAILABLE @30 MIN	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK	CLOSE DG-2 BRKR (210 @ 30 MIN)	CASE A (185 @ 30 MIN)
G-10S	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE A (185 @ 30 MIN)
TRAIN A POWER	HI PZR LEVEL (50%)	FAILED	FAILED	AVAILABLE @30 MIN	AVAILABLE	1/LOOP FAILED SHUT	CLOSE DG-2 BRKR (210 @ 30 MIN)	CASE A (185 @ 30 MIN)
G-10W	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	AVAILABLE	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE A (185 @ 30 MIN)
FLOW INDICATION	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	AVAILABLE @30 MIN	FAILED	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE A (185 @ 30 MIN)
TRAIN B POWER	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	FAILED	1/LOOP FAILED OPEN	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE A (185 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
(POST-CYCLE 10 CONFIGURATION)
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: SINGLE STEAM GENERATOR LOSS OF FEEDWATER FROM 50% POWER

COMMON CAUSE FAILURES: NONE
STM/FW MISMATCH SCRAM: BYPASSED

ACCEPTANCE CRITERION: NO PRESSURIZER FILL

SINGLE FAILURE	EFFECT ON RPS/AFWS: REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FLOW CONTROL VLVS	ACTION (AFW FLOW)	APPLICABLE ANALYSIS (REQUIRED AFW FLOW)
G-10	HI PZR LEVEL (50%)	FAILED	AVAILABLE @30 MIN	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK	CLOSE DG-2 BRKR (210 @ 30 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)
G-10S	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)
TRAIN A POWER	HI PZR LEVEL (50%)	FAILED	FAILED	AVAILABLE @30 MIN	AVAILABLE	1/LOOP FAILED SHUT	CLOSE DG-2 BRKR (210 @ 30 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)
G-10W	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	AVAILABLE	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)
FLOW INDICATION	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	AVAILABLE @30 MIN	FAILED	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)
TRAIN B POWER	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	FAILED	1/LOOP FAILED OPEN	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
(POST-CYCLE 10 CONFIGURATION)
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: COMPLETE LOSS OF MAIN FEEDWATER
FROM 100% POWER

COMMON CAUSE FAILURES: NONE
STM/FW MISMATCH SCRAM: AVAILABLE

ACCEPTANCE CRITERION: NO PRESSURIZER FILL

SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FLOW CONTROL VLVS	ACTION (AFW FLOW)	APPLICABLE ANALYSIS (REQUIRED AFW FLOW)
	←——— EFFECT ON RPS/AFWS						———→	
G-10	STM/FW MISMATCH	FAILED	AVAILABLE @30 MIN	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK	CLOSE DG-1 BRKR (184 @ 30 MIN) OR CLOSE DG-2 BRKR (210 @ 30 MIN)	CASE B (165 @ 30 MIN)
G-10S	STM/FW MISMATCH	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE B (165 @ 30 MIN)
TRAIN A POWER	STM/FW MISMATCH	FAILED	FAILED	AVAILABLE @30 MIN	AVAILABLE	1/LOOP FAILED SHUT	CLOSE DG-2 BRKR (210 @ 30 MIN)	CASE B (165 @ 30 MIN)
G-10W	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	AVAILABLE	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE B (165 @ 30 MIN)
FLOW INDICATION	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	AVAILABLE @30 MIN	FAILED	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE B (165 @ 30 MIN)
TRAIN B POWER	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	FAILED	1/LOOP FAILED OPEN	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE B (165 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
(POST-CYCLE 10 CONFIGURATION)
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: COMPLETE LOSS OF MAIN FEEDWATER
FROM 50% POWER

COMMON CAUSE FAILURES: NONE
STM/FW MISMATCH SCRAM: BYPASSED

ACCEPTANCE CRITERION: NO PRESSURIZER FILL

	{------------	------------	------------ EFFECT ON RPS/AFWS	------------	------------	------------}	APPLICABLE ANALYSIS
SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FLOW CONTROL VLVS	ACTION (AFW FLOW)	(REQUIRED AFW FLOW)
G-10	HI PZR LEVEL (50%)	FAILED	AVAILABLE @30 MIN	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK	CLOSE DG-2 BRKR (210 @ 30 MIN)	CASE C (185 @ 30 MIN)
G-10S	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @30 MIN	AVAILABLE	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)
TRAIN A POWER	HI PZR LEVEL (50%)	FAILED	FAILED	AVAILABLE @30 MIN	AVAILABLE	1/LOOP FAILED SHUT	CLOSE DG-2 BRKR (210 @ 30 MIN)	CASE C (185 @ 30 MIN)
G-10W	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	AVAILABLE	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)
FLOW INDICATION	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	AVAILABLE @30 MIN	FAILED	2/LOOP OK	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)
TRAIN B POWER	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @30 MIN	FAILED	FAILED	1/LOOP FAILED OPEN	NONE REQUIRED (218 @ 3.5 MIN)	BOUNDED BY CASE C (185 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
(POST-CYCLE 10 CONFIGURATION)
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN FEEDWATER LINE BREAK, UPSTREAM OF S/G CHECK VALVES FROM 100% POWER

COMMON CAUSE FAILURES: ONE FEEDWATER LINE RUPTURED. ALL AFW TO THE AFFECTED LINE ASSUMED LOST
STM/FW MISMATCH SCRAM: AVAILABLE

ACCEPTANCE CRITERION: NO CORE UNCOVERY

	EFFECT ON RPS/AFWS							APPLICABLE ANALYSIS
SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FLOW CONTROL VLVS	ACTION (AFW FLOW)	(REQUIRED AFW FLOW)
G-10	STM/FW MISMATCH	FAILED	AVAILABLE @15 MIN	AVAILABLE @15 MIN	AVAILABLE	2/LOOP OK	CLOSE DG-2 BRKR AND EQUALIZE FLOW (140 @ 15 MIN)	CASE D (125 @ 30 MIN)
G-10S	STM/FW MISMATCH	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @15 MIN	AVAILABLE	2/LOOP OK	(97 @ 3.5 MIN) EQUALIZE FLOW (145 @ 15 MIN)	BOUNDED BY CASE D (125 @ 30 MIN)
TRAIN A POWER	STM/FW MISMATCH	FAILED	FAILED	AVAILABLE @15 MIN	AVAILABLE	1/LOOP FAILED SHUT	CLOSE DG-2 BRKR AND EQUALIZE FLOW (140 @ 15 MIN)	CASE D (125 @ 30 MIN)
G-10W	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	FAILED	AVAILABLE	2/LOOP OK	(97 @ 3.5 MIN) EQUALIZE FLOW (145 @ 15 MIN)	BOUNDED BY CASE D (125 @ 30 MIN)
FLOW INDICATION	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	AVAILABLE @15 MIN	FAILED	2/LOOP OK	(97 @ 3.5 MIN) CLOSE DG-1 BRKR (146 @ 15 MIN)	BOUNDED BY CASE D (125 @ 30 MIN)
TRAIN B POWER	STM/FW MISMATCH	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	FAILED	FAILED	1/LOOP FAILED OPEN	(97 @ 3.5 MIN) CLOSE DG-1 BRKR (146 @ 15 MIN)	BOUNDED BY CASE D (125 @ 30 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
(POST-CYCLE 10 CONFIGURATION)
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN FEEDWATER LINE BREAK, UPSTREAM OF S/G CHECK VALVES
FROM 50% POWER

COMMON CAUSE FAILURES: ONE FEEDWATER LINE RUPTURED. ALL AFW TO THE AFFECTED LINE ASSUMED LOST

STM/FW MISMATCH SCRAM: BYPASSED

ACCEPTANCE CRITERION: NO CORE UNCOVERY

	EFFECT ON RPS/AFWS							APPLICABLE ANALYSIS
SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FLOW CONTROL VLVS	ACTION (AFW FLOW)	(REQUIRED AFW FLOW)
G-10	HI PZR LEVEL (50%)	FAILED	AVAILABLE @15 MIN	AVAILABLE @15 MIN	AVAILABLE	2/LOOP OK	CLOSE DG-2 BRKR AND EQUALIZE FLOW (140 @ 15 MIN)	CASE E (125 @ 15 MIN)
G-10S	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	FAILED	AVAILABLE @15 MIN	AVAILABLE	2/LOOP OK	(97 @ 3.5 MIN) EQUALIZE FLOW (145 @ 15 MIN)	BOUNDED BY CASE E (125 @ 15 MIN)
TRAIN A POWER	HI PZR LEVEL (50%)	FAILED	FAILED	AVAILABLE @15 MIN	AVAILABLE	1/LOOP FAILED SHUT	CLOSE DG-2 BRKR AND EQUALIZE FLOW (140 @ 15 MIN)	CASE E (125 @ 15 MIN)
G-10W	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	FAILED	AVAILABLE	2/LOOP OK	(97 @ 3.5 MIN) EQUALIZE FLOW (145 @ 15 MIN)	BOUNDED BY CASE E (125 @ 15 MIN)
FLOW INDICATION	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	AVAILABLE @15 MIN	FAILED	2/LOOP OK	(97 @ 3.5 MIN) CLOSE DG-1 BRKR (146 @ 15 MIN)	BOUNDED BY CASE E (125 @ 15 MIN)
TRAIN B POWER	HI PZR LEVEL (50%)	AVAILABLE @3.5 MIN	AVAILABLE @15 MIN	FAILED	FAILED	1/LOOP FAILED OPEN	(97 @ 3.5 MIN) CLOSE DG-1 BRKR (146 @ 15 MIN)	BOUNDED BY CASE E (125 @ 15 MIN)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
(POST-CYCLE 10 CONFIGURATION)
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN FEEDWATER LINE BREAK, DOWNSTREAM OF S/G CHECK VALVES FROM 100% POWER

COMMON CAUSE FAILURES: ONE LINE RUPTURED AT STEAM GENERATOR. AFW TO AFFECTED LINE AND STEAM TO G-10 TURBINE ASSUMED LOST

STM/FW MISMATCH SCRAM: AVAILABLE

ACCEPTANCE CRITERION: NO CORE UNCOVERY

SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FLOW CONTROL VLVS	ACTION (AFW FLOW)	APPLICABLE ANALYSIS (REQUIRED AFW FLOW)
	{------ EFFECT ON RPS/AFWS ------}							
G-10		NO STEAM						
G-10S	STM/FW MISMATCH	NO STEAM	FAILED	AVAILABLE @1 MIN*	AVAILABLE	2/LOOP OK	NONE REQUIRED (280 @ 1 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)
TRAIN A POWER	STM/FW MISMATCH	NO STEAM	FAILED	AVAILABLE @1 MIN*	AVAILABLE	1/LOOP FAILED SHUT	NONE REQUIRED (280 @ 1 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)
G-10W	STM/FW MISMATCH	NO STEAM	AVAILABLE @1 MIN*	FAILED	AVAILABLE	2/LOOP OK	NONE REQUIRED (270 @ 1 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)
FLOW INDICATION	STM/FW MISMATCH	NO STEAM	AVAILABLE @15 MIN#	AVAILABLE @1 MIN*	FAILED	2/LOOP OK	NONE REQUIRED (280 @ 1 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)
TRAIN B POWER	STM/FW MISMATCH	NO STEAM	AVAILABLE @1 MIN*	FAILED	FAILED	1/LOOP FAILED OPEN	NONE REQUIRED (270 @ 1 MIN+)	BOUNDED BY CASE F (250 @ 15 MIN+)

AUXILIARY FEEDWATER/REACTOR PROTECTION SYSTEMS
(POST-CYCLE 10 CONFIGURATION)
EVENT-SPECIFIC SINGLE FAILURE RESPONSE ANALYSIS
SAN ONOFRE NUCLEAR GENERATION STATION, UNIT 1

EVENT: MAIN FEEDWATER LINE BREAK, DOWNSTREAM OF S/G CHECK VALVES
FROM 50% POWER

COMMON CAUSE FAILURES: ONE LINE RUPTURED AT STEAM GENERATOR. AFW TO AFFECTED LINE AND STEAM TO G-10 TURBINE ASSUMED LOST

STM/FW MISMATCH SCRAM: BYPASSED

ACCEPTANCE CRITERION: NO CORE UNCOVERY

	EFFECT ON RPS/AFWS							APPLICABLE ANALYSIS
SINGLE FAILURE	REACTOR SCRAM	G-10	G-10S	G-10W	FLOW INDICATION	FLOW CONTROL VLVS	ACTION (AFW FLOW)	(REQUIRED AFW FLOW)
G-10		NO STEAM						
G-10S	HI PZR PRESSURE	NO STEAM	FAILED	AVAILABLE @1 MIN*	AVAILABLE	2/LOOP OK	NONE REQUIRED (280 @ 1 MIN+)	BOUNDED BY CASE 6 (250 @ 15 MIN+)
TRAIN A POWER	HI PZR PRESSURE	NO STEAM	FAILED	AVAILABLE @1 MIN*	AVAILABLE	1/LOOP FAILED SHUT	NONE REQUIRED (280 @ 1 MIN+)	BOUNDED BY CASE 6 (250 @ 15 MIN+)
G-10W	HI PZR PRESSURE	NO STEAM	AVAILABLE @1 MIN*	FAILED	AVAILABLE	2/LOOP OK	NONE REQUIRED (270 @ 1 MIN+)	BOUNDED BY CASE 6 (250 @ 15 MIN+)
FLOW INDICATION	HI PZR PRESSURE	NO STEAM	AVAILABLE @15 MIN#	AVAILABLE @1 MIN*	FAILED	2/LOOP OK	NONE REQUIRED (280 @ 1 MIN+)	BOUNDED BY CASE 6 (250 @ 15 MIN+)
TRAIN B POWER	HI PZR PRESSURE	NO STEAM	AVAILABLE @1 MIN*	FAILED	FAILED	1/LOOP FAILED OPEN	NONE REQUIRED (270 @ 1 MIN+)	BOUNDED BY CASE 6 (250 @ 15 MIN+)

INTERLOCK BLOCKS AUTO-START

* SISLOP/DG/PUMP START

+ PLUS 5 MIN FOR REFILL OF INTACT FW LINES

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION			FAILURE MODE	LOCAL EFFECTS AND DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECT ON AFWS	REMARKS
ITEM	TRAIN	COMPONENT						
1	A	S/G Water Level Narrow Range Instrumentation (Part of Loop 2400)	Level High (Output High)	2-out-of-3 S/G Logic reduced to 2-out-of-2 on remaining S/G's	Control Room Indication; Periodic Testing	Redundant Train, Manual Initiation	Train A initiation may not be provided automatically when 2 S/G's at low level condition	Actuation Devices include: LT2400A, B, C; LYV2400A, B, C; LI2400A, B, C; LYB2400A, B, C (Ref: 451775 Rev. 1, 5159842 Rev. 4)
			Level Low (Output Low)	2-out-of-3 S/G Logic reduced to 1-out-of-2 on remaining S/G's	Control Room Indication, Status; Periodic Testing	None required, Manual Mode and Redundant Train	Train A flow may be provided automatically when only 1 S/G at low level condition	Operator can place train in manual mode and prevent start. Train B is still available
2	A	AFW Initiation Logic (Part of Loop 2400)	Untripped (output high)	Loss of capability to provide automatic initiation of AFW Train A	Periodic Testing, Control Room Status at Redundant Train Initiation	Redundant Train, possible Manual Initiation	Train A initiation not provided automatically when S/G's at low level condition	Initiation Devices include: LYY2400A, B; HS2400A, B; LYL2400A, B; LYC2400A through I (Ref: 451775 Rev. 1, 5159842 Rev. 4)
			Tripped (output low)	Initiates G10S and G10 pumps in "lag" mode; if G10W is not delivering flow, G10 and G10S will start, and their isolation valves will open	Control Room Status, Alarm	None Required, Manual Mode and Redundant Train	Train A flow provided to S/G's (represents less than 5% of normal feed-water flow)	Operator can place train in manual mode and then stop, or prevent start if still in "lag" period. Train B is still available
3	A	G10S Pump Suction Pressure Instrumentation (Loop 2010)	Pressure Low (Output Low)	Inoperability of Train A automatic (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	Control Room Alarm, Indication; Periodic Testing	Redundant Train	Inoperability of Train A automatic (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	Automatic Protection Interlock Devices include: PT2010, PYV2010, PI2010A, PYB2010, PYT2010, PYY2010, PYC2010A, PYC2010B (Ref: 451791 Rev. 1, 5159842 Rev. 4). NOTE: EQ is required
			Pressure High (Output High)	Inoperability of Train A motor-driven pump automatic protection	Periodic Testing	None Required, Manual Mode and Redundant Train	Inoperability of Train A motor-driven pump automatic protection	For equipment protection only; automatic protection not required to prevent pump run-out in new design
4	A	Motor-driven AFW Pump (G10S)	Fails to start	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	Periodic Testing; Control Room Status, Alarm, Indication	Redundant Train	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	(Ref: 5180611 Rev. 1)

NOTE: "*" denotes new equipment, tag number(s) to be provided upon design completion.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION			FAILURE MODE	LOCAL EFFECTS AND DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECT ON AFWS	REMARKS
ITEM	TRAIN	COMPONENT						
5	A	G10S Pump Discharge Pressure Instrumentation (Loop 2011)	Pressure Low (Output Low)	Inoperability of G10S pump discharge pressure indication	Periodic Testing, Control Room Indication	None required	Inoperability of G10S pump discharge indication	Indication Devices include: PT2011, PYV2011, PI2011, PYB2011, PYC2011A, PYC2011B (Ref: 451666 Rev. 4, 5159842 Rev. 4). NOTE: EQ is required
			Pressure High (Output High)	Inoperability of G10S pump discharge pressure indication	Control Room Indication, Periodic Testing	None Required	Inoperability of G10S pump discharge indication	
6	A	G10S Cross-tie to 1st point heater (MOV1204)	Fails in the closed position	No AFW effect	Periodic Testing, Control Room Status	None required	None	(Ref: 5159559 Rev. 2, 5180661 Rev. 1)
			Fails to close	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	Periodic Testing; Control Room Status, Alarm, Indication	Redundant Train	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	MOV1204 can be closed by manual operation from Control Room or locally at valve
7	A	G10S Pump Discharge Valve (MOV1202)	Fails to the open position	If open before G10S Pump at normal operating speed, will cause insignificant delay in pump providing full flow	Control Room Status	None required	If open before G10S Pump at normal operating speed, will cause insignificant delay in pump providing full flow	(Ref: 5159841 Rev. 2, 5180611 Rev. 1)
			Fails to open	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	Periodic Testing; Control Room Status, Indication	Redundant Train	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	MOV1202 can be opened by manual operation from Control Room or locally at valve

NOTE: "*" denotes new equipment, tag number(s) to be provided upon design completion.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION			FAILURE MODE	LOCAL EFFECTS AND DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECT ON AFWS	REMARKS
ITEM	TRAIN	COMPONENT						
8	A	AFW Flow Control Valve (FCV) 2300, 2301, or *	Fails closed (F.C.)	FCV closes	Control Room Indication, Alarm	FCV *, 3301, or 3300 (Redundant Train)	None (full flow available through Train B parallel FCV).	Control Devices include: FCV2300, FCV2301, FCV*, FY2300A, FY2301A, FY*A, FYI2300, FYI2301, FYI*, FC2300, FC2301, FC*, HC2300, HC2301, HC*, FY2300B, FY2301B, FY*B, PCV2300A, PCV2300B, PCV2301A, PCV2301B, PCV*A, PCV*B; ZSO2300A, B; ZSC2300A, B; ZSO2301A, B; ZSC2301A, B; ZSO*A, B; ZSC*A, B (Ref: 451874 Rev. 2, 5159842 Rev. 4)
			Fails to close	FCV remains open.	Periodic Testing; Control Room Indication, possible alarm	Combined G10 and G10S pump capacity	Loss of flow equalization capability for FWLB	Combined G10 and G10S capacity provides minimum flow through at least 2 intact feedwater lines without flow equalization
9	A	Vital Bus No. 3A	Fails to supply power	In Train A AFW: - Loss of S/G water level narrow range instrumentation - Loss of status indication - Loss of AFW Initiation Logic - Loss of G10S and G10 pumps' suction pressure automatic protection - Loss of G10S and G10 pumps' discharge pressure automatic operation interlocks - Loss of FCVs control (F.C.) - Loss of G10 pump control - G10 Pump goes into "warmup" condition - Loss of G10 pump discharge valve (CV3213) control (F.O.)	Control Room Indication, Alarm	Redundant Train	Train A initiation not provided automatically when S/G's at low level condition; Train A FCV's fail closed to preserve Train B equalization capability	G10S pump, MOV1202, and MOV1204 are still available by manual operation from Control Room; G10 pump can be started locally (Ref: 5102174 Rev. 37, 5159794 Rev. 3 - Revise, 5159842 Rev. 4 - Revise)
10	A	125 Vdc Bus No. 1	Fails to supply power	Same as Vital Bus No. 3A above plus: - Loss of G10S pump control - Loss of G10S pump discharge valve (MOV1202) control (Fails - as is)	Control Room Indication, Alarm	Redundant Train	Train A controls inoperable	G10 pump can be started locally; G10S pump can be started from 480V Swgr breaker, since its electrical fault protection does not require external control power (Ref: 5146828 Rev. 24, 5180611 Rev. 1)

NOTE: "*" denotes new equipment, tag number(s) to be provided upon design completion.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS AND DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECT ON AFWS	REMARKS
11	A	480V MCC No. 1	Fails to supply power	In Train A AFW: - Loss of MOV1202 control - Loss of MOV1204 control (both Fail Locked - as is)	Control Room Status	Redundant Train	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	MOV1202 and MOV1204 can be operated locally at each valve. G10 Pump is still available (Ref: 5102165 Rev. 38, 5146828 Rev. 24, 5159559 Rev. 2, 5159841 Rev. 2)
12	A	480V Swgr No.1	Fails to supply power	Same as 480V MCC No. 1 above plus: - Loss of G10S Pump	Control Room Status, Alarm, Indication	Redundant Train	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	G10 Pump is still available (Ref: 5146828 Rev. 24, 5148062 Rev. 9, 5150885 Rev. 8)
13	A	4160V Bus No. 1C	Fails to supply power	Same as 480V swgr No. 1 above	Control Room Alarm, Status, Indication	Redundant Train	Inoperability of Train A (motor-driven) pumping capability for MSLB or FWLB (downstream of check valves)	G10 Pump is still available (Ref: 5146828 Rev. 24, 5102162 Rev. 16, 5130351 Rev. 5, 5150876 Rev. 10)
14	A	G10 Pump Suction Pressure Instrumentation (Loop 3010)	Pressure Low (Output Low)	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action	Control Room Indication, Alarm; Periodic Testing	Redundant Train and manual loading of Diesel Generator	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action	Automatic Protection Interlock Devices include: PT3010, PYV3010, PI3010A, PYB3010, PYT3010, PYY3010, PYC3010A, PYC3010B (Ref: 451869 Rev. 1 - Revise, 5159842 Rev. 4 - Revise). NOTE: EQ is required
			Pressure High (Output High)	Inoperability of steam turbine-driven pump automatic protection	Periodic Testing	None Required	Inoperability of steam turbine-driven pump automatic protection	For equipment protection only; automatic protection not required to prevent pump run-out in new design
15	A	Steam turbine-driven AFW Pump (G10)	Fails to start	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action	Periodic Testing; Control Room Status, Alarm, Indication	Redundant Train and manual loading of Diesel Generator	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action	Failure to start could also be "warmup" failure (Ref: 5159794 Rev. 3 - Revise)

NOTE: "*" denotes new equipment, tag number(s) to be provided upon design completion.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS AND DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECT ON AFWS	REMARKS
16	A	G10 Pump Discharge Pressure Instrumentation (Loop 3011)	Pressure Low (Output Low)	Inoperability of G10 pump discharge pressure indication	Periodic Testing, Control Room Indication	None required	Inoperability of G10 pump discharge pressure indication	Indication Devices include: PT3011, PYV3011, PI3011, PYB*, PYC*A, PYC*B (Ref: 235863 Rev. 2 - Revise, 5159843 Rev. 2 - Revise) NOTE: EQ is required
			Pressure High (Output High)	Inoperability of G10S pump discharge pressure indication	Control Room Indication, Periodic Testing	None Required	Inoperability of G10S pump discharge pressure indication	
17	A	G10 Pump Discharge Valve (CV3213)	Fails open (F.O.)	If F.O. before G10 Pump at normal operating speed, will cause insignificant delay in pump providing full flow	Control Room Status, Alarm	None required	If F.O. before G10 Pump at normal operating speed, will cause insignificant delay in pump providing full flow	(Ref: 5159744 Rev. 3 - Revise)
			Fails to open	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action	Periodic Testing; Control Room Status, Alarm, Indication	Redundant Train and manual loading of Diesel Generator	Inoperability of automatic pumping capability for LOP and reduces Train A flow available via operator Control Room action	CV3213 can be opened by manual operation from Control Room or locally at valve
18	A	G10W Pump Discharge manifold flow switch (first) (Loop * or *)	Flow Low (Output Low)	G10S & G10 Pumps start and operate at minimum flow (assume auto initiation previously given). Discharge valves do not open due to compensating provision	Periodic Testing, Control Room Status	G10W Pump Discharge Manifold 2nd flow switch for Train A pump discharge valve operation	G10S & G10 Pumps start and operate at minimum flow (assume auto initiation previously given). Discharge valves do not open due to compensating provision	Interlock final design not compoete. Final design will preclude concurrent operation of Trains A and B (in Auto mode); Train B will act as lead pump train and Train A as lag pump train; will address concurrent single failures, effects of valve leakage, physical separation requirements and other relevant criteria
			Flow High (Output High)	Inoperability of Train A automatic pumping capability	Control Room Status, Periodic Testing	Redundant Train	Inoperability of Train A automatic pumping capability	

NOTE: "*" denotes new equipment, tag number(s) to be provided upon design completion.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION			FAILURE MODE	LOCAL EFFECTS AND DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECT ON AFWS	REMARKS
ITEM	TRAIN	COMPONENT						
19	A	G10W Pump Discharge Manifold flow switch (second) (Loop * or *)	Flow Low (Output Low)	Train A discharge valves open but Train A pumps do not start (assume auto initiation previously given) due to compensating provision	Periodic Testing, Control Room Status	G10W Pump Discharge Manifold 1st flow switch for Train A pump operation	Discharge valves open but Train A Pumps do not start (assume auto initiation previously given) due to compensating provision	Interlock final design not complete. Final design will preclude concurrent operation of Train A and B (in Auto mode); Train B will act as lead pump train and Train A as lag pump train; will address concurrent single failures, effects of valve leakage, physical separation requirements and other relevant criteria
			Flow High (Output High)	Inoperability of Train A automatic pumping capability	Control Room Status, Periodic Testing	Redundant Train	Inoperability of Train A automatic pumping capability	
20	B	S/G Water Level Narrow Range Instrumentation (Part of Loop 3400)	Level High (Output High)	2-out-of-3 S/G Logic reduced to 2-out-of-2 on remaining S/G's	Control Room Indication; Periodic Testing	Redundant Train, Manual Initiation	Train B initiation may not be provided automatically when 2 S/G's at low level condition	Actuation Devices include: LT3400A, B, C; LYV3400A, B, C; LI3400A, B, C; LYB3400A, B, C (Ref: 451776 Rev. 1 and 5159843 Rev. 2)
			Level Low (Output Low)	2-out-of-3 S/G Logic reduced to 1-out-of-2 on remaining S/G's	Control Room Indication, Status; Periodic Testing	None Required, Manual Mode and Redundant Train	Train B flow may be provided automatically when only 1 S/G at low level condition	Operator can place train in manual mode and prevent start. Train A is still available
21	B	AFW Initiation Logic (Part of Loop 3400)	Untripped (output high)	Loss of capability to provide automatic initiation of AFW Train B	Periodic Testing, Control Room Status at Redundant Train Initiation	Redundant Train, possible Manual Initiation, Manual Mode Start	Train B initiation not provided automatically when S/G's at low level condition	Initiation Devices include: LYY3400A, B; HS3400A, B; LYL3400A, B; LYC3400A through J (Ref: 451776 Rev. 1, 5159843 Rev. 2)
			Tripped (output low)	Initiates G10W pump and discharge valve	Control Room Status, Alarm	None Required, Manual Mode and Redundant Train	Train B flow provided to S/G's (represents less than 5% of normal free-water flow)	Operator can place train in manual mode and then stop. Train A is still available

NOTE: "*" denotes new equipment, tag number(s) to be provided upon design completion.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION ITEM	TRAIN	COMPONENT	FAILURE MODE	LOCAL EFFECTS AND DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECT ON AFWS	REMARKS
22	B	G10W Pump Suction Pressure Instrumentation (Loop *)	Pressure Low (Output Low)	Inoperability of Train B automatic pumping capability	Control Room Alarm, Indication; Periodic Testing	Redundant Train, Manual Mode Start	Inoperability of Train B automatic pumping capability	Automatic Protection Interlock Devices include: PT*, PYV*, PYY*, PI*, PYT*, PYC*, and PYB* (Ref: New Elementary and Loop Diagrams) NOTE: EQ is required
			Pressure High (Output High)	Inoperability of Train B pump automatic protection	Periodic Testing	None Required	Inoperability of Train B pump automatic protection	For equipment protection only; automated protection not required to prevent run-out in new design
23	B	Motor-driven AFW Pump (G10W)	Fails to start	Inoperability of Train B pumping capability	Periodic Testing; Control Room Status, Alarm, Indication	Redundant Train	Inoperability of Train B pumping capability	G10S and G10 pumps start based on G10W Pump discharge manifold or discharge low pressure signal - assume auto initiation previously given (Ref: New Elementary Diagram)
24	B	G10W Pump Discharge Pressure Instrumentation (Loop *)	Pressure Low (Output Low)	Inoperability of Train B pump discharge pressure indication	Periodic Testing, Control Room Indication	None Required	Inoperability of Train B pump discharge pressure indication	Indication Devices include: PT*, PYV*, and PI* (Ref: New Elementary and Loop Diagrams)
			Pressure High (Output High)	Inoperability of Train B pump discharge pressure indication	Control Room Indication, Periodic Testing	None required	Inoperability of Train B pump discharge pressure indication	
25	B	G10W Pump Discharge Valve (FV3110)	Fails open (F.O.)	If F.O. before G10W Pump at normal operating speed, will cause insignificant delay in pump providing full flow	Control Room Status	None Required	If F.O. before G10W Pump at normal operating speed, will cause insignificant delay in pump providing full flow	(Ref: New Elementary Diagram)
			Fails to open	Inoperability of Train B pumping capability	Periodic Testing; Control Room Status, Indication	Redundant Train	Inoperability of Train B pumping capability	FV3110 can be opened by manual operation from Control Room or locally at valve

NOTE: "*" denotes new equipment, tag number(s) to be provided upon design completion.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION			FAILURE MODE	LOCAL EFFECTS AND DEPENDENT FAILURES	METHOD OF DETECTION	INHERENT COMPENSATING PROVISION(S)	EFFECT ON AFWS	REMARKS
ITEM	TRAIN	COMPONENT						
26	B	AFW Flow Control Valve (FCV) *, 3301, or 3300	Fails to the closed position	FCV closes	Control Room Indication, Alarm	FCV 2300, 2301, or * (Redundant Train)	None (full flow available through Train A parallel FCV)	Control Devices include: FCV3300, FCV3301, FCV*, FY3300A, FY3301A, FY*A, FYI3300, FYI3301, FYI*, HC3300, HC3301, HC*, FC3300, FC3301, FC*, FY3300B, FY3301B, FY*B, PCV3300A, PCV3301A, PCV*A, PCV*B, PCV3300B, PCV3301B; ZS03301A, B; ZSO*A, B; ZS03300A, B; ZSC3300A, B; ZSC3301A, B; ZSC*A, B; ZSO*A, B (Ref: 451875 Rev. 2, 5159843 Rev. 2)
			Fails open (F.O.)	FCV remains open	Periodic Testing; Control Room Indication, Alarm	Combine G10 and G10S capacity	Loss of flow equalization capability for FWLB	Combined G10 and G10S pumps capacity provides minimum flow through at least 2 intact feedwater lines without equalization
27	B	Vital Bus No. 5	Fails to supply power	Complete loss of AFW flow indication. In Train B AFW: - Loss of S/G water level narrow range instrumentation - Loss of status indication - Loss of AFW Initiation Logic - Loss of G10W pump's suction pressure automatic protection - Loss of G10W pump's discharge pressure indication - Loss of FCVs control (F.O.) - Loss of G10W pump discharge valve (FV3110) control (F.O.)	Control Room Indication, Alarm	Redundant Train, with combined G10 and G10S capacity for FWLB (upstream of check valves)	Train B initiation not provided automatically when S/G's at low level condition; loss of flow equalization capability for FWLB (upstream of check valves)	G10W Pump is still available by manual operation from Control Room. (Ref: 5159826 Rev. 3 - Revise, New Elementary Diagram)

NOTE: "*" denotes new equipment, tag number(s) to be provided upon design completion.

AUXILIARY FEEDWATER SYSTEM (AFWS) SINGLE FAILURE ANALYSIS
SONGS UNIT 1

IDENTIFICATION			FAILURE	LOCAL EFFECTS AND	METHOD OF	INHERENT COMPENSATING		
ITEM	TRAIN	COMPONENT	MODE	DEPENDENT FAILURES	DETECTION	PROVISION(S)	EFFECT ON AFWS	REMARKS
28	B	125 Vdc Bus No. 2	Fails to supply power	Same as Vital Bus No. 5 above, plus: - Loss of G10W Pump control	Control Room Indication, Alarm	Redundant Train	Train B controls inoperable	G10W Pump could be started from 4160V Swgr breaker, but without electrical fault protection since it requires external control power (Ref: 5146828 Rev. 24 - Revise, New Elementary Diagram)
29	B	480V MCC No. 2, 2A, or 2B	Fails to supply power	No AFW effect	Control Room Status	None required	None	(Ref: 5146828 Rev. 24)
30	B	480V Swgr No. 2	Fails to supply power	No AFW effect	Control Room Alarm, Status, Indication	None Required	None	(Ref: 5146828 Rev. 24, 5148063 Rev. 11, 5150885 Rev. 8)
31	B	4160V Bus No. 2C	Fails to supply power	In Train B AFW: - Loss of G10W Pump	Control Room Alarm, Status, Indication	Redundant Train	Inoperability of Train B pumping cability	(Ref: 5146828 Rev. 24, 5102163 Rev. 15 - Revise, 5130351 Rev. 5, 5150876 Rev. 10)
32	B	AFW Flow Indication (Loop 3453, 3454, or 3455)	Flow Low (Output Low)	Inoperability of flow equalization capability	Periodic Testing, Control Room Indication	Combined G10 & G10S Pumps capacity (Redundant Train)	Inoperability of flow equalization capability	Operator would use Train B indication to balance flow under line break-pressurized S/G's scenario. Balancing need can be avoided by running both G10 and G10S Pumps together. Indication Devices include: FTH3453, FYV3453B, FYQ3453B, FYA3453, FTL3453, FYV3453A, FYQ3453A, FYS3453A, FI3453, FYI3453, FTH3454, FYV3454B, FYQ3454B, FYA3454, FTL3454, FYV3454A, FYQ3454A, FYS3454A, FI3454, FYI3454, FTH3455, FYV3455B, FYQ3455B, FYA3455, FTL3455, FYV3455A, FYQ3455A, FYS3455A, FI3455, FYI3455 (Ref: 451876 Rev. 1, 5159843 Rev. 2)
			Flow High (Output High)	Inoperability of flow equalization capability.	Control Room Indication, Periodic Testing	Combined G10 & G10S Pumps capacity (Redundant Train)	Inoperability of flow equalization capability	

NOTE: "*" denotes new equipment, tag number(s) to be provided upon design completion.

EMERGENCY CORE COOLING SYSTEM REFERENCES

Piping and Instrumentation Diagrams

5178105	Pressurizer and Pressure Relief Tank System
5178110	Reactor Coolant Pump Seal Water System
5178115	Safety Injection System
5178135	Volume Control and Charging System
5178136	Volume Control and Charging System
5178205	Main Feedwater System
5178206	Main Feedwater System
5678769	Safety Injection System (1976)

One Line Diagrams

5102165	480 V MCC-1 Front
5102166	480 V MCC-1 Rear
5102169	480 V MCC-2A Front and Rear
5102170	480 V MCC-3 Front
5102171	480 V MCC-3 Rear
5102173	125 VDC System #1
5146828	Main One Line
5148063	SWGR 2 and 3
5149348	125 VDC System #2

Elementary Diagrams

63715	Safety Injection System
455369	MOV-1100B and MOV-1100D
455370	Safety Injection Pumps
455371	MOV-356, MOV-357, MOV-358
455373	HV-851A and HV-851B
455374	HV-854A and HV-854B
455429	Station Service Transformer #3 480 V ACB
455431	Bus Tie 2 - 3 480 V ACB
455457	FCV-1112 Solenoid Valve
455448	CV-202, ... CV-304, CV-305
5130351	4.16 kV Busses Undervoltage Relays
5149858	Main Feedwater Pumps
5150626	Charging Pumps
5150876	4.16 kV Busses Undervoltage and Generator Underfrequency Relays
5151028	MOV-1100C
5151906	480 V SWGR #3 125 VDC Control
5151922	Station Service Transformer #3 4.16 kV ACB

Other Drawings

N1542 sh. 51	Reactor Auxiliaries (FC-1112)
451408	FIT-1112/FC-1112 Loop Diagram
5149178	Load Sequence Table, Train 1 (sh. 1)
5149179	Load Sequence Table, Train 1 (sh. 2)
5149181	Load Sequence Table, Train 2 (sh. 1)
5149182	Load Sequence Table, Train 2 (sh. 2)
5149957	Emergency Operating Condition, Train 1
5149958	Emergency Operating Condition, Train 2
5149975	Connection Data Table, SIS/LOP Lockout, Train 2

Other Documents

SD-S01-580	System Description: Safety Injection, Recirculation and Containment Spray Systems
SD-S01-590	System Description: Safeguard Load Sequencing System
NUS Report	NUS-1972: Single Failure Analysis, SONGS 1 Emergency Core Cooling System (December 1976)

SAFETY INJECTION, RECIRCULATION, AND CONTAINMENT SPRAY SYSTEMS

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CONTROLLED LOCATION

This System Description is approved per SO123-0-44, System Description Revision and Approval. Contact CDM to verify revision information.

PREPARED BY: M. Reid Brady 11/18/85
Author Date

APPROVED BY: K. Krieger 11/18/85
Manager, Operations Date

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FOREWORD

FUNCTION: The Safety Injection, Recirculation, and Containment Spray Systems are designed to maintain the Reactor Core covered with coolant, maintain containment sphere pressure within design limits and subsequently prevent the uncontrolled release of radioactive fission products resulting from a loss of coolant accident.

The following System Description contains three separate and distinct System Descriptions identified as Parts I, II, and III. Each of the systems has unique functions and design bases but all three are related and dependent upon each other to accomplish a primary function; to maintain public safety by mitigating core damage resulting from overheating.

The combination of all three System Descriptions reflects existing P&IDs and training documentation.

PART I

SAFETY INJECTION SYSTEM

SAFETY INJECTION SYSTEM

1.0 FUNCTIONS/DESIGN BASES

1.1 The Safety Injection System System has the following main functions:

1.1.2 The Safety Injection System is designed to mitigate core damage resulting from overheating following a loss of coolant accident. This function is accomplished by immediate injection of borated water (negative reactivity insertion) to the core and by subsequent recirculation of the borated primary coolant through the core for long-term post LOCA cooling.

1.2 The Safety Injection System has the following additional function:

1.2.1 The Safety Injection System will also inject borated water to provide necessary negative reactivity insertion during rapid cooldown of the primary coolant system following a secondary side Steam Line Break.

1.3 The Safety Injection System has the following Design Basis:

1.3.1 The Safety Injection System is designed to prevent the uncontrolled release of fission products resulting from cladding failure (fuel rod damage) in the event of a rupture (break) of any size line of the Reactor Coolant System. This includes a complete serverance of a Reactor Coolant Loop.

1.3.2 The Safety Injection System is designed to limit fission product release from a stainless steel clad core to 6% of that projected for a complete core meltdown.

1.3.3 The Safety Injection System is designed to insure that no inadvertent system operation could constitute a hazard such as the addition of unborated feedwater (positive reactivity insertion) to the Reactor Coolant System.

1.3.4 To ensure system reliability, the system is provided with separation of component power supplies and a continuous power source to vital components.

1.3.5 The system is designed to operate satisfactorily with second order mechanical equipment failures i.e., with a loss of coolant accident as a first order condition, the failure of any component to respond actively in the prescribed manner can be tolerated without loss of ability of the system to perform its intended function.

1.3.6 The design of the equipment in the Safety Injection System is in accordance with stringent seismic ground motion criteria of 0.5Gs.

2.0 DESCRIPTION

2.1 System Overview

2.1.1 Main Flow Path (See Figure 1A)

The Safety Injection System is divided into two independent pumping trains. The two Safety Injection (SI) pumps take suction from the Refueling Water Storage Tank (RWST) through locked open manually operated valves.

Each Safety Injection pump discharges through a check valve to a pneumatic hydraulic valve HV853 A/B which opens on a safety injection signal. Both safety injection pump discharge lines contain pressure instrumentation and a minimum flow recirculation line that discharges to a common header back to the RWST. The recirculation line provides a flow path for testing and to prevent overheating when operating with normal discharge valves closed.

The main feed pumps take suction from the Safety Injection pumps and discharge through check valves to pneumatic hydraulic valves HV-851A & B.

From HV851A&B, Safety Injection water flows to a common header which supplies three separate injection lines via motor-operated isolation valves. (These MOV's also open on a safety injection signal.) Flow then passes through check valves which prevent Reactor Coolant System backflow to the Safety Injection System. From each check valve, flow is directed to its respective Reactor Coolant System cold leg.

2.1.2 Additional Flow Paths

.1 The main feed pumps are equipped with bypass lines with manual isolations to allow for circulation of borated water from the RWST through the safety injection pumps and through idle sections of safety injection piping to recirculation lines upstream of MOV's 850AB&C back to the RWST. This is provided to maintain consistent boron concentration in the system following periodic testing.

.2 Charging system contribution; when a safety injection actuation occurs, the Reactor Coolant System pressure may be above the shutoff head of the main feed pumps (approximately 1175 psig) to allow for immediate injection of borated water. The charging flow control valve FCV-1112 automatically opens to provide maximum charging into the Reactor Coolant System (Non running pump locks out).

SAFETY INJECTION SYSTEM

2.0 DESCRIPTION (Continued)

2.1.2.2 Cold Leg Injection Flowpath:

The charging pumps take suction from the refueling water storage tank through motor-operated valves that open automatically upon a safety injection signal. Flow discharges through flow control valves which can be opened manually for a safety injection flowpath.

From the flow control valves, flow travels through three injection lines and on to motor-operated valves on each cold leg where it is injected into the Reactor Coolant System.

.3 Initial High Pressure Injection Flowpath:

The preferred charging pump takes suction from the RWST through MOV883 and MOV 1100 B & D which open on an S.I. signal. From the charging pump flow is directed to FCV-1112 (which opens fully on an SIS) to CV-304 and on to RCS Cold Leg A.

2.1.3 **General Control Scheme**

Most components in the Safety Injection System are manually operated from the Control Room or automatically operated by the Safeguards Load Sequencial System.

The safety injection signals are initiated either by containment pressure instrumentation or pressurizer pressure instrumentation. (See System Description SD-S01-590, Safeguards Load Sequencing System.)

Safety injection may be manually initiated from the Control Room by the use of either of two pushbuttons and two hand switches located on the SLSS Surveillance Panel.

Initiation of safety injection will actuate first out annunciator and warning systems in the plant, including an emergency siren, horns and the Automated Alert System.

2.0 DESCRIPTION (Continued)

2.2 Components

2.2.1 REFUELING WATER STORAGE TANK (RWST)

RWST (CRS-D-1)

PURPOSE:	To provide a source of highly borated water for Safety Injection Operations, Refueling Operations, Containment Spray Operations (see part III of this System Description) and a reserve supply for the Chemical and Volume Control System.
CAPACITY:	240,000 gallons
MINIMUM REQUIRED CAPACITY:	220,000 gallons (35' 5 3/8")
FLUID STORED:	3750 - 4300 ppm borated water
DESIGN TEMPERATURE:	140° F
DESIGN PRESSURE:	Atmospheric
DESIGN MATERIAL:	Plastite Lined carbon steel
TANK HEIGHT:	37 ft. 1 in.
TANK DIAMETER:	34 ft. 0 in.
VENTS:	York Demister
LEVEL INCREMENTS:	~ 567 gallons/inch ~ 2,400 gallons/%
LEVEL INSTRUMENTATION:	
LT 950:	Provides signal to Control Room Annunciator to LI 950 Control Room Indicator for RWST level Range 0-100%
LS 30:	Provides signal to Control Room Annunciator Hi-Lo Alarm
LS 69:	Provides signal to Control Room Annunciator Low-Low Alarm
ALARM SETPOINTS:	
HI LEVEL:	35'11" to alert Operator tank is near overflow
LO LEVEL:	35'8"
LO-LO LEVEL:	approaching minimum required volume 21% (50,000 gallons) on LI 950

2.0 DESCRIPTION (Continued)

2.2.2 REFUELING WATER STORAGE TANK ISOLATION VALVE (MOV-883)

MOV 883	
PURPOSE:	To provide a flow path from the Refueling Water Storage Tank to the Charging and Refueling pumps.
OPERATOR TYPE:	480 V Induction Motor
VALVE TYPE:	Gate Valve
VALVE SIZE:	8" (inch)
FAIL POSITION:	As Is
OPENING TIME:	2 min. 50 sec.
CLOSING TIME:	2 min. 50 sec.
DESIGN MATERIAL:	Stainless Steel
INDICATIONS AT CONTROL SWITCH:	Green-Closed Red-Open
TRIPS:	Excessive Torque Thermal Overload

MOV883 requires the use of two switches for opening and closing. One switch has backlighted indication with open and close pushbuttons. The second switch is a "power cutout" pushbutton. The pushbutton must be depressed to enable valve repositioning.

2.0 DESCRIPTION (Continued)

2.2.3 EAST AND WEST SAFETY INJECTION PUMPS (G50A and G50B)

S.I. PUMPS (G50A AND G50B)	
PURPOSE:	-To provide NPSH to the Main Feed pumps when drawing from RWST in S.I. Mode -To recirculate borated water through idle sections of the Safety Injection System.
LOCATION:	Approximately six (6) feet south of the RWST.
FLUID PUMPED:	Borated Water (up to 4300 ppm)
DESIGN FLOWRATE:	10,500 gpm (required to support main feed pump flow requirements during S.I.
PRIME MOVER:	4160 V, Induction Motor
DESIGN HORSEPOWER:	700 HP
DESIGN SPEED:	1200 RPM
NPSH REQUIRED:	16 Feet
NPSH AVAILABLE:	30 Feet
DESIGN DISCHARGE PRESSURE:	150 psig @ shutoff head, 106 psig, @ 10, 500 gpm
PUMP SEAL TYPE:	Garlock Packing
DESIGN MATERIAL:	304 Stainless Steel
AUTOMATIC ACTIONS:	Starts on SIAS/Pumps trip on OVERCURRENT AND UNDERVOLTAGE
PRESSURE INSTRUMENTATION:	
PT 910A&B:	Provide signal to Control Room (Discharge Pressure)
PI 910A&B:	Control Room Discharge Pressure Indicators 0-300 psig
PUMP BEARING TEMPERATURES:	Bearing Temperatures are monitored by temperature elements TE 913, 914, 915, & 916 and are recorded in the Control Room by Trend Recorder TR-1119.

2.0 DESCRIPTION (Continued)

2.2.3 EAST AND WEST SAFETY INJECTION PUMPS

Each safety injection pump can be manually operated by a START-STOP spring return-to-neutral handswitch located on the Control Room North Vertical Board.

The pumps can also be started automatically by a safety injection signal (see System Description SD-SO1-590, Safeguards Load Sequencing System). When started by a safety injection signal, the pumps can be stopped only after the SIS is RESET.

Above each control switch in the Control Room are pump status lights: Red-Start, Green-Stop, Blue-Safety Injection Signal, White-Normal and an ammeter.

2.0 DESCRIPTION (Continued)

2.2.4 EAST AND WEST MAIN FEED PUMPS (G3A AND G3B)

MAIN FEED PUMPS

PURPOSE:	To pump borated water into the RCS during S.I. Mode
TYPE:	Two Stage, Double Volute, Centrifugal
PRIME MOVER:	4160 V, Induction Motor
DESIGN HORSEPOWER:	3500 HP
DESIGN SPEED:	3550 RPM
TEMPERATURE OF PUMPED FLUID:	351° F Feedwater 40° F - 90° F Safety Injection
ADITIONAL DESIGN FEATURE:	The Main Feed pumps are designed to withstand a 300° F temperature drop in a 10 second interval. The requirement is necessary because of the dual function of the pumps.
DESIGN FLOWRATE:	7,000 gpm Feed Mode 10,500 gpm SI Mode
DESIGN HEAD:	1,825 ft
SHUTOFF HEAD:	2,360 ft
NPSH:	180 ft SI Mode
DESIGN MATERIAL:	Chrome Alloy Steel
PUMP SEAL TYPE:	Mechanical

2.0 DESCRIPTION (Continued)

2.2.4 EAST AND WEST MAIN FEED PUMPS (G3A AND G3B)

CONTROLS AND INTERLOCKS

Manual Start: Each Main Feed Pump can be started by pushbuttons located on the Control Room "J" Console. Depressing the Start pushbutton energizes the Closing Relay. The Closing Relay Contact closes, causing the Breaker to Close and Pump to Start.

Manual Stop: Depressing the Stop Pushbutton energizes the Tripping Relay. The Tripping Relay Contact opens, the breaker trips, and the pump stops.

Automatic Start: The Main Feed Pumps can also be started by a Safety Injection Signal from the Safeguards load Sequencing system. Sequencer 2 closes Sequencer 2 Contacts. This causes the Running Pump to Trip (Normal Trip Circuit). The 162-1 Time Delay Relay Timer energizes for 11 seconds. When timer "Times Out" the Time Delay Relay energizes. Pump Trip Contact from Sequencer opens and the 162-1 Time Delay Relay Contact in the closing Circuit closes. The Normal Closing Circuit energizes, closing the Breaker, which starts the Pump.

Main Feed Pumps Start Interlocks:	186 Relay (Overcurrent) 150 Relay (Undervoltage) FW/TD (Feedwater/Time Delay Relays) 162-1 Time Delay Relay (from Sequencer - 11 Seconds to allow for Realignment to Safety Injection Mode)

SIMPLIFIED ELEMENTARY DIAGRAM FOR MAIN FEEDWATER PUMPS

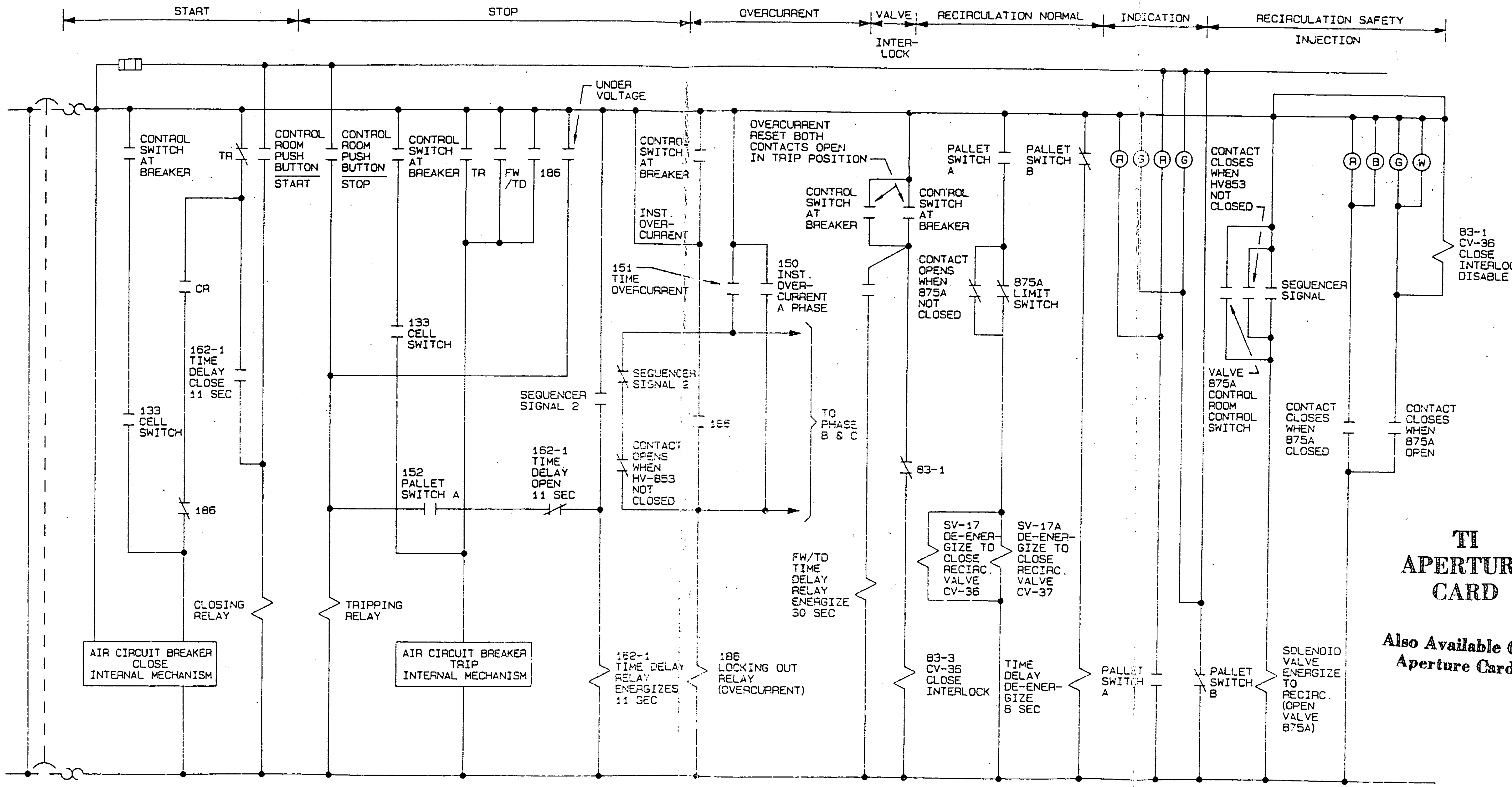


FIGURE I-3
SD-S01-580-I-3-0

A50638500

8711100274-37

2.0 DESCRIPTION (Continued)

2.2.5 MAIN FEED PUMP S.I. DISCHARGE VALVES (HV-851 A&B)

	HV-851 A&B
PURPOSE:	To provide a discharge flowpath from the Main FeedPumps to the Safety Injection Header.
OPERATOR TYPE:	Pneumatic/Hydraulic
VALVE SIZE:	14"
VALVE TYPE:	Double Disc Gate Valves
FAIL POSITION:	Open
OPENING TIME:	5 seconds
CLOSING TIME:	15 minutes (normally 5-7 minutes)
DESIGN PRESSURE:	1500 psig
DESIGN DIFFERENTIAL-OPEN:	1500 psig
DESIGN DIFFERENTIAL-CLOSE:	50 psig
DESIGN TEMPERATURE:	350° F
DESIGN MATERIAL:	Stainless Steel

Control Sequence, and Interlocks
See Figure - Next page

For HV-851A or B to open, the associated condensate suction valve (HV-854A or B) must be closed. HV-851A or B can then be opened by operation of its handswitch in the Control Room or automatically by is associated Sequencer (HV-851A - Sequencer #2, HV-851B - Sequencer #1).

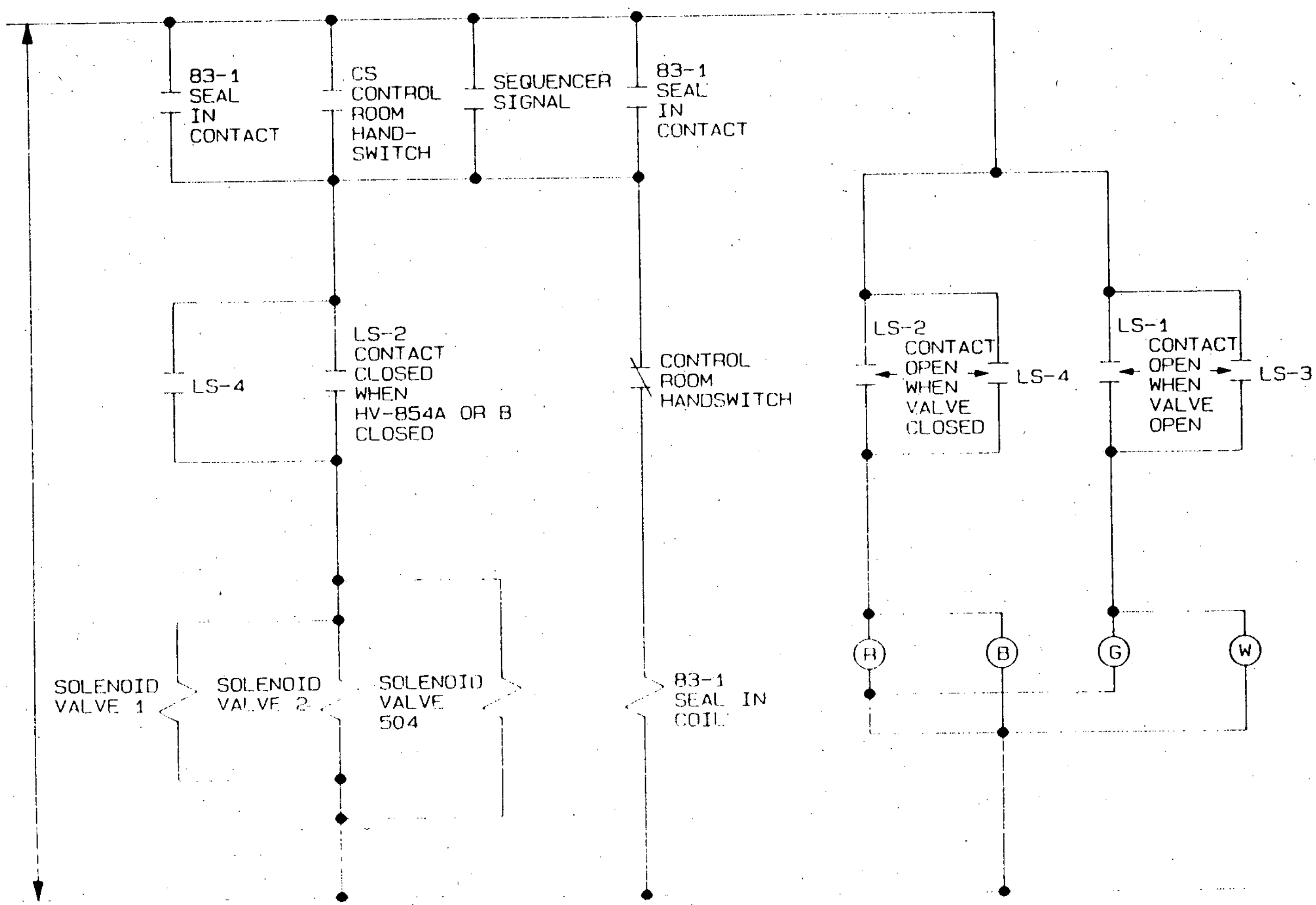
To close HV-851A or B; the associated Sequencer must be reset, and the control switch operated to the close position.

HV-851A & B are interlocked with HV-854A & B. The valves cannot open unless the associated condensate valves (HV-854A or B) are closed. This prevents unborated water addition to the RCS.

HV-851A & B have solenoid-operated bonnet vent valves. The valves vent pressure between the double discs to the feed pump discharge. These vent valves open automatically when HV-851A and B are opened. Venting the bonnet of internal pressure prevents disc binding and impaired movement. The solenoids may also be controlled manually from the North Vertical Board above its respective HV-851 valve by manual pushbuttons (open-close).

SAFETY INJECTION SYSTEM

FIGURE I-4: SIMPLIFIED ELEMENTARY HV-851 A & B



2.0 DESCRIPTION (Continued)

2.2.6 MAIN FEED PUMP S.I. SUCTION VALVES (HV-853 A&B)

HV-853 A&B	
PURPOSE:	To provide a flowpath from the Safety Injection Pumps Discharge to the Main Feed Pump Suctions.
OPERATOR TYPE:	Pneumatic/Hydraulic
VALVE SIZE:	16"
VALVE TYPE:	Double Disc Gate Valves
FAIL POSITION:	Open
OPENING TIME:	5 seconds
CLOSING TIME:	15 minutes
DESIGN PRESSURE:	350 psig
DESIGN DIFFERENTIAL:	350 psig
DESIGN TEMPERATURE:	350° F
DESIGN MATERIAL:	Carbon Steel

Control Sequence, Indications and Interlocks (See Figure (Next Page)

To open HV853 A or B the Control Room Handswitch may be taken to Open (manually) or automatically from a Safeguards Load Sequencer signal. To close HV 853 A or B there must be no Sequencer Signal and the Control Room Handswitch is taken to Close.

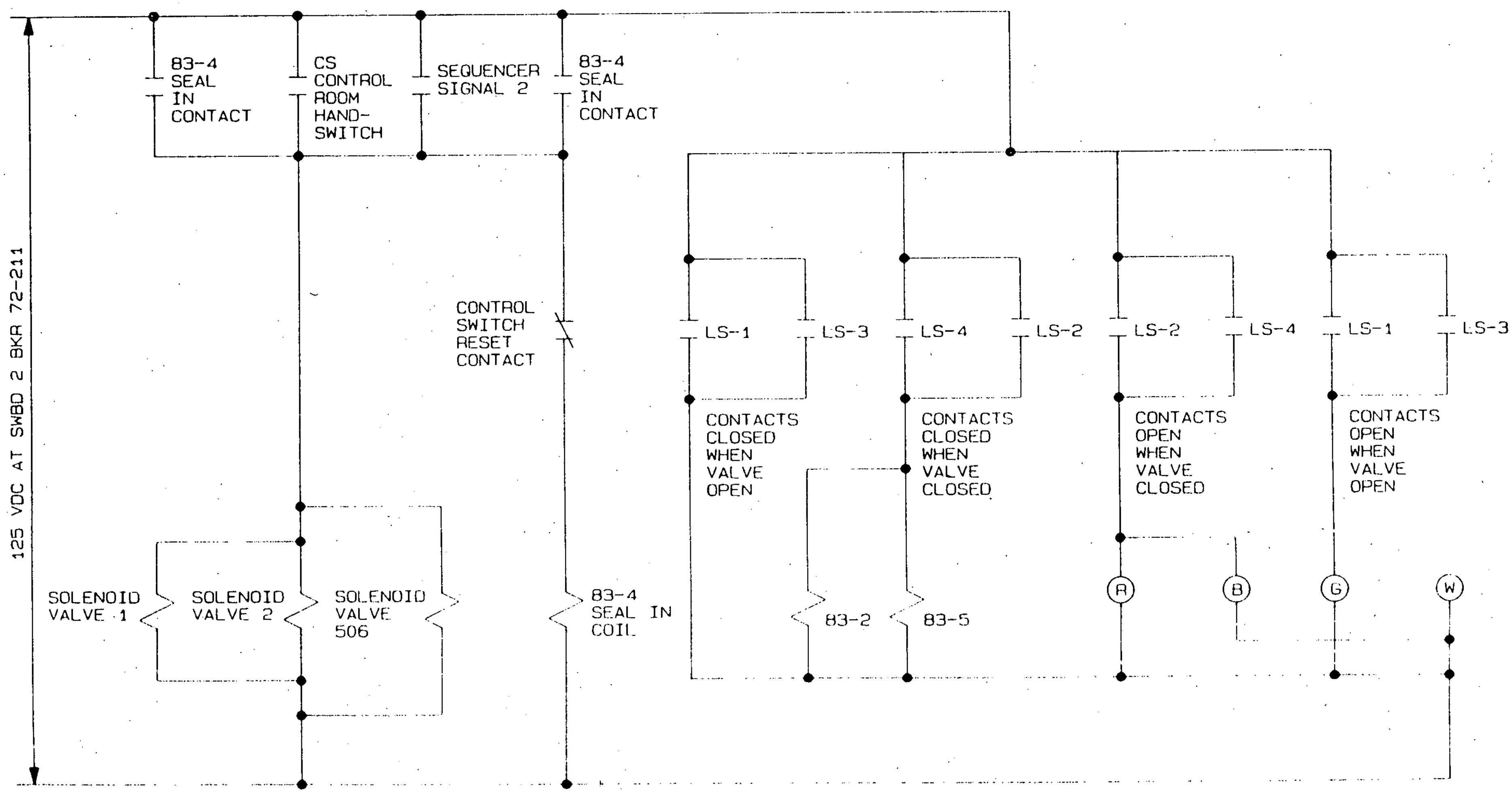
There are four indicating lights associated with each valve: Red - Open, Green - Closed, White - Normal and Blue - Safety Injection Signal from the Sequencer.

HV853 A&B are interlocked with the Main Feed Pumps. If the valves are not open within 30 seconds, the associated Main Feed Pump trips.

HV853 A&B have manual bonnet vent valves normally left open. These valves relieve bonnet pressure to the suction of the feed pumps. This allows quick opening of the valves by relieving pressure between double discs. The pressure, if not relieved, forces the discs out against their seat that may cause binding and impaired operation.

SAFETY INJECTION SYSTEM

FIGURE I-5: SIMPLIFIED ELEMENTARY HV-853 A & B



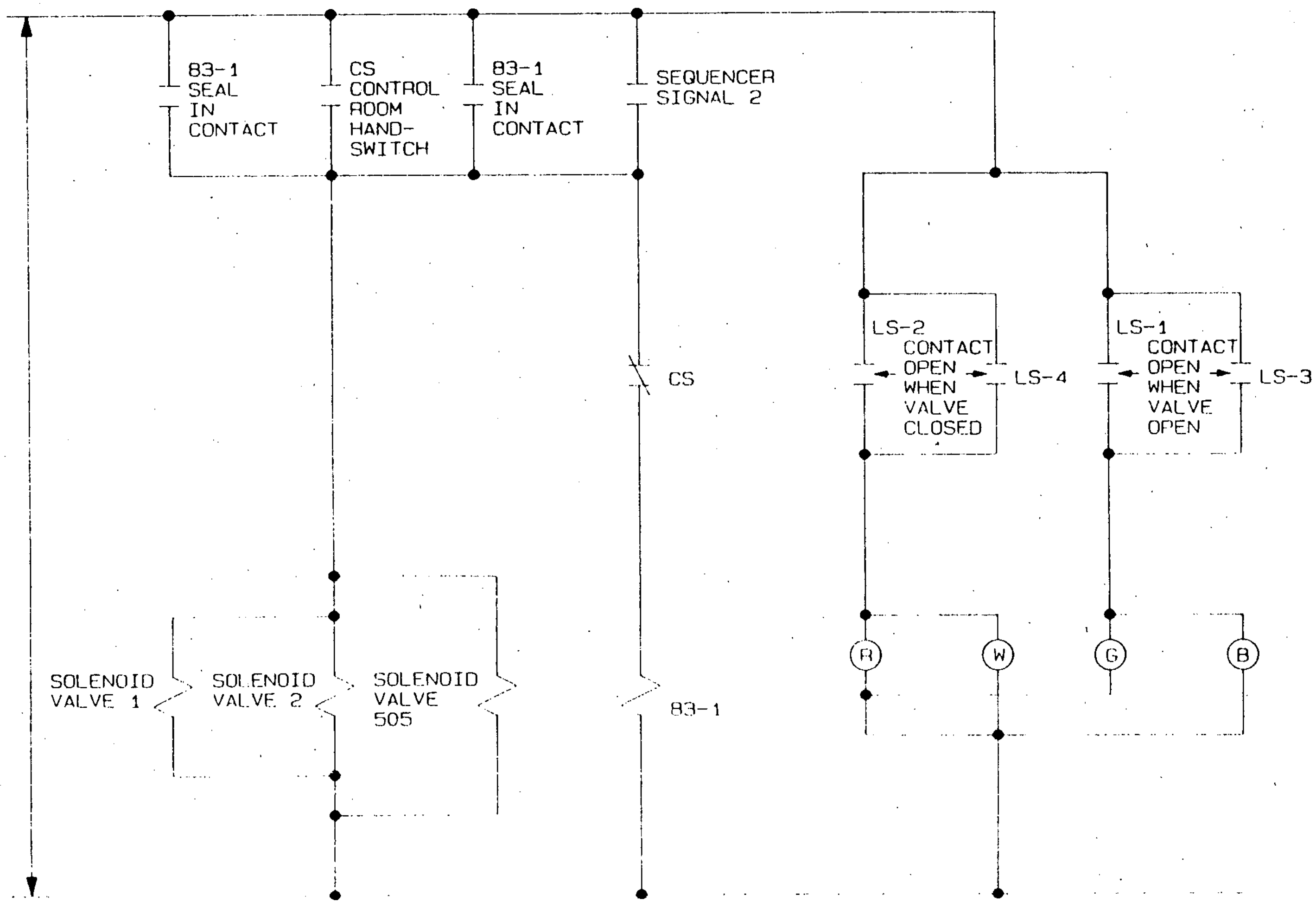
2.0 DESCRIPTION (Continued)

2.2.7 MAIN FEED PUMP FEEDWATER DISCHARGE VALVES (HV 852 A&B)

HV-852 A&B	
PURPOSE:	To assure maximum flow to the Safety Injection System when the Main Feed Pumps are in the SI Mode.
OPERATOR TYPE:	Pneumatic/Hydraulic
VALVE SIZE:	12"
VALVE TYPE:	Double Disc Gate Valves
FAIL POSITION:	Closed
OPENING TIME:	15 minutes (normally 5-7 minutes)
CLOSING TIME:	5 seconds
DESIGN PRESSURE:	1500 psig
DESIGN TEMPERATURE:	350° F
DESIGN DIFFERENTIAL:	1500 psig
DESIGN MATERIAL:	Carbon Steel
CONTROL SEQUENCE:	See Figure (Next Page)
OPEN:	No Sequencer Signal and Control Room Handswitch to Open
CLOSE:	Sequencer Signal or Control Room Handswitch to Close
INDICATIONS: AT CONTROL SWITCH	- Red Light - Open - Green Light - Closed - White Light - Normal - Blue Light - Safety Injection Signal (Sequencer)

SAFETY INJECTION SYSTEM

FIGURE I-6: SIMPLIFIED ELEMENTARY HV-852 A & B



2.0 DESCRIPTION (Continued)

2.2.8 MAIN FEED PUMP CONDENSATE SUCTION VALVES (HV-854 A&B)

HV-854 A&B	
PURPOSE:	To provide a positive isolation of the Condensate System from the Safety Injection System when the Main Feed Pumps are in the Safety Injection Mode.
OPERATOR TYPE:	Pneumatic/Hydraulic
VALVE SIZE:	16"
VALVE TYPE:	Double Disc Gate Valves
FAIL POSITION:	Closed
OPENING TIME:	15 minutes (normally 5-7 minutes)
CLOSING TIME:	5 seconds
DESIGN PRESSURE:	350 psig
DESIGN TEMPERATURE:	350° F
DESIGN DIFFERENTIAL:	350 psig
DESIGN MATERIAL:	Carbon Steel

CONTROL SEQUENCE, INDICATIONS AND INTERLOCKS (See Figure Next Page)

To open: HV851 A & B must be closed with no Sequencer signal and Control Room Handswitch to Open.

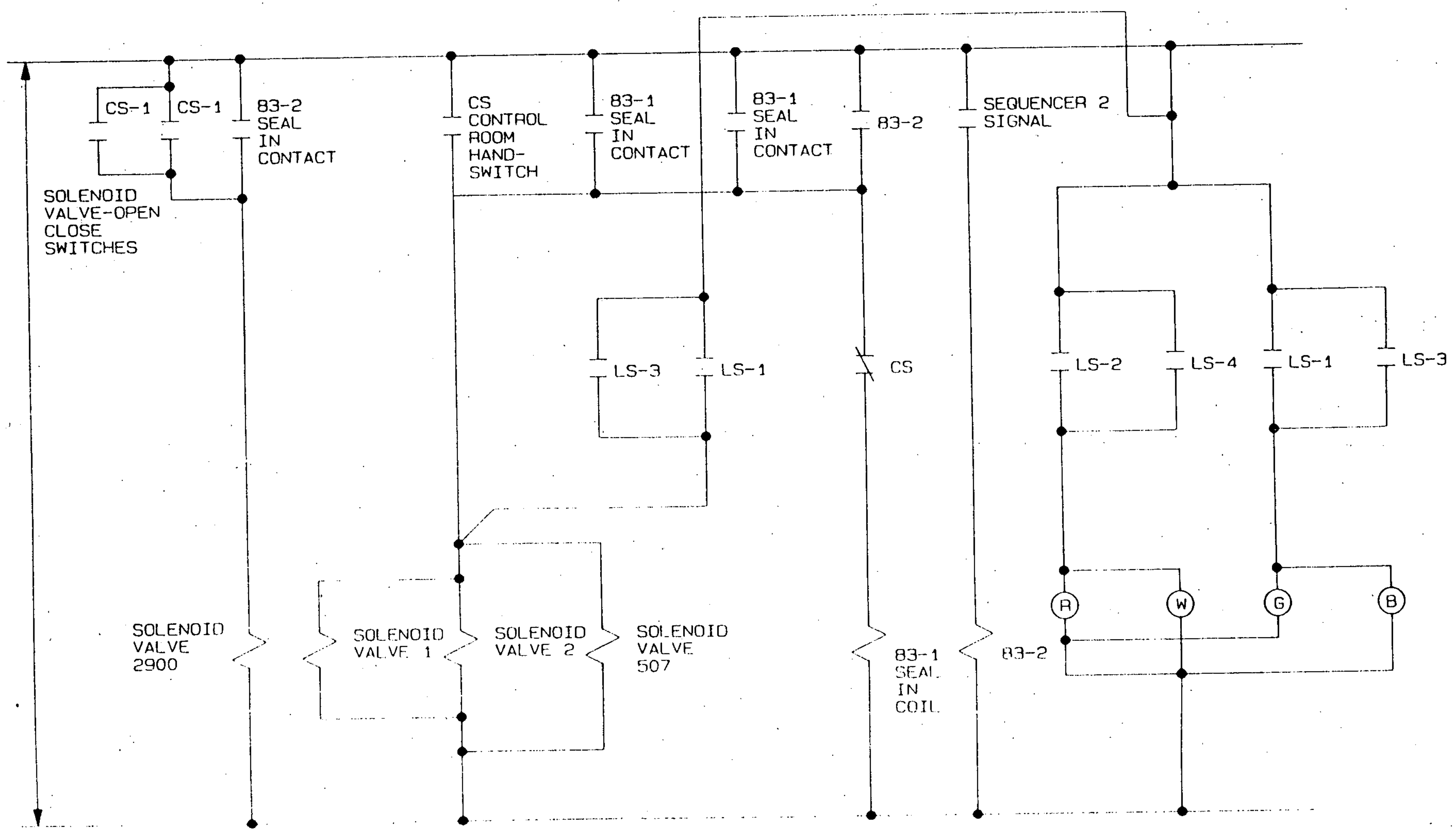
To close: No Sequencer Signal and Control Room Handswitch to Close.

There are four indicating lights associated with each valve: Red - Open, Green - Closed, White - Normal, and Blue - Safety Injection Signal from the Sequencer.

HV854 A & B must be fully closed prior to HV851 A & B being opened. Signal is provided by Limit Switches in the Control Scheme of HV854 A & B.

SAFETY INJECTION SYSTEM

FIGURE I-7: SIMPLIFIED ELEMENTARY HV-854 A & B



2.0 DESCRIPTION (Continued)

2.2.9 PNEUMATIC/HYDRAULIC CONTROL SYSTEM FOR HVs 851, 852, 853, AND 854 A&B

The Pneumatic/Hydraulic valves are designed to move to the safety-related position within 5 seconds. This is accomplished by the use of a gas-charged accumulator, driving the piston to the required position. The valves are moved to the non-safety related position by a pneumatic hydraulic motor which takes approximately 15 minutes.

HV-851 AND HV-853 A and B Operation (See Figure 1, Page 25)

OPEN
- Safety Injection Signal or Control Switch to Open
- SV 524, 528, 526 and 530 energize and close. (Service Air to P/H Pumps)
- Pneumatic/Hydraulic pump motive force is removed
- SV1 and SV2 are energized and open
- Oil Ports off top of the Actuator Piston
- Accumulator Oil Pressure forces Actuator Piston up
- Valve opens

CLOSE:
- No Safety Injection Signal and Control Switch taken to open to Reset Valve. (Safety Injection Sequencer Reset does not reset valve) or Control Switch taken to close (only if no SI Signal has opened valve)
- SV1 AND SV2 de-energize and close
- SV524, 528, 526 and 530 de-energize and open (Service Air supply to P/H Pumps)
- 70 to 1 ratio Pneumatic/Hydraulic Pump starts
- Oil is forced into top of piston cylinder, forcing piston down
- As piston moves down - valve closes and oil is forced back to Accumulator
- Accumulator is recharged by piston movement

HV-852 AND HV-854 A and B Operation (See Figure 2 Page 26)

The valves close on receipt of a Safety Injection Signal. The closing sequence is identical to the opening sequence of HVs 851 and 853 A&B with the exception of valve numbers supplying Motive Force to the P/H pumps.

Opening of the valves is identical to the closing sequence for HV 851 and HV 853 A&B.

All of the pneumatic valves are normally operated by service air. High pressure nitrogen flasks supply backup Motive Force for the pumps. A Solenoid Valve at the flasks and a selector switch located in the Control Room allow for alignment when service air supply fails.

2.0 DESCRIPTION (Continued)

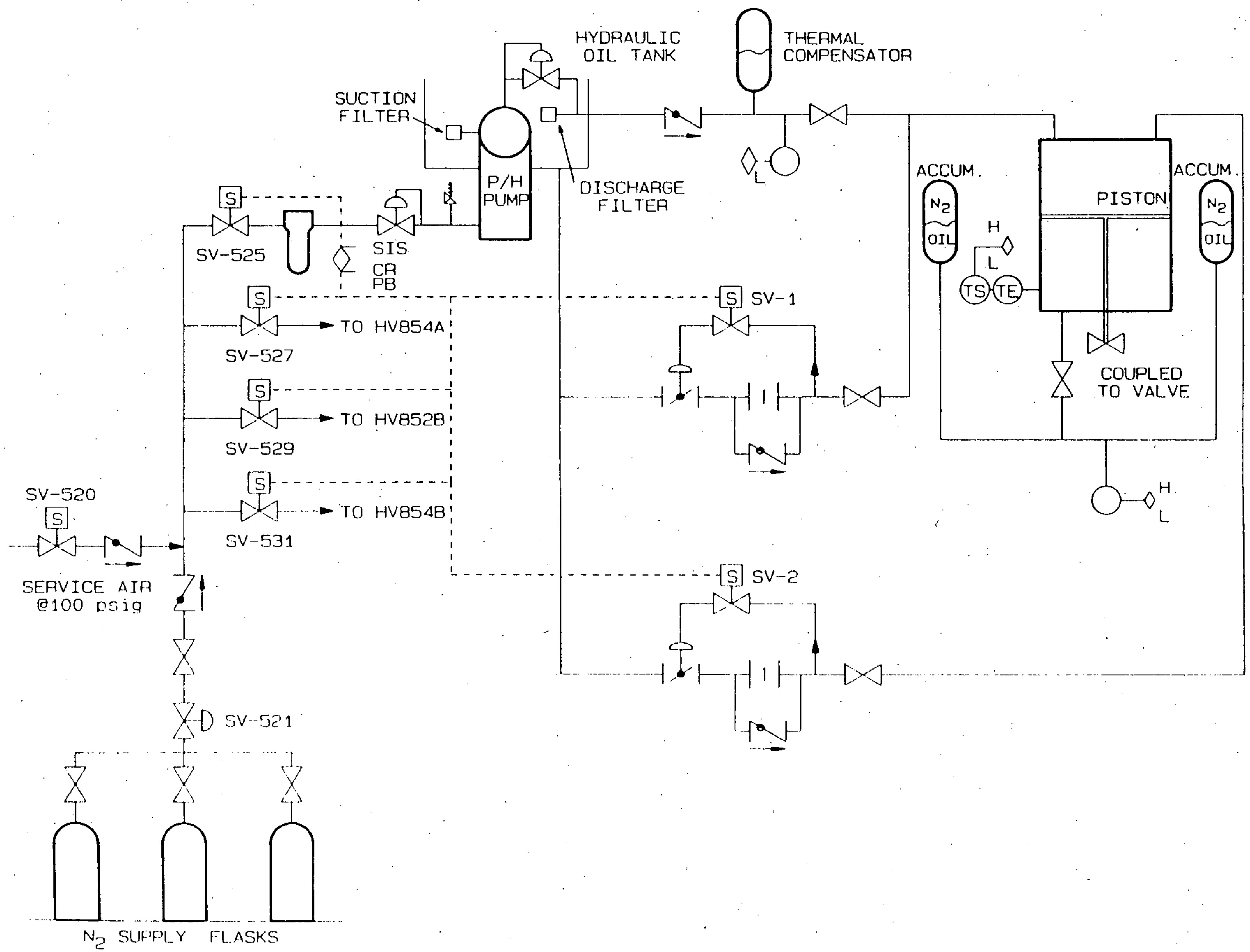
2.2.9 PNEUMATIC/HYDRAULIC CONTROL SYSTEM FOR HVs 851, 852, 853, AND 854 A&B (Continued)

To maintain proper oil viscosity for more reliable operation, each valve is equipped with Hydraulic Oil Heaters controlled by temperature controllers which maintain the temperature at 80-140°F.

The signal conditioning alarm system (SCAS) utilizes pressure transducers, installed in the cylinder hydraulic system of each valve actuator to monitor system pressure.

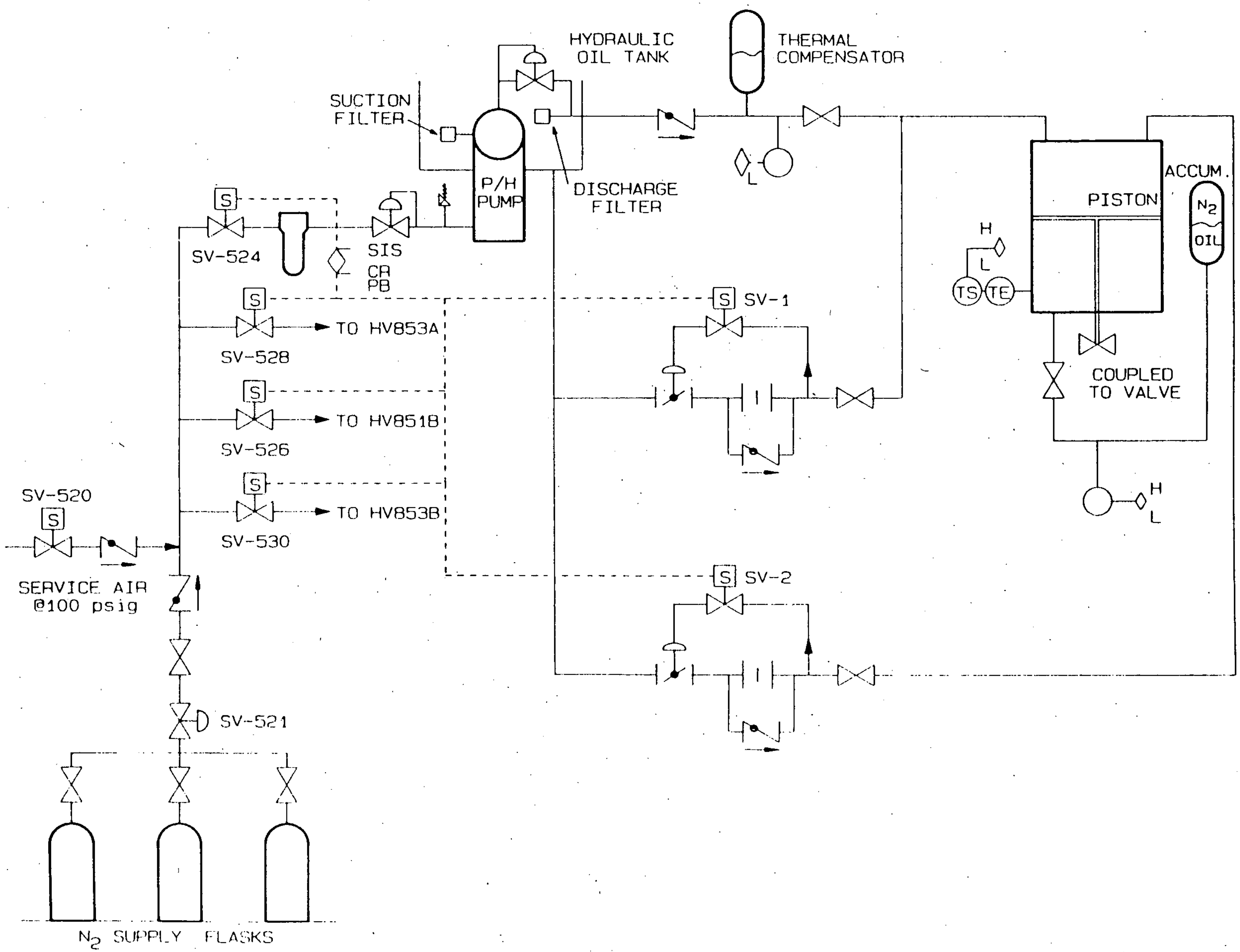
SAFETY INJECTION SYSTEM

FIGURE I-8: HV-852 A & B AND HV-854 A & B
ACTUATION SCHEME



SAFETY INJECTION SYSTEM

FIGURE I-9: HV-851 A & B AND HV-853 A & B
ACTUATION SCHEME



2.0 DESCRIPTION (Continued)

2.2.10 MAIN FEED PUMP SAFETY INJECTION RECIRCULATION VALVES (CV875 A&B)

	CV-875 A AND B
PURPOSE:	To provide initial recirculation flow path from Main Feed Pumps in SI Mode to the RWST.
OPERATOR TYPE:	Pneumatic Diaphragm
VALVE TYPE:	Gate Valves
VALVE SIZE:	3"
FAIL POSITION:	Closed
DESIGN MATERIAL:	Stainless Steel

Control Sequence, and Indications (see Main Feed Pump Elementary)

CV's 875 A&B can be opened automatically as follows: The valves will open immediately on receipt of a S.I. Signal. Open when HV 853 A or B respectively is open or intermediate, or MANUALLY by use of the Control Room Handswitch on North Vertical Board.

CV's 875 A&B can be closed when HV 853 A or B is closed (respectively), No Safety Injection Signal is present and the Control Room Handswitch is taken to close.

There are four indicating lights associated with each valve: Red - Open, Green - Closed, White - Normal, Blue - Safety Injection Signal from the Sequencer.

2.0 DESCRIPTION (Continued)

2.2.11 SAFETY INJECTION TO RCS ISOLATION VALVES

MOVs 850 A,B&C	
PURPOSE:	To provide a flowpath from Safety Injection to the Reactor Coolant System. (One valve for each of the three RCS loops)
VALVE SIZE:	6"
VALVE TYPE:	Gate Valve
OPERATOR TYPE:	480 V Induction Motor
DESIGN MATERIAL:	Stainless Steel
DESIGN PRESSURE:	2485 psig
DESIGN DIFFERENTIAL:	1600 psig
DESIGN TEMPERATURE:	650° F
OPENING TIME:	10 seconds
CLOSING TIME:	10 seconds
FAIL POSITION:	As Is

CONTROL TRIPS AND INDICATION (See Figure next page)

MOV's 850 A,B&C can be opened from the Control Room by taking the respective handswitch to open. This closes contacts which energize the opening coil. The valves may also be opened by sequencer signal. The signal energizes a time delay coil which, after eleven seconds, closes a time delay contact. Once closed, this energizes the opening coil.

MOV 850A receives a signal from Sequencer 2
MOV 850B - Sequencer 1
MOV 850C - Sequencer 1 and 2

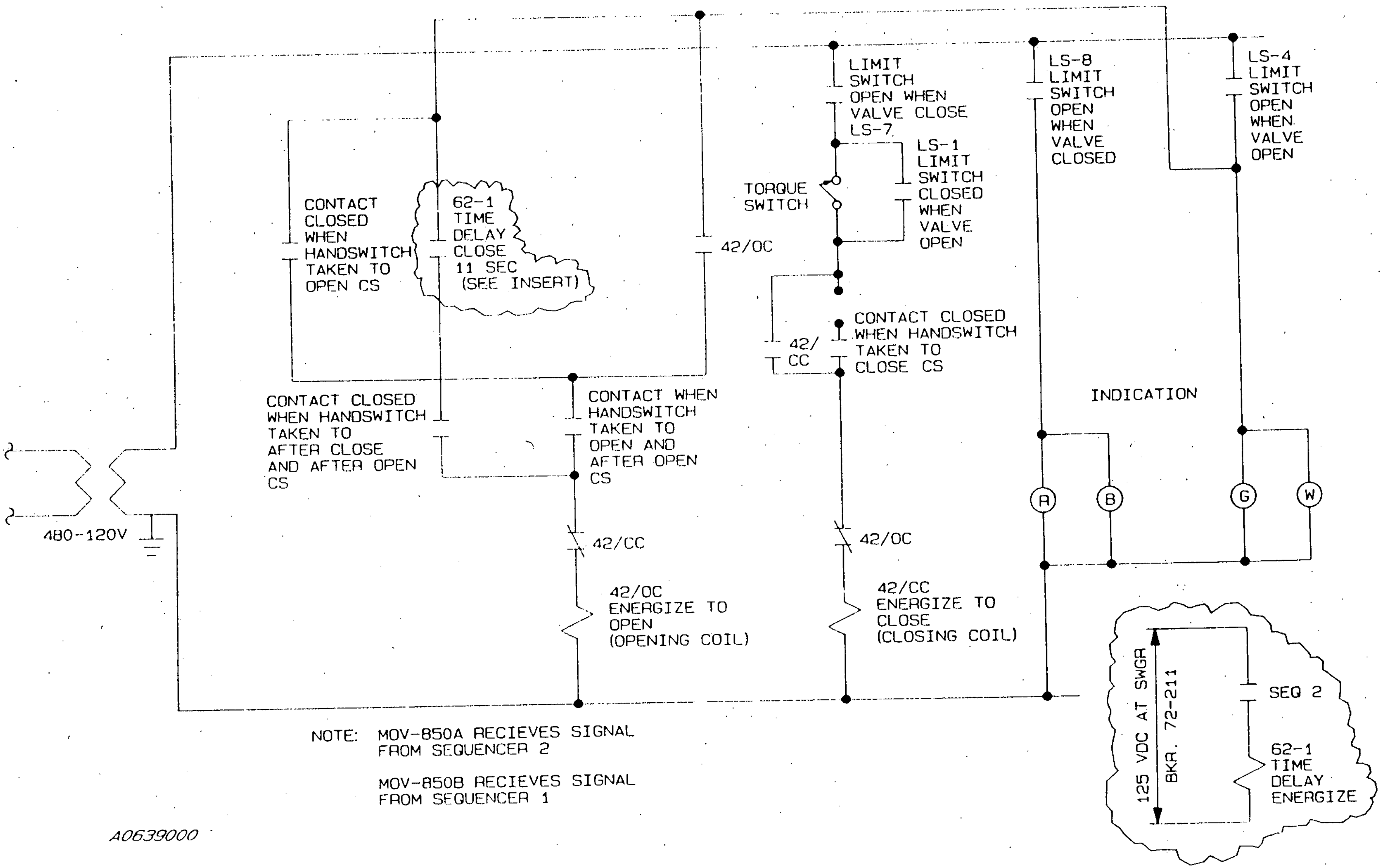
All three valves can be closed by taking the Control Room Handswitch to close causing opening contacts to de-energize and closing contacts to close, thus energizing the closing coil.

The Torque Switch will cause the Motor Breaker to trip.

INDICATIONS: AT CONTROL SWITCH	- Red Light - Open - Green Light - Closed - Blue Light - Safety Injection Signal - White Light - Normal

SAFETY INJECTION SYSTEM

FIGURE I-10: SIMPLIFIED ELEMENTARY MOV-850 A & B



NOTE: MOV-850A RECIEVES SIGNAL FROM SEQUENCER 2

MOV-850B RECIEVES SIGNAL FROM SEQUENCER 1

A0639000

2.0 DESCRIPTION (Continued)

2.2.12 NORTH AND SOUTH CHARGING PUMPS

CHARGING PUMPS	
PURPOSE:	To provide some SI flow when the RCS pressure is above the shutoff head of the feed pumps. (In Safety Injection Mode) See also SD-SO1-310 Chemical & Volume Control System
LOCATION:	Both Charging Pumps are located in the Reactor Auxiliary Building below the volume control tank (below the 20-foot elevation). (Lower Radwaste)
TYPE:	12 Stage, Centrifugal
PRIME MOVER:	4160 V Induction Motor
DESIGN HORSEPOWER:	550 HP
DESIGN SPEED:	3570 rpm
MAXIMUM DESIGN FLOW RATE:	213 gpm
NORMAL OPERATING FLOWRATE:	136 gpm
MAXIMUM DESIGN PRESSURE:	2735 psig
NORMAL OPERATING PRESSURE:	2300 psig
SUCTION PRESSURE:	30 psig
NPSH REQUIRED:	11 feet
NPSH AVAILABLE:	30 feet

CONTROLS:

Each pump has a start/stop pushbutton on the "J" Console of the Control Room.

Each pump has a lockout switch located in the 4KV Room. The switch positions are
Bus 1C - OFF - Bus 2C. These positions select the preferred Charging Pump for Safety Injection.

Position 1C - South Charging Pump selected to run. North Charging Pump must be in the same position. This will lockout the North Charging Pump.

OFF - Pump will start on Safety Injection signal

2C - North Charging Pump selected to run South Charging Pump Lockout switch must be in the 2C position.

2.0 DESCRIPTION (Continued)

2.2.12 NORTH AND SOUTH CHARGING PUMPS (Continued)

CONTROLS: (Continued)

Each pump has a reset button located below its respective Start/Stop Switch. This allows for reset of the pump. If pump is locked out by a Safety Injection signal, it must be independently reset. (Reset of SIS will not reset pump) and first out annunciator "Charging Pump Auto Start Blocked".

AUTOMATIC ACTIONS:

Starts:
- Low Charging Header Pressure @ 2200 psig
- Running Pump 186 lockout relay energized. (non-running pump starts)
- SIS - Preferred pump starts if previously stopped

Trips:
- Undervoltage (restart available 35 seconds after voltage restored)
- Overcurrent
- Safety Injection Signal/Loss of Power
- Manual
- SIS - Non-preferred pump trips if running

INDICATIONS:

- Red Light - Breaker Closed - pump running
- Green Light - Breaker Open - Pump Off
- Motor Amps - "J" Console
- "Charging Pump Auto Start Blocked" Alarm
- PI1119A and PI1119B on the North Vertical Board Indicates Charging Pump Discharge Presure
- FI1112 Flow Indication on "J" console

2.0 DESCRIPTION (Continued)

2.2.13 SEAL INJECTION FILTER BYPASS VALVES (MOVs 18 AND 19)

MOVs 18 AND 19	
PURPOSE:	To provide a flowpath bypassing the Seal Injection filters that allows for Cold Leg injection to the Reactor Coolant System
OPERATOR TYPE:	480 V Induction Motor
VALVE TYPE:	Gate Valves
VALVE SIZE:	4" (inch)
FAIL POSITION:	As Is
OPENING TIME:	120 seconds
CLOSING TIME:	120 seconds
DESIGN MATERIAL:	Stainless Steel
CONTROL:	Both valves are controlled by hand switches in the Control Room. There are no automatic functions associated with MOVs 18 and 19.
INDICATIONS: AT CONTROL SWITCH	- Green Light - Closed - Red Light - Open
TRIPS:	Excessive Torque Thermal; Overload

2.0 DESCRIPTION (Continued)

2.2.14 CHARGING FLOW CONTROL VALVE

FCV-1112	
PURPOSE:	To provide a flowpath from the Charging Pumps to establish initial Safety Injection flow to the Reactor Coolant System through the charging flowpath.
SIZE:	4"
VALVE TYPE:	Gate
OPERATOR TYPE:	Pneumatic (Service Air)
OPENING TIME:	120 seconds
CLOSING TIME:	120 seconds
DESIGN MATERIAL:	Stainless Steel
FAIL POSITION:	Open
DESIGN PRESSURE:	2700 psig
DESIGN TEMPERATURE:	250° F
MAXIMUM FLOW:	125 gpm

AUTOMATIC ACTIONS:

Goes full Open on Safety Injection signal

MANUAL OVERRIDE: FCV 1112 controls are equipped with a Safety Injection signal override pushbutton. (Allows returning valve to normal operation mode.)

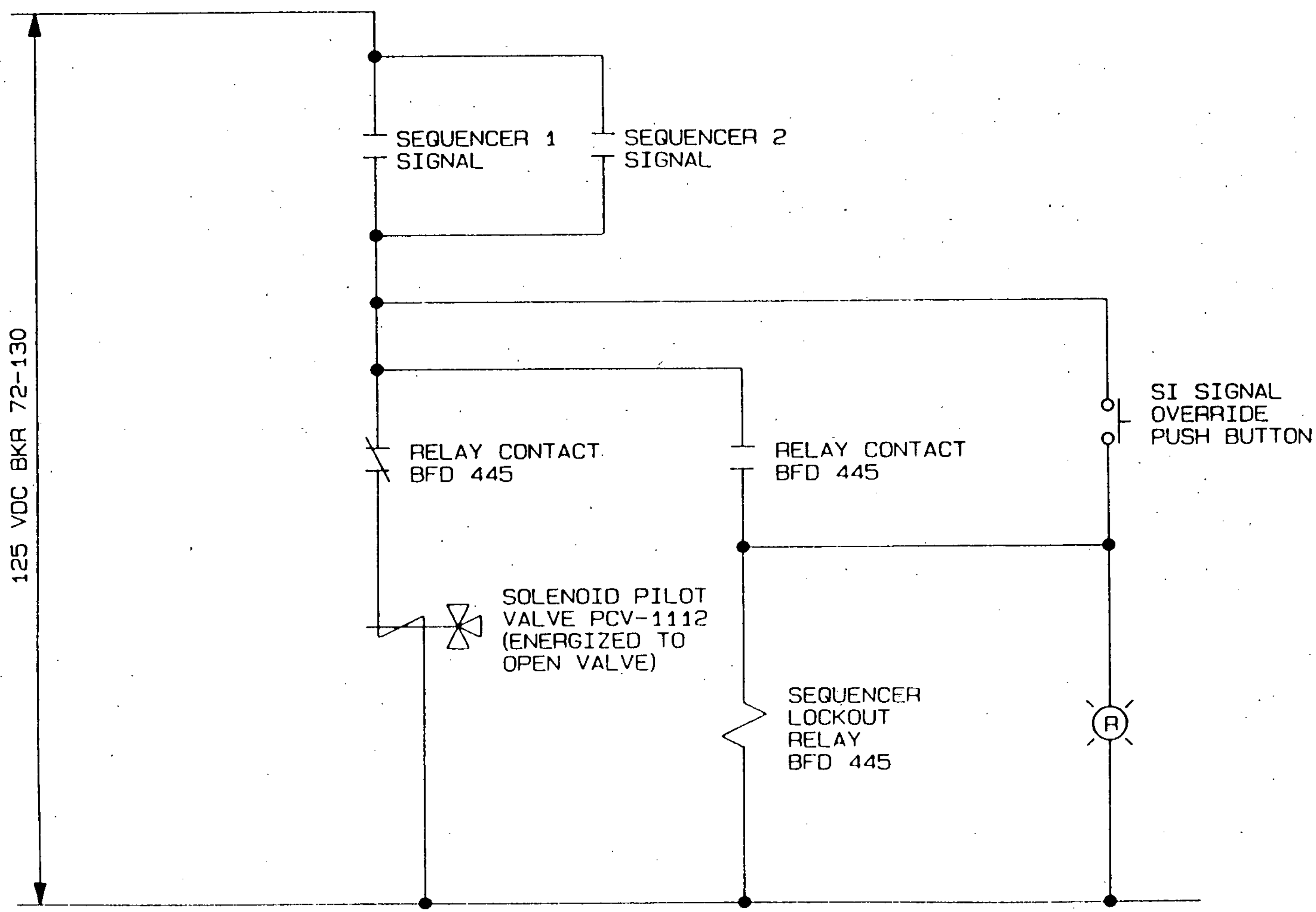
See Figure on next page.

A Safety Injection signal (generated from either sequencer) energizes a solenoid pilot valve. This provides control air to FCV 1112 and the valve opens fully.

When the override pushbutton is depressed, the sequencer lockout relay (BFD 445) is energized. This energizes both relay contacts #1 Opens and #2 Closes. The solenoid pilot valve then de-energizes and closes. This returns FCV 1112 control to normal.

SAFETY INJECTION SYSTEM

FIGURE I-11: SIMPLIFIED ELEMENTARY FOR FCV-1112



2.0 DESCRIPTION (Continued)

2.2.15 COLD LEG INJECTION VAVLES (MOV's 356, 357 and 358)

MOVs 356, 357, AND 358	
PURPOSE:	To provide a flowpath for the Cold Leg Injection from either charging pump.
SIZE:	2 inch
VALVE TYPE:	Gate Valve
OPERATOR TYPE:	480 V Induction Motor
DESIGN MATERIAL:	Stainless Steel
OPENING TIME:	120 seconds
CLOSING TIME:	120 seconds
FAIL POSITION:	As Is
CONTROL & INDICATION:	Each valve has an Open/Close handswitch located on the West Vertical Board of the Control Room. Operation of the valves is by handswitch only. There are no automatic functions associated with the valves.

3.0 OPERATION

3.1 Normal Operations

The Safety Injection System is designed to mitigate core damage following a loss of coolant accident. It is maintained in standby readiness for use when indications dictate a progression of events toward a LOCA.

The Safety Injection System is aligned for its intended use during all plant transitions and power operations. Prior to removing Safety Injection from service a $\geq$ 4% Δ K/K shutdown margin (Hot Standby Xenon-free, all rods in) condition must be verified. Normal standby alignment is performed when Reactor Coolant System pressure is above 500 psig during plant startup. There must be two (2) positive barriers between the Reactor Coolant System and the unborated feedwater condensate system to prevent overpressurization and unborated water flow into the RCS when RCS pressure is less than 500 psig.

The Safety Injection System is designed so that two (2) independent pumping trains are available for delivery of water borated at refueling concentration into the Reactor Coolant System.

The Safety Injection System will begin operation upon receipt of a safety injection signal from 2 out of 3 high containment pressures or 2 out of 3 low pressurizer pressures. The sequencer sends a start signal to designated pumps and valves so that the system automatically aligns itself for injection operations from the refueling water storage tank to the reactor coolant system cold legs. (See System Description SYS DES-S01-590, Safeguards Load Sequencing System.)

When initiated Safety Injection will continue until terminated by the operator when the RWST level approaches 21%, the suction limit for the Safety Injection and Main Feed pumps.

Operator action is required to establish long term recirculation or other plant configuration when emergency operating instructions dictate.

The Safety Injection System piping is maintained filled (with borated Water) and depressurized when in standby.

4.0 REFERENCES

4.1 P&ID's

4.1.1	5178205	Feedwater System, Sheet 1
4.1.2	5178206	Feedwater System, Sheet 2
4.1.3	5178207	Feedwater System, Sheet 3
4.1.4	5178115	Safety Injection System
4.1.5	5178135	Volume Control & Charging System, Sheet 1
4.1.6	5178136	Volume Control & Charging System, Sheet 2

4.2 Elementaries

4.2.1	1542 006	MOV 850A and 850B Safety Injection
4.2.2	1542 008	MOVs 1100B and 1100D
4.2.3	1542 010	Charging Pumps
4.2.4	1542 011	Safety Injection Pumps
4.2.5	1542 031	MOVs 866A & B, 356, 357, 358, 18, 19
4.2.6	1542 032	MOV 1100C
4.2.7	1542 033	HVs 853A & B Feedwater Discharge Valves
4.2.8	1542 034	HV 851A & B Safety Injection Valves
4.2.9	1542 035	HV 851, 852, 853, 854A & B Pneumatic Scheme
4.2.10	1542 035A	Feedwater Pump SI Valves - Hydraulic Scheme
4.2.11	1542 006A	MOV 805C
4.2.12	1542 096	MOV 883 Refueling Water Storage Tank Isol.
4.2.13	1542 137	Safety Injection Sequencer No. 1
4.2.14	1542 138	Safety Injection Sequencer No. 2
4.2.15	1543 001	Feedwater Pumps
4.2.16	1543 002	Feedwater Control Diagram
4.2.17	1543 008	HV 854A & B Safety Injection Valves
4.2.18	1543 011	HV 852A & B

4.0 REFERENCES (Continued)

4.3 Technical Manuals

Later

4.4 Procedures

4.4.1 Operating Instructions

S01-3-1, Plant Startup from Cold Shutdown to Hot Standby

S01-3-2, Plant Startup from Hot Standby to Minimum Load

S01-3-3, Plant Operation from Minimum Load to Full Power

S01-3-4, Plant Shutdown from Full Power to Hot Standby

S01-3-5, Plant Shutdown from Hot Standby to Cold Shutdown

S01-4-17, Safety Injection System Operations

S01-4-28, Flushing the Safety Injection, Recirculation and Containment Spray System

S01-4-39, Safety Injection System Alignment

S01-12.3-2, Hot Operational Test of the Safety Injection and Containment Spray System

S01-12-3.7, Monthly Sequencer Testing

4.4.2 Emergency Operating Instructions

S01-1.0-10, Reactor Trip of Safety Injection

S01-1.0-12, Safety Injection Termination Following Spurious Safety Injection

S01-1.0-31, Safety Injection Termination Following Loss of Secondary Coolant

S01-1.0-23 Transfer to Cold Leg Injection and Recirculation

PART II

RECIRCULATION SYSTEM

RECIRCULATION SYSTEM

1.0 FUNCTIONS/DESIGN BASES

1.1 The Recirculation System has the following main function:

To provide long term core cooling following a loss of coolant accident using spilled reactor coolant.

1.2 The Recirculation System has the following Design Bases:

1.2.1 To provide sufficient water flow to the reactor core for Long term, post accident cooling, when the RWST inventory is discharged into the containment sump following a LOCA.

1.2.2 To accomplish its intended function with any one component failing to respond as required.

1.2.3 The system is designed such that the components may be operated for long periods without maintenance.

2.0 DESCRIPTIONS

2.1 System Overview

2.1.1 Main flow path(s) (see Figure 1A & 2A)

Normal Cold Leg Recirculation: The two Recirculation Pumps, take suction from the containment sphere sump through open flanges. Flow is then directed through a recirculation line that discharges back to the sump to purge discharge piping for ~ 2 minutes.

The Recirc Pumps discharge through normally closed MOV's 866A and B then through the Recirculation Heat Exchanger CRS-E-11. Flow then travels through normally open manual valves to the charging pump suction header. Flow then travels through MOV's 1100 B and D (charging Pump Suctions) and is discharged to charging flow control valves FCV 1115D, E, and F. Flow travels through the normal charging seal injection path to MOV's 356, 357 and 358 into the Reactor Coolant System Cold Legs.

2.0 DESCRIPTION (Continued)

2.1.2 **Additional flow path(s)**

.1 Alternate Cold Leg Injection

This flow path also uses the Recirculation Pumps through the Recirculation Heat Exchanger to the Refueling Pumps suction. Flow then travels through MOV 880 (Refueling to Charging Crosstie valve) into the normal Cold Leg Injection line downstream of the Seal Injection filter bypass valves MOV 18 and 19.

This alignment is used when normal Cold Leg Injection is unavailable and RCS pressure is less than 200 psig.

.2 Normal Hot Leg Injection

The flow path uses the Recirculation Pumps and Heat Exchanger. From here flow is directed to the Charging Pumps through MOV's 1100 B&D to the Regenerative Heat Exchanger. Flow is then directed through the Auxiliary Spray Valve CV-305 into the pressurizer and on into the Loop B Hot Leg.

.3 Alternate hot leg injection (see Figure 2B)

This flow path uses the recirculation pumps and heat exchanger. Flow is then directed to the refueling pumps and then to the letdown system manual valve LDS-020. From here, injection flow travels through the residual heat removal system in reverse direction (from normal RHR or letdown flow) through a manually operated valve to the RHR heat exchangers and their inlet valves to RHR-MOV-822A and B).

From, this point, flow travels through manual valve and enters the bypass line of the east RHR pump (G-14A). Flow is then directed through MOVs 814 and 813 and into Reactor Coolant Loop Hot Leg C.

2.0 DESCRIPTION (Continued)

2.2 Components

2.2.1 CONTAINMENT SPHERE SUMP

CONTAINMENT SPHERE SUMP	
PURPOSE:	The containment sphere sump will serve as a "catch all" for spilled reactor coolant and injected RWST water.
LOCATION:	- 10 ft elevation inside containment
DEPTH:	6 ft 6 in.
SIZE:	100 ft^3
CAPACITY:	750 Gallons

LEVEL INDICATIONS AND ALARMS:

The Containment Sump High Level Alarm is annunciated at - 14'3" (this is approximately 4'3" from the top) on the auxiliary annunciator panel by level transmitters. Two wide range level indicators are used for post accident level monitoring - level indicator switches 2002 and 3002. The range for these indicators is - 9'2" to + 12 feet (represents ~ 600,000 gallons). Control Room indication is on the north vertical board. Two narrow range level indicators are utilized for post accident level monitoring. Level indicator switches 2001 and 3001 monitor between 15'6" to - 9'7". Control Room indication is located on the north vertical board.

Level Transmitter 2002 annunciates "CONTAINMENT WATER LEVEL HIGH" at - 3 ft. This informs the Control Room that enough level is available to start the recirculation pumps.

"SPHERE SUMP HIGH LEVEL" is alarmed by Level Switch 83 at 4'3" from the top of the sump (2'3" in the sump). "SPHERE SUMP HIGH-HIGH LEVEL" is alarmed by level switch 73 at 4'6" in the sump.

A minimum of 5,400 pounds of anhydrous tri-sodium phosphate is on a rack at the -10 foot level of containment.

During a loss of coolant accident, the TSP will dissolve, increasing the pH in the water in the containment sump, to greater than 7 within 4 hours. The TSP reduces corrosion on stainless steel components required for long term decay heat removal. The sump is covered by a stainless steel cage with a mesh screen that prevents any loose materials from entering the sump. The sump area cage is located at the lowpoint of the containment and is submerged several feet during a LOCA.

2.0 DESCRIPTION (Continued)

2.2.2 EAST AND WEST RECIRCULATION PUMPS

(G-45A & B)

PURPOSE:	To transfer water (LOCA spillage) from the containment sump to charging pump or refueling pump suctions.
PRIME MOVER:	Horizontally mounted 480 V Submersible Induction Motor Canned
DESIGN SPEED:	1800 RPM
DESIGN HORSEPOWER:	75 HP
TYPE:	Single Stage, Centrifugal
NPSH REQUIREMENTS:	8 feet
NPSH AVAILABLE:	10 feet under LOCA conditions
DESIGN FLOWRATE:	800 gpm
DESIGN TEMPERATURE:	300° F
DESIGN PRESSURE:	300 psig
DESIGN HEAD:	150 feet
SHUTOFF HEAD:	180 feet
DESIGN MATERIAL:	Carbon Steel
PUMPED FLUID TEMPERATURE:	40-270° F
CONTROLS:	Each pump has a START/STOP/SPRING RETURN to Neutral Control Switch on the West Vertical Board. With a 10 second time delay to allow service water flow to pump seals for dry test operation. There are no automatic functions associated pump operation.
INDICATIONS (AT CONTROL SWITCH):	Pump Motor Amps for each pump Green - Stop Red - Running
INSTRUMENTATION: FLOW:	East pump - FIS 520 West pump - FIS 521

2.0 DESCRIPTION (Continued)

2.2.2 EAST AND WEST RECIRCULATION PUMPS (Continued)

Each pump is capable of delivering sufficient water to keep the core covered after safety injection is terminated. The pumps are capable of sustained operation in the high temperature, pressure, and humidity associated with a loss-of-coolant accident. A suction cage are provided to protect the pumps from debris during operation. The materials used are designed to withstand the thermal stresses associated with beginning recirculation.

FT 500 and FT 501 are located inside containment, outside the bioshield on the - 14' elevation. The flow indicating switches provide indication of pump discharge flow. The flow switches range is 0-900 gallons per minute. The transmitters also input the spray flow limiting system (see System Description, SYSDES-SD-SO1-580, Part III Containment Spray System).

Recirculation Flow

Flow is the only parameter measured on the recirculation system. There are two flow elements, FE 500 and FE 501 and two flow transmitters, FT 500 and FT 501, that provide signals to flow indicator switches located FIS 520 and 521 on the Control Room west vertical board.

2.0 DESCRIPTION (Continued)

2.2.3 RECIRCULATION PUMP DISCHARGE VALVES

MOV 866 A & B	
PURPOSE:	To provide a flowpath from the recirculation pumps to the charging pump and refueling pump suctions.
OPERATOR TYPE:	480 V Induction Motor. 3 HP
VALVE TYPE:	Gate Valves
VALVE SIZE:	4"
DESIGN TEMPERATURE:	350° F
OPENING TIME:	120 seconds
CLOSING TIME:	120 seconds
CONTROLS:	Open/Close backlighted pushbuttons on West Vertical Board.
INDICATIONS:	Green - Closed Red - Open

2.0 DESCRIPTION (Continued)

2.2.4 RECIRCULATION HEAT EXCHANGER

RECIRCULATION HEAT EXCHANGER	
PURPOSE:	To Cool recirculated spilled reactor coolant
HEAT EXCHANGER TYPE:	Crossflow, Tube and Shell
SHELL SIDE	
FLUID:	Component Cooling Water
FLOW RATE:	1000 gpm
TEMPERATURE IN:	110° F
TEMPERATURE OUT:	160° F
OPERATING PRESSURE:	50 psig
MAXIMUM PRESSURE LOSS:	15 psi
DESIGN PRESSURE:	150 psig
DESIGN TEMPERATURE:	200° F
TUBE SIDE	
FLUID:	Partially Borated Water (spilled coolant)
FLOW RATE:	1600 gpm
TEMPERATURE IN:	270° F
TEMPERATURE OUT:	240° F
OPERATING PRESSURE:	100 psig
MAXIMUM PRESSURE LOSS:	10 psi
DESIGN PRESSURE:	150 psig
DESIGN TEMPERATURE:	300° F

Component Cooling Water to the Heat Exchanger is controlled by valves CCW-CV737A and 737B. Valve controls are open/close pushbuttons located on the West Vertical Board with GREEN-CLOSED-RED-OPEN indicating lights.

2.0 DESCRIPTION (Continued)

2.3 Power Supplies

RECIRCULATION SYSTEM COMPONENT POWER SUPPLIES

COMPONENT	LOCATION	BREAKER
East Recirc-Pump	480 V Bus #1	52-11
West Recirc-Pump	480 V Bus #2	52-1207
MOV 866A	480 V MCC #1	42-1182
MOV 866B	480 V MCC #2	42-1278

3.0 OPERATIONS

3.1 Normal Operations

The recirculation system is placed in service manually (from the Control Room) after RWST Injection Phase of S.I. has been completed. System alignment begins when the refueling water storage tank level is reduced to 21%.

Approximately 19 hours after a loss-of-coolant accident occurs, the system is aligned for hot leg recirculation. The Recirculation System is normally maintained in standby readiness.

The Recirculation System is aligned for its intended use during all plant transitions and power operations. Prior to removing this portion of Safety Injection from service a $\geq$4% Δ K/K shutdown margin (Hot Standby Xenon-free, all rods in) condition must be verified. Normal arrangement (alignment) must begin immediately upon Reactor Coolant System pressure above 500 psig during plant startup.

RECIRCULATION SYSTEM

4.0 REFERENCES

4.1 P&ID's

4.1.1 5178120 Containment Spray & Recirculation System Sheet 1

4.1.2 5178121 Containment Spray & Recirculation System Sheet 2

4.2 Elementaries

4.2.1 1542 001 Safety Injection Recirculation Pumps

4.2.2 1542 031 MOV 866 A & B, 356, 357, 358, 18, 19

4.3 Procedures

4.3.1 Operating Instructions

S01-4-17, Flushing Safety Injection and Recirculation

S01-4-28, Hot Operational Test of Safety Injection

S01-4-41, CS and Recirculating System Alignment

4.3.2 Emergency Operating Instructions

S01-1.0-20, Loss of Reactor Coolant

S01-1.0-22, Post LOCA Cooldown and Depressurization

S01-1.0-23, Transfer to Cold Leg Injection and Recirculation

S01-1.2-1, Response to Inadequate Core Cooling

S01-1.5-2, Response to High Containment Sump Level

PART III

CONTAINMENT SPRAY SYSTEM

CONTAINMENT SPRAY SYSTEM

1.0 FUNCTIONS/DESIGN BASES

1.1 The Containment Spray System has the following main functions:

1.1.1 The Containment Spray System will spray borated water at refueling concentrations into the upper containment sphere to reduce containment pressure following a loss of coolant accident or a loss of secondary coolant.

1.1.2 The Containment Spray System will, with Hydrazine solution injected, wash down radioactive particulate matter and airborne iodine fission products released by a LOCA.

1.1.3 The Containment Spray System will assist in the recirculation of (Partially Borated) spilled reactor coolant, in the event the charging pumps become inoperable, in response to inadequate core cooling.

1.2 The Containment Spray System has the following Design Basis:

1.2.1 The system is designed such that power will be continuously available to its components.

1.2.2 The system components are qualified in accordance with stringent ground motion criteria (.5G).

1.2.3 The system is designed to operate satisfactorily with second order malfunctions, i.e. with a LOCA as a first order malfunction, the failure of any component to respond actively in the prescribed manner can be tolerated without loss of ability of the system to perform its intended function.

2.0 DESCRIPTION

2.1 System Overview

The Containment Spray System is designed to spray cool water into the upper containment sphere to reduce pressure and to ensure that the containment design pressure of 49.4 psig is not exceeded in the event of a loss of coolant accident when Reactor Coolant System fluid is spilling into containment. The system accomplishes this by utilizing 2 spray pumps, spray valves, spray nozzles and associated piping and instrumentation.

2.1.1 **Main flow path(s) (see Figure 3A)**

The two Refueling Water Pumps (Containment Spray) take suction from the Refueling Water Storage Tank through motor operated valve MOV 883. This supply ensures all water added to the containment sump contributes to the post accident shutdown margin. Suction flow is then directed to each of the pump suction lines through manual isolation valves and into the pumps suction.

Flow is then from the pumps into two 6 inch headers and through manual valves 237 and 524, then into a common discharge header. Flow is directed to the Spray Flow Limiter Valves CRS CV-517 and CRs CV-518 and on through spray flow restricting orifices RO-525 and RO-523. From these orifices flow is directed to the Spray Valves CV-82 and CV-114 and on to the sphere spray nozzles that form 4 ring headers in the containment overhead. A Recirculation line back to the RWST from the spray header is provided for system functional testing.

2.1.2 **Additional flow path(s) (see Figures 3A and 3C):**

.1 The Refueling Water Pumps (Containment Spray) can also be used for recirculation if the charging pumps become inoperable. Flow is from the Containment sump to the Recirculation Pumps through the Recirculation Heat exchanger to the common Refueling Pumps suction header.

.2 Hydrazine is added to the Containment Spray Water to facilitate scrubbing of post LOCA Iodine Fission Products from the containment atmosphere. Two positive displacement pumps SHA-G200A & G200B take suction from the Hydrazine Storage Tank SHA-D-200 and through solenoid operated discharge valves SV600 and SV601 to a common discharge header that ties into the discharge header of the refueling water pumps.

.3 The Refueling Water pumps also provide fire suppression spray in containment. The flow path is the same for containment spray except fire spray valve CV-92 is used versus normal spray valves.

2.0 DESCRIPTION (Continued)

2.2 Components

2.2.1 NORTH AND SOUTH REFUELING WATER PUMPS (G27N&S)

REFUELING WATER PUMPS (G-27N&S)	
PURPOSE:	To provide motive force for flow from the RWST to the Containment Spray Nozzles.
LOCATION:	North of the Refueling Water Storage Tank
TYPE:	Single Stage Centrifugal
PRIME MOVER:	480 V, 3 Phase, Induction Motor
FLUID PUMPED:	Borated Water
DESIGN FLOWRATE:	1000 GPM (To provide flow for effective nozzle spray)
MAXIMUM DESIGN PRESSURE:	600 psig
DESIGN DISCHARGE PRESSURE:	350 psig
NPSH REQUIREMENT:	14 feet
NPSH AVAILABLE:	30 FEET
DESIGN HORSEPOWER:	150 HP
DESIGN MATERIAL:	Austenetic Stainless Steel
SEAL TYPE:	Mechanical
CONTROL SEQUENCE:	See Figure Next Page
START:	- Containment Spray Actuation Signal - Control Room Pushbutton to Start - No CSAS Sealed In
STOP:	- Control Room Pushbutton to Stop - Overcurrent, Undervoltage - The pumps also have an override feature which allows them to be stopped with a Containment Spray Actuation Signal locked in.
INSTRUMENTATION:	Discharge pressures are indicated locally for each pump and by PI 165 on the North Vertical Board. (Common discharge pressure)

2.0 DESCRIPTIONS (Continued)

2.1.3 General Control Scheme

The Containment Spray System can be actuated by two methods:

.1 Manually from the control room west vertical board by depressing back lighted handswitches (see detailed Control Scheme).

.2 Automatically by containment pressure with receipt of a series of specific input signals (see detailed Control Scheme).

2.0 DESCRIPTION (Continued)

2.2.2 SPRAY CONTROL VALVES

CV-82 AND CV-114

PURPOSE:	To control Flow from Refueling Water Pumps to the Spray Nozzles in containment.
OPERATOR TYPE:	Pneumatic Positioner (Service Air)
VALVE TYPE:	Butterfly Valve
VALVE SIZE:	6" (inch)
FAIL POSITION:	OPEN
CONTROL:	The Spray Valves are controlled by solenoid valves that de-energize on a containment spray actuation signal. This causes the valves to Open - to allow the valves to align for injection into containment. The valves can be controlled manually from the Control Room by pushbuttons (open-close) HS-2057A&B and HS-2058A&B respectively on the West Vertical Board
INDICATIONS AT CONTROL SWITCH:	Green - Closed Red - Open White - Normal

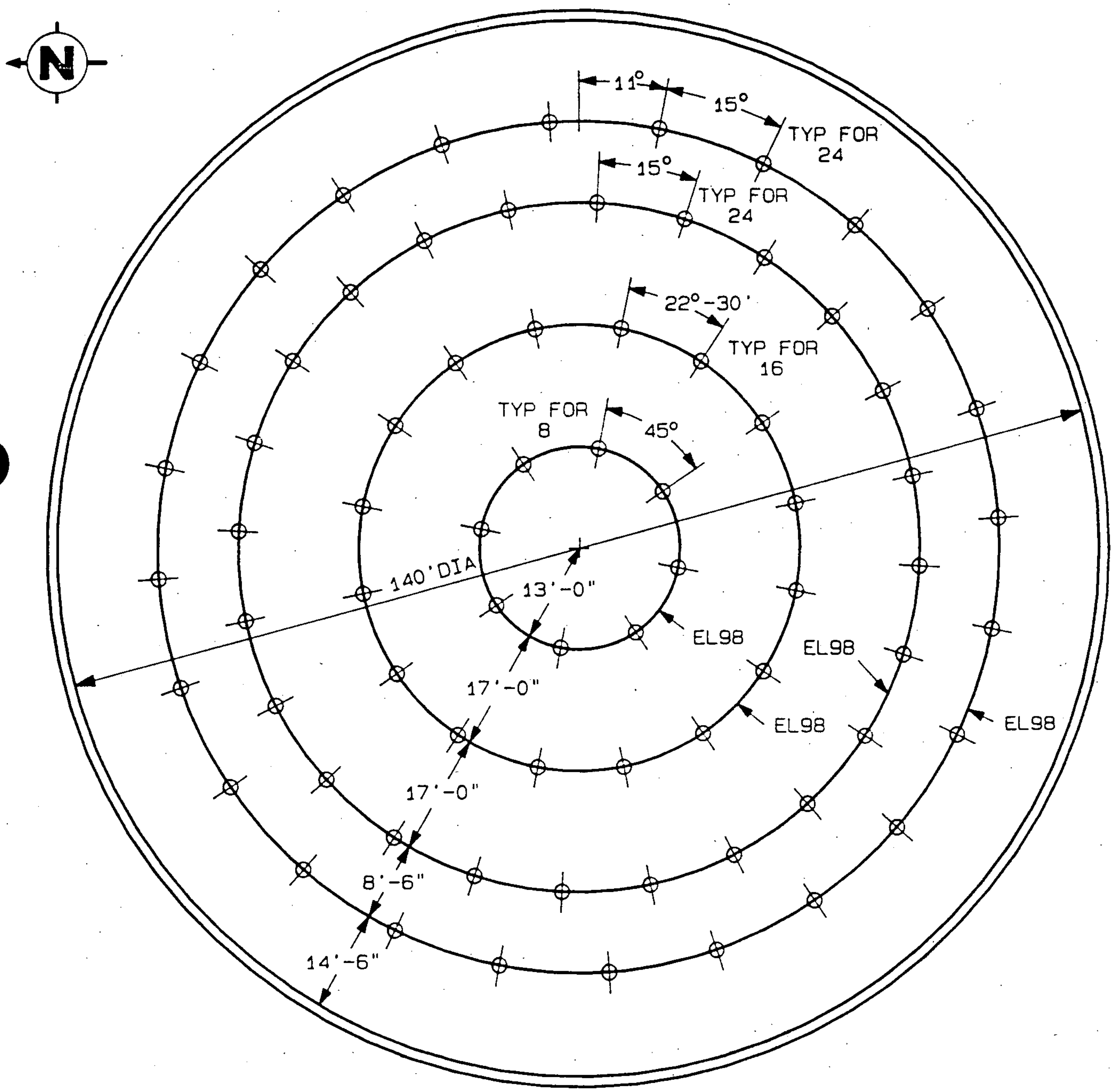
2.0 DESCRIPTION (Continued)

2.2.3 CONTAINMENT SPRAY NOZZLES

CONTAINMENT SPRAY NOZZLES	
PURPOSE:	To evenly disperse, throughout containment, a chemically treated water solution for air-borne fission product removal and containment pressure reduction following a LOCA.
FLUID SPRAYED:	Borated water with Hydrazine added
NUMBER OF NOZZLES:	72
NOZZLE TYPE:	Full Cone, Center Jet
DESIGN FLOW:	15 gpm per nozzle
DESIGN DIFFERENTIAL:	15 psi
SPRAY ORIFICE SIZE:	3/8"
NOZZLE HEADER DESIGN:	See Figure next page The Header is oriented to ensure uniform coverage of the containment volume outside the secondary shield.

CONTAINMENT SPRAY SYSTEM

FIGURE III-4: SPRAY NOZZLE ARRANGEMENT
UPPER CONTAINMENT SPHERE



2.0 DESCRIPTION (Continued)

2.2.4 HYDRAZINE STORAGE TANK

HYDRAZINE STORAGE TANK	
PURPOSE:	To provide a source of 21% by weight Hydrazine solution for injection into the containment spray system to facilitate iodine fission product removal from the containment atmosphere following a LOCA.
LOCATION:	Auxiliary Building Roof
CAPACITY:	200 Gallons
FLUID STORED:	21% by Wt. Hydrazine
DESIGN TEMPERATURE:	150° F
DESIGN PRESSURE:	10 psig
DESIGN MATERIAL:	Stainless Steel
OVERPRESSURE RELIEF:	Pressure Relief Valve set at 8 psig 2 Vacuum Breakers (Diaphragm Type)
INSTRUMENTATION:	
PRESSURE:	Indicated in the Control Room by PSI-510
LEVEL:	Level Transmitters 500A&B provide a signal to the Control Level Indicators LIS-500A and LIS-500B

The Tank Capacity and location are designed to provide the necessary NPSH for the Hydrazine Pumps. It is provided with a recirculation pump to maintain a well mixed solution. The Tank is pressurized with a nominal 2 psig nitrogen to minimize hyrazine degradation during long term storage. (Hydrazine is an oxygen scavenger)

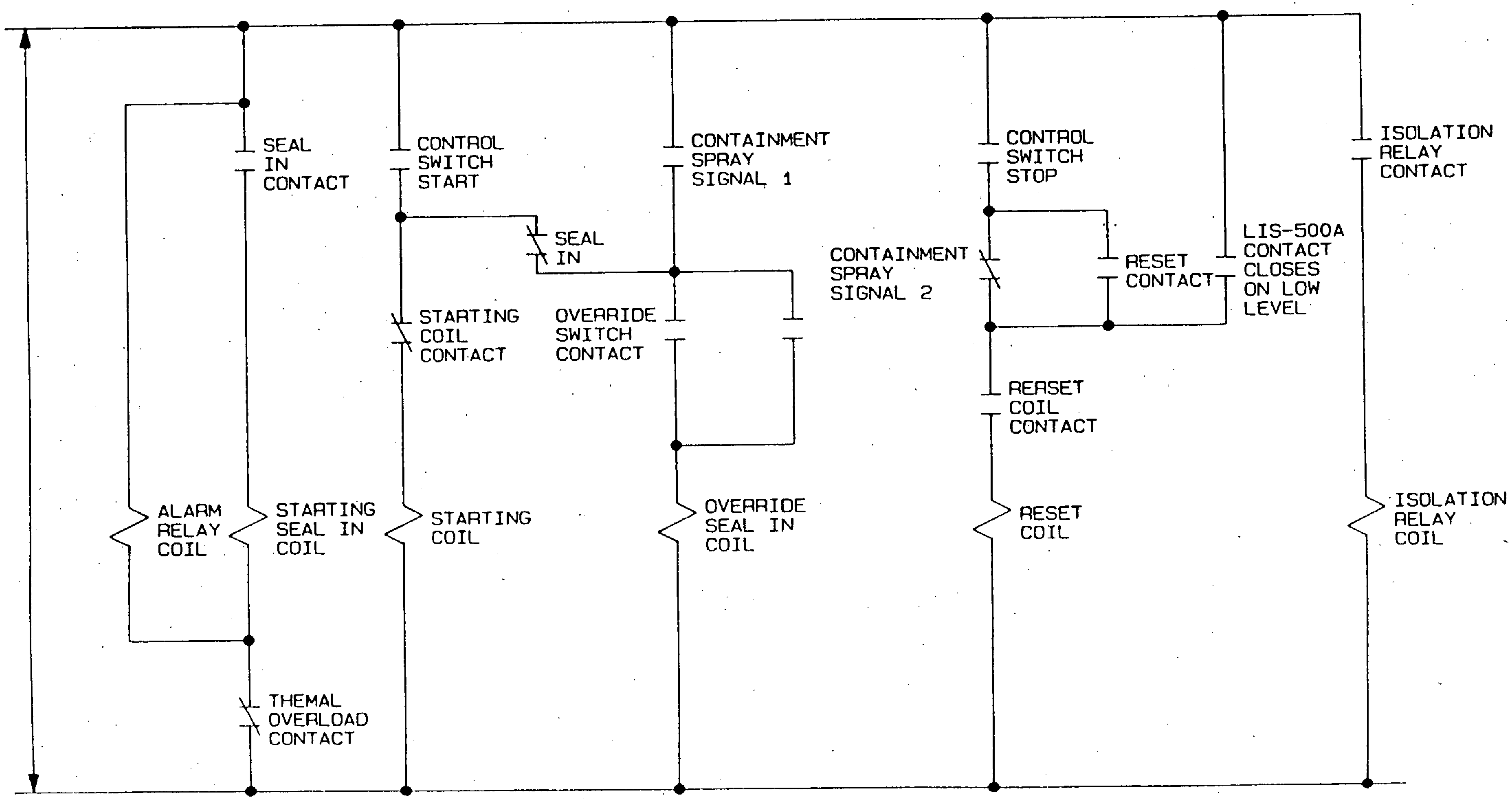
2.0 DESCRIPTION (Continued)

2.2.5 EAST AND WEST HYDRAZINE ADDITION PUMPS (G-200A AND G-200B)

G-200A AND G-200B	
PURPOSE:	To transfer measured amounts of hydrazine solution from the hydrazine storage tank to the containment spray header
PRIME MOVER:	480 V. Induction Motor
TYPE:	Positive Displacement (to insure accurate flow control)
DESIGN FLOWRATE:	0.4 gpm
MAXIMUM DISCHARGE PRESSURE:	325 psig
DESIGN TEMPERATURE:	150° F
DESIGN MATERIAL:	Austenitic Stainless Steel
PUMPED FLUID:	21% by wt. Hydrazine Solution
PUMP FLUID TEMPERATURE:	40-90° F
OVERPRESSURE RELIEF:	Relief Valves 2003A&B Relieve to the Hydrazine Tank
INSTRUMENTATION:	
DISCHARGE PRESSURE:	Local Pressure Indicators 1121 & 1122
DISCHARGE FLOW:	FT 506 & 507 Respectively Provide flow indication in the Control Room to FIS-500 and FIS-501
CONTROL SEQUENCE:	See Figure Next Page
START:	No Override, Adequate Tank Level Control Room Handswitch to Start CSAS Signal
STOP:	No CSAS Signal Control Switch to Stop Low Suction Pressure (from Tank Level Transmitters LT-500A&B

CONTAINMENT SPRAY SYSTEM

FIGURE III-5: SIMPLIFIED ELEMENTARY HYDRAZINE ADDITION PUMPS



2.0 DESCRIPTION (Continued)

2.2.6 SPRAY FLOW LIMITER SYSTEM CV's 517 and 518

In the event that the recirculation pumps are being used to supply the Containment Spray System. The Spray Flow Limiter System is available. The system was installed because of the difference in flow rates of the recirculation pumps (800 gpm) and the refueling pumps (1000 gpm). If one of the recirculation pumps failed it would be possible for the refueling pump(s) to take all of the discharge flow and thereby starve the charging pumps.

The Spray Flow Limiter System is composed of two Pneumatic/ Hydraulic Spray Valves CV-512 and CV-518. In parallel with a flow restricting orifice, and a "Spray Flow Limiter Switch" located on the west vertical board. The Switch has two positions - enable and disable. Each of the Control Valves (CV-517 & 518) have a handswitch (Open - Close - Override). When the control switch is placed in the "ENABLE" position, if there is a flow imbalance from the recirculation pumps an alarm will sound, "Recirculation Pump Flow Measurement Trouble." This will cause CV-517 and 518 to close. Flow will then be restricted by the flow restricting orifice RO-526.

Normally the system is not placed in the Enable position. The operator aligns the system by closing CV-517 & 518 and verifies only one refueling water pump is running, thereby preventing flow imbalance.

2.3 Detailed Control Scheme

2.3.1 Manual Actuation

Each train has two handswitches labeled: "CSAS TRAIN A PUMPS" and "CSAS TRAIN A VALVES" for Train A and "CSAS TRAIN B PUMPS" and "CSAS TRAIN B VALVES" for Train B.

A manual initiation of containment spray requires that both switches for a respective train be depressed simultaneously. Depressing of these handswitches will cause the pump to start and all necessary valves to align to begin spray.

2.3.2 Containment Spray Actuation System (CSAS) (see Figure 3B)

The Containment Spray Actuation System actuates containment spray upon receipt of specific signals from parameters which it monitors. It is composed of a logic cabinet, located behind the west vertical board, with two test panels: one for Train A pumps and valves and one for Train B pumps and valves, associated instrumentation and controls.

2.0 DESCRIPTION (Continued)

2.3.2.1 Automatic Actuation

The CSAS will automatically actuate containment spray when the following conditions are met.

1) Two (2) out of three (3) high containment pressures from pressure transmitters PT-501, 502 and 503 at 10 psig

2) S.I. Signal

3) Normal voltage on vital 4160V Bus 1C & 2C for 10 seconds.

As indicated there are two independent actuation Trains (A & B) each with their own controls and instrumentation. Each Train has an independent power supply to ensure reliability and redundancy.

2.3.2 **Pressure**

Containment Spray Header Pressure is transmitted to the Control Room by pressure transmitter PT 18 located in the RWST PIT, North wall. This pressure transmitter sends a signal to the control room to pressure indicator PI-165 on the North Vertical Board.

2.3.3 **Flow**

Containment Spray System Flow is measured by Flow Element FE-522. From the Flow Element a signal is sent to the Control Room by Flow Transmitter FT-904 to FIS-522 on the West Vertical Board.

2.0 DESCRIPTIONS (Continued)

2.4 Power Supplies

CONTAINMENT SPRAY SYSTEM POWER SUPPLIES

COMPONENT	LOCATION	BRKR
North Refueling Water Pump	480V Bus 1	52-1119
South Refueling Water Pump	480V Bus 2	52-1219
Spray Valve CV-82	120 VAC	8-1111V
Spray Valve CV-114	120 VAC	8-1214V
Fire Spray Valve CV-92	120 VAC Bus 1	8-1112V
Hydrazine Addition Pump A	East MCC1	42-1153
Hydrazine Addition Pump B	East MCC 2A	42-12A79
Hydrazine Pump Discharge Valve SV 600	Vital Bus 1&3 120 VAC	8-1115 8-1314
Hydrazine Pump Discharge Valve SV 601	120 VAC	CSAS Inverter
Spray Flow Limiter Valves CV-517	120 VAC Bus 1	8-1113V
CV-518	120 VAC Bus 2	8-1214V

3.0 OPERATION

3.1 Normal Operations

The Containment Spray System may be started manually from the control room or automatically by a Containment Spray Actuation signal. The system is aligned for operation during all mode changes and power operations. Prior to removing containment spray from service the reactor coolant system temperature must be below 200° F

4.0 REFERENCES

4.1 P&ID's

4.1.1	5178120	Containment Spray & Recirculation System Sheet 1
4.1.2	5178121	Containment Spray & Recirculation System Sheet 2
4.1.3	5178125	Containment Spray Hydrazine Add System

4.2 Elementaries

4.2.1	1540 170	CSAS Inverter
4.2.2	1542 004	Refueling Water Pumps
4.2.3	1542 085	Cont. Spray Actuation System A PWR & Cont.
4.2.4	1542 085A	Cont. Spray Actuation System A PWR & Cont.
4.2.5	1542 085B	Cont. Spray & Hydrazine Add Cont. Sys. (Pumps)
4.2.6	1542 085C	Cont. Spray & Hydrazine Add Cont. Sys. (Valves)
4.2.7	1542 085D	Cont. Spray & Hydrazine Add Cont. Sys.
4.2.8	1542 085E	Cont. Spray & Hydrazine Add Cont. Sys. Sh. 2
4.2.9	1542 086	Cont. Spray Actuation Sys. B PWR & Cont.
4.2.10	1542 086A	Cont. Spray Actuation Sys. B PWR & Cont.
4.2.11	1542 087	CV 82, 114 Cont. Spray Valve Cont.

4.3 Technical Manuals

Later

4.4 Procedures

4.4.1 Operating Instructions

SO1-12.8-13, Recirculation System Leakage Test

SO1-12.3-35, Cont. Spray and Recirculation System Safety-Related Alignment

SO1-12.8-5, Cold Operability Test of Cont. Spray Actuation System.

4.0 REFERENCES (Continued)

4.4 Procedures (Continued)

4.4.2 Emergency Operating Instructions

S01-1.0-10, Reactor Trip of Safety Injection

S01-1.0-23, Transfer to Cold Leg Injection and Recirculation

S01-1.0-20, Loss of Reactor Coolant

S01-1.2-1, Response to Inadequate Core Cooling

S01-1.5.1, Response to High Containment Pressure

4.4.3 I & C Surveillance Test

S01-II-3.4.13, Containment Spray Actuation System Calibration

FIGURE I-2: SAFETY INJECTION ACTUATION LOGIC

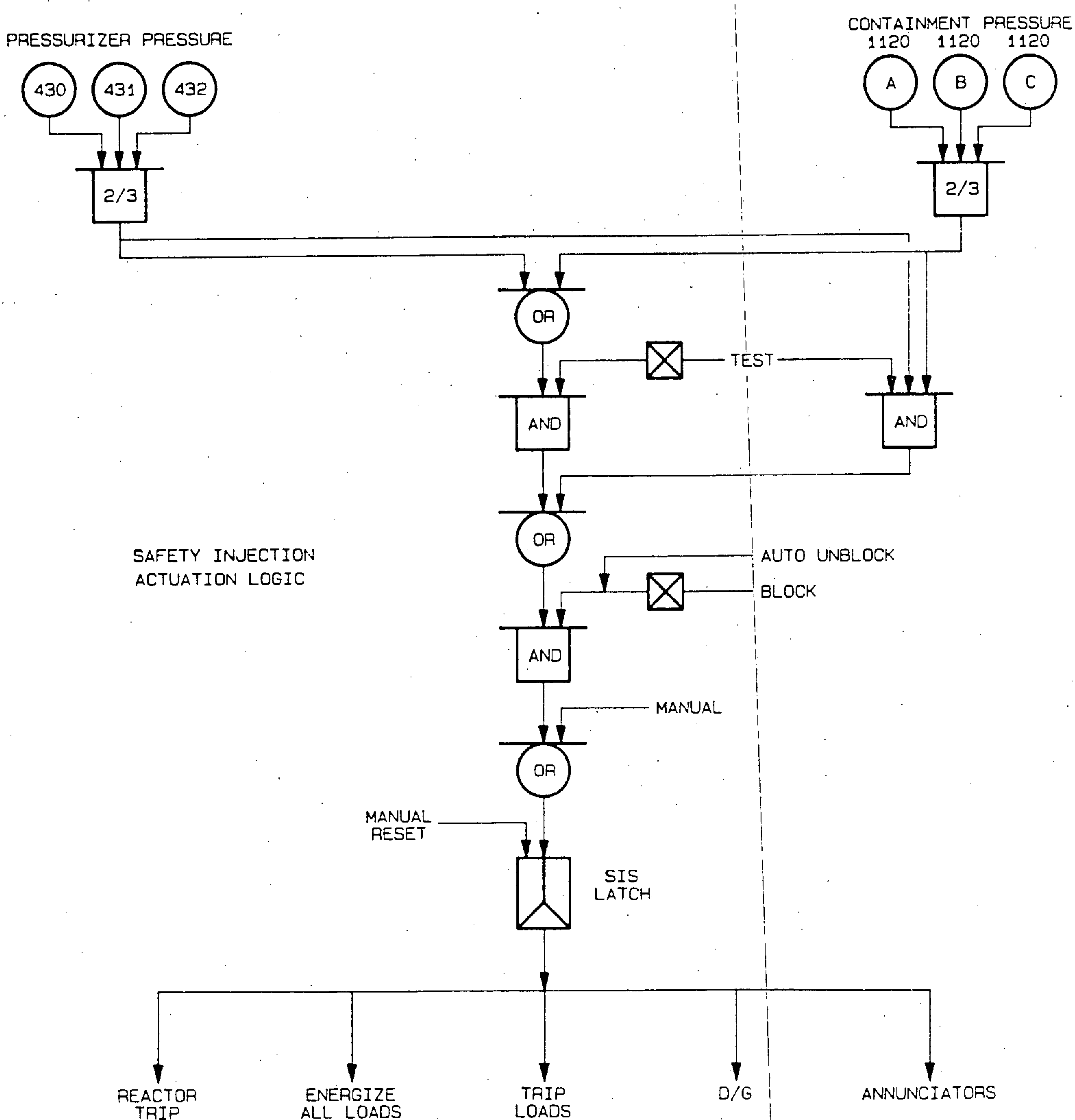


FIGURE II-2: ALTERNATE HOT LEG RECIRCULATION FLOW PATH

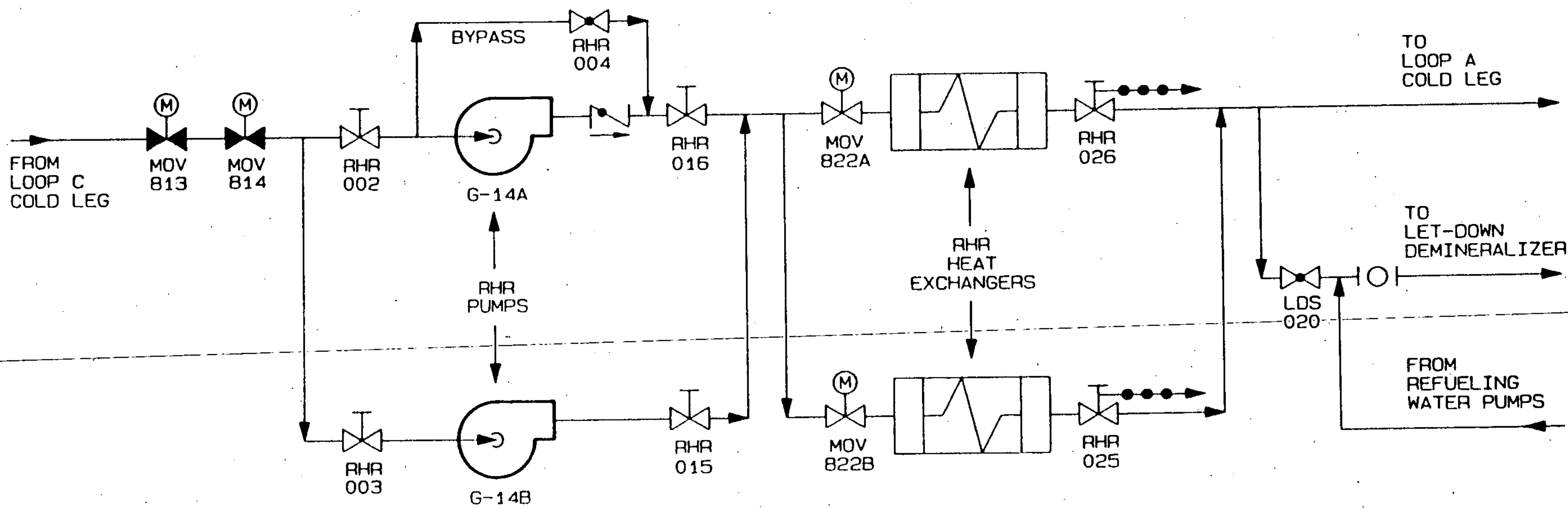


FIGURE III-2: CONTAINMENT SPRAY ACTUATION LOG

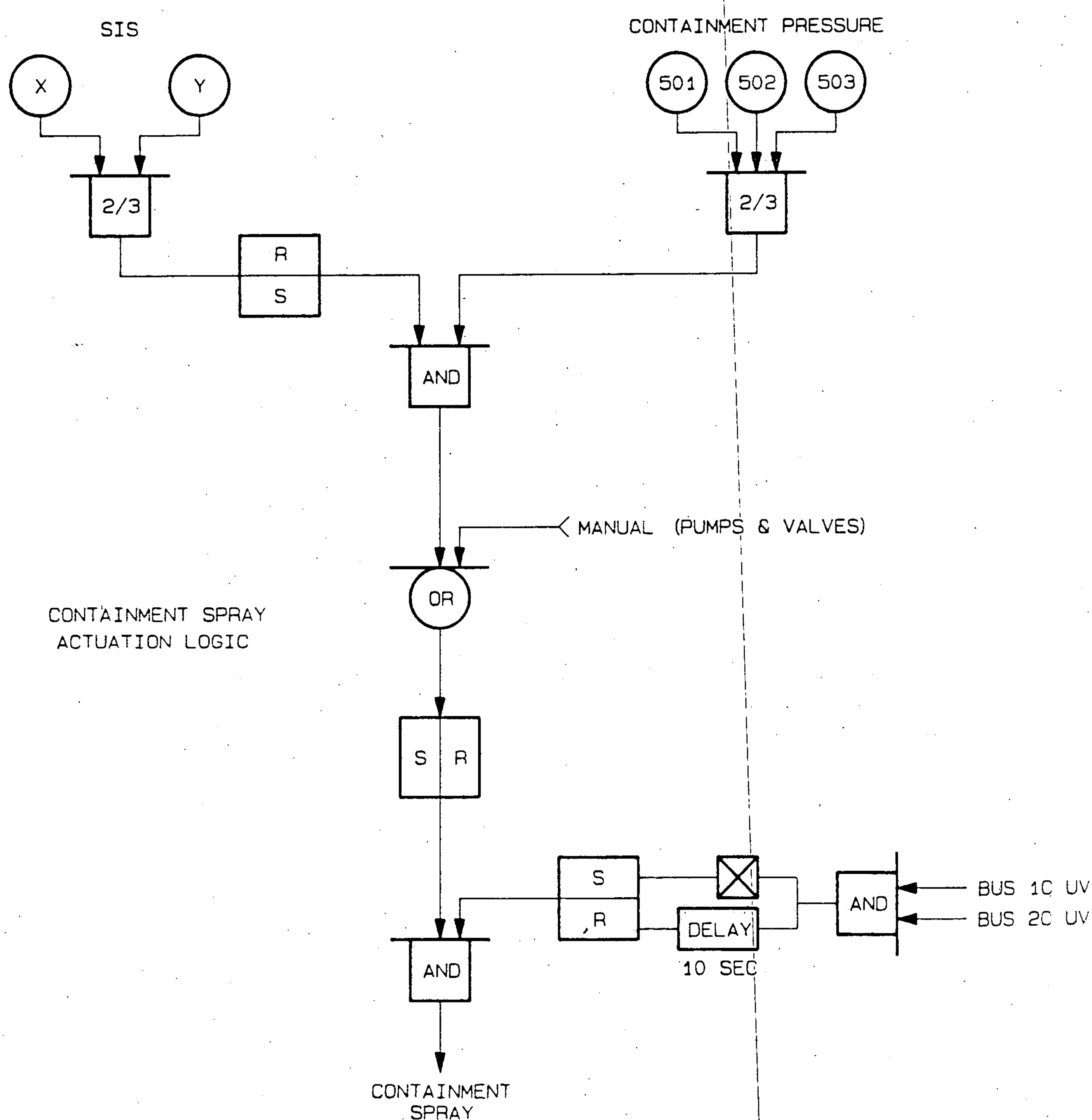
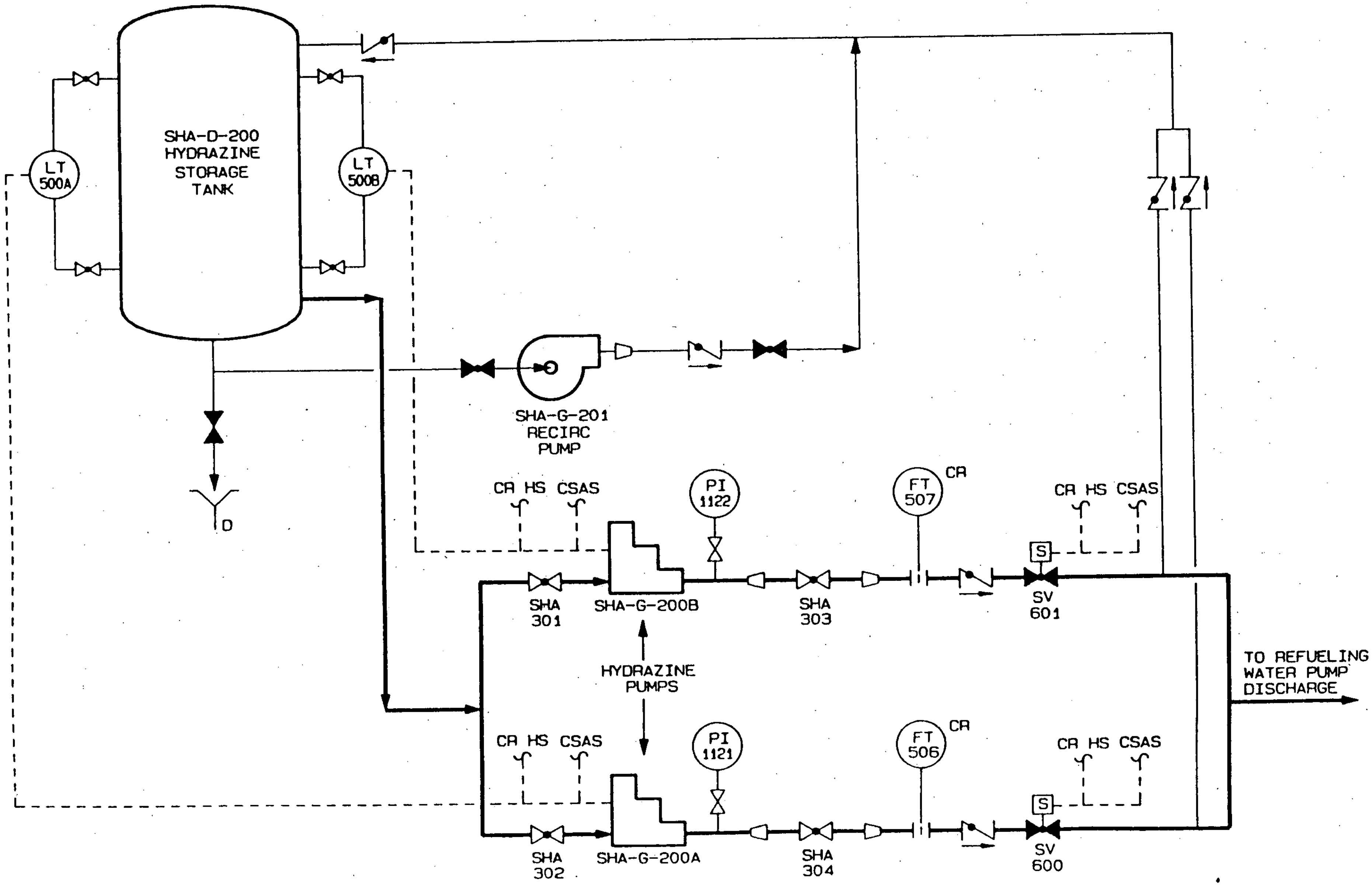


FIGURE III-3: HYDRAZINE ADDITION SYSTEM



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APPENDIX A

CONTROL ROOM ANNUNCIATORS

REACTOR PLANT NO. 1

1) S.I. Header High Pressure - 200 psi PC-911

2) Hydrazine Level LO - 5% Hydrazine Tank Level

3) Hydrazine Tank Pressure HI/LO - High: 8 psig; LO: 2 psig

4) Containment Spray Flow LO - 800 gpm

REACTOR PLANT NO. 2

1) Recirculation Pump Flow Measurement Trouble - High: 730 gpm; Low: 450 gpm

2) Containment Spray Flow Limit in Effect - Enable Button Pushed

3) CSAS Cabinet Under Test Train A - Door of Cabinet is Open

4) CSAS Cabinet Under Test Train B - Door of Cabinet is Open

5) Refueling Water Valve #883 Not Open - Limit Switch

6) Cont. Press. Under Test Channel A - Test Switch In Test

7) Cont. Press. Under Test Channel B - Test Switch In Test

8) Cont. Press. Under Test Channel C - Test Switch In Test

RX PLANT MATRIX PARTIAL TRIP

1) Cont. Spray Actuation Train A -2 of 3 Cont. Press. Greater Than or Equal to 10 psig and S.I.S. Signal or Pushbutton.

2) Cont. Spray Actuation Train B -2 of 3 Cont. Press. Greater Than or Equal to 10 psig and S.I.S. Signal or Pushbutton.

3) Cont. Press. HI Trip Channel A - 10 psig

4) Cont. Press. HI Trip Channel B - 10 psig

5) Cont. Press. HI Trip Channel C - 10 psig

6) CSAS-A Power Failure Lockout - LO Voltage to CSAS Train A

7) CSAS-B Power Failure Lockout - LO Voltage to CSAS Train B

APPENDIX B

DEVELOPMENTAL RESOURCES

Safety Injection System

B.1 P&ID's

B.1.1	5178205	Feedwater System, Sheet 1
B.1.2	5178206	Feedwater System, Sheet 2
B.1.3	5178207	Feedwater System, Sheet 3
B.1.4	5178115	Safety Injection System
B.1.5	5178135	Volume Control & Charging System, Sheet 1
B.1.6	5178136	Volume Control & Charging System, Sheet 2

B.2 Elementaries

B.2.1	1542 006	MOV 850A and 850B Safety Injection
B.2.2	1542 008	MOVs 1100B and 1100D
B.2.3	1542 010	Charging Pumps
B.2.4	1542 011	Safety Injection Pumps
B.2.5	1542 031	MOVs 866A & B, 356, 357, 358, 18, 19
B.2.6	1542 032	MOV 1100C
B.2.7	1542 033	HVs 853A & B Feedwater Discharge Valves
B.2.8	1542 034	HV 851A & B Safety Injection Valves
B.2.9	1542 035	HV 851, 852, 853, 854A & B Pneumatic Scheme
B.2.10	1542 035A	Feedwater Pump SI Valves - Hydraulic Scheme
B.2.11	1542 006A	MOV 805C
B.2.12	1542 096	MOV 883 Refueling Water Storage Tank Isol.
B.2.13	1542 137	Safety Injection Sequencer No. 1
B.2.14	1542 138	Safety Injection Sequencer No. 2
B.2.15	1543 001	Feedwater Pumps
B.2.16	1543 002	Feedwater Control Diagram

APPENDIX B

DEVELOPMENTAL RESOURCES
(Continued)

B.2 Elementaries (Continued)

B.2.17 1543 008 HV 854A & B Safety Injection Valves

B.2.18 1543 011 HV 852A & B

B.3 Procedures

B.3.1 Operating Instructions

S01-3-1, Plant Startup from Cold Shutdown to Hot Standby

S01-3-2, Plant Startup from Hot Standby to Minimum Load

S01-3-3, Plant Operation from Minimum Load to Full Power

S01-3-4, Plant Shutdown from Full Power to Hot Standby

S01-3-5, Plant Shutdown from Hot Standby to Cold Shutdown

S01-4-17, Safety Injection System Operations

S01-4-28, Flushing the Safety Injection, Recirculation and Containment Spray System

S01-4-39, Safety Injection System Alignment

S01-12.3-2, Hot Operational Test of the Safety Injection and Containment Spray System

S01-12-3.7, Monthly Sequencer Testing

B.3.2 Emergency Operating Instructions

S01-1.0-10, Reactor Trip of Safety Injection

S01-1.0-12, Safety Injection Termination Following Spurious Safety Injection

S01-1.0-31, Safety Injection Termination Following Loss of Secondary Coolant

APPENDIX B

DEVELOPMENTAL RESOURCES
(Continued)

Recirculation System

B.1 P&ID's

B.1.1 5178120 Containment Spray & Recirculation System Sheet 1

B.1.2 5178121 Containment Spray & Recirculation System Sheet 2

B.2 Elementaries

4.2.1 1542 001 Safety Injection Recirculation Pumps

4.2.2 1542 031 MOV 866 A & B, 356, 357, 358, 18, 19

B.3 Procedures

B.3.1 Operating Instructions

S01-4-17, Flushing Safety Injection and Recirculation

S01-4-28, Hot Operational Test of Safety Injection

S01-4-41, CS and Recirculating System Alignment

B.3.2 Emergency Operating Instructions

S01-1.0-20, Loss of Reactor Coolant

S01-1.0-22, Post LOCA Cooldown and Depressurization

S01-1.0-23, Transfer to Cold Leg Injection and Recirculation

S01-1.2-1, Response to Inadequate Core Cooling

S01-1.5-2, Response to High Containment Sump Level

APPENDIX B

DEVELOPMENTAL RESOURCES
(Continued)

Containment Spray System

B.1 P&ID's

B.1.1 5178120 Containment Spray & Recirculation System Sheet 1

B.1.2 5178121 Containment Spray & Recirculation System Sheet 2

B.1.3 5178125 Containment Spray Hydrazine Add System

B.2 Elementaries

B.2.1 1540 170 CSAS Inverter

B.2.2 1542 004 Refueling Water Pumps

B.2.3 1542 085 Cont. Spray Actuation System A PWR & Cont.

B.2.4 1542 085A Cont. Spray Actuation System A PWR & Cont.

B.2.5 1542 085B Cont. Spray & Hydrazine Add Cont. Sys. (Pumps)

B.2.6 1542 085C Cont. Spray & Hydrazine Add Cont. Sys. (Valves)

B.2.7 1542 085D Cont. Spray & Hydrazine Add Cont. Sys.

B.2.8 1542 085E Cont. Spray & Hydrazine Add Cont. Sys. Sh. 2

B.2.9 1542 086 Cont. Spray Actuation Sys. B PWR & Cont.

B.2.10 1542 086A Cont. Spray Actuation Sys. B PWR & Cont.

B.2.11 1542 087 CV 82, 114 Cont. Spray Valve Cont.

B.3 Procedures

B.3.1 Operating Instructions

S01-12.8-13, Recirculation System Leakage Test

S01-12.3-35, Cont. Spray and Recirculation System Safety-Related Alignment

S01-12.8-5, Cold Operability Test of Cont. Spray Actuation System.

APPENDIX B

DEVELOPMENTAL RESOURCES
(Continued)

B.3 Procedures (Continued)

B.3.2 Emergency Operating Instructions

S01-1.0-10, Reactor Trip of Safety Injection

S01-1.0-23, Transfer to Cold Leg Injection and Recirculation

S01-1.0-20, Loss of Reactor Coolant

S01-1.2-1, Response to Inadequate Core Cooling

S01-1.5.1, Response to High Containment Pressure

B.3.3 I & C Surveillance Test

S01-II-3.4.13, Containment Spray Actuation System Calibration

B.4 Technical Specifications

Sections 3.3, 4.2

B.5 Final Safety Analysis Report

Volume I	Section:	1.1.13, 1.3, 1.4
Volume II	Section:	4.1
Volume IV	Section:	7
Volume V	Section:	8, 10, 11, 12, 13

SAFEGUARD LOAD SEQUENCING SYSTEM

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SAFEGUARD LOAD SEQUENCING SYSTEM

TABLE OF CONTENTS
(Continued)

This System Description is approved per SO123-0-44, System Description Revision and Approval. Contact CDM to verify revision information.

PREPARED BY: Gary Beck _____ Author 10-24-85 Date

APPROVED BY: [signature] _____ Manager, Operations 11/8/85 Date

SAFEGUARD LOAD SEQUENCING SYSTEM

1.0 FUNCTIONS/DESIGN BASES

1.1 The Safeguard Load Sequencing System has the following main functions:

1.1.1 The main function of the Safeguard Load Sequencing System (SLSS) is to detect and react to Low Pressurizer Pressure, High Containment Pressure and 4160 V Bus 1C and/or 2C Undervoltage Signals. The SLSS actuates and sequences the various Emergency Safeguard Features in the event of a Safety Injection System signal (SIS), Loss of Offsite Power (LOP), Loss of 4160 V Bus 1C/2C (LOB), or Safety Injection System and Loss of Offsite Power (SISLOP).

1.2 The Safeguard Load Sequencing System has the following additional functions:

1.2.1 The Safeguard Load Sequencing System provides: Manual Actuation of the SIS and/or LOP Signals, Manual Blocking of the SIS Signal, and Manual Resetting of the SIS and/or LOP Signal(s).

1.3 The Safeguard Load Sequencing System has the following Design Basis:

1.3.1 The Safeguard Load Sequencing System is designed to ensure proper load sequencing of the Emergency Safeguard Features to mitigate postulated accidents.

1.3.2 The Safeguard Load Sequencing System is designed to ensure proper loading of the Emergency Safeguard Features onto the Electrical Safety Buses such that an overload condition on the buses does not occur.

1.3.3 The Safeguard Load Sequencing System is designed to support Online Testing to ensure the system and/or components are capable of performing the main function.

2.0 DESCRIPTION

2.1 System Overview

2.1.1 Safeguard Load Sequencing System Automatic Actions

The Safeguard Load Sequencing System actuates the Safety Injection System upon receipt of a Safety Injection System (SIS) signal. In the event of an SIS, the Safeguard Load Sequencing System automatically starts the Diesel Generators, but does not automatically close the Diesel Generator Output Breakers and simultaneously loads the Emergency Safeguards Features onto their respective buses.

In the event of a Loss of Offsite Power (LOP) condition without a SIS, the Safeguard Load Sequencing System automatically starts the Diesel Generators but does not automatically close the Diesel Generator Output Breakers and does not load the Emergency Safeguards Features onto their respective buses.

In the event of a Loss of 4160 V Bus 1C or 2C (LOB), the Safeguard Load Sequencing System automatically starts the Diesel Generator associated with the lost bus but does not automatically close the Diesel Generator Output Breaker and does not load the Emergency Safeguards Features onto the bus.

In the event a SIS and a LOP (SISLOP) occur together, the Safeguard Load Sequencing System trips and/or locks out certain loads (see 2.3.2), automatically starts the Diesel Generators, places the Diesel Generators onto the 4160 V Buses and sequentially loads the Emergency Safeguards Equipment onto their respective buses.

The Safeguard Load Sequencing System also trips the Reactor on a SIS and/or LOP and sends logic actuation signals to the Containment Isolation and Containment Spray Systems on a SIS or a SISLOP.

2.1.2 Safeguard Load Sequencing System

The Safeguard Load Sequencing System (SLSS) is composed of two independent and redundant Sequencer Trains which are identified as Sequencer 1 and Sequencer 2.

Sequencer 1 provides the actuation and sequencing signals for the Safety Injection System Train A components. Sequencer 1 also provides an actuation input signal to the Containment Spray System Train A Logic and the Containment Isolation System Train A Logic.

Sequencer 2 provides the actuation and sequencing signals for the Safety Injection System Train B components. Sequencer 2 also provides an actuation input signal to the Containment Spray System Train B Logic and the Containment Isolation System Train B Logic.

2.0 DESCRIPTION (Continued)

2.1.2 **Safeguard Load Sequencing System** (Continued)

Each Sequencer is composed of two subchannels which are identified as Subchannel X and Subchannel Y. The subchannels are independent of each other, but share the common input signals of Pressurizer Pressure, Containment Pressure, 4160 V Bus 1C and 2C Undervoltage, Diesel Generator Volts/Freq, Diesel Generator Output Breaker Status, and Sequencer in Test Conditions, through Isolation Circuits.

EXAMPLE: Subchannel X and Y for Sequencer 1, each receive the same pressure signal input from Pressurizer Pressure Bistable Controllers PC-430GX, PC-431EX and PC-432CX, while Subchannel X and Y, for Sequencer 2, each receive the same pressure input signal from Pressurizer Pressure Bistable Controllers PC-3000A, PC-3000B and PC-3000C (see Figure 2).

Each Sequencer initiates six Load Groups, A through F; the groups, timing sequences and components operated are identified in Section 2.3.2. The timing sequences are initiated only on a SISLOP actuation.

The Remote Surveillance Panels, one for each Sequencer, input four manual signals to its respective Sequencer Cabinet. These signals are: SIS Trip, SIS Reset, LOP Trip and LOP Reset.

2.1.3 **Safeguard Load Sequencing System Manual Functions**

.1 Manual Actuation of SIS or LOP is accomplished at the Remote Surveillance Panel by depressing the Trip pushbutton and turning the Trip/Reset Switch to Trip, for the appropriate actuation signal and Sequencer. The requirement that both the pushbutton and the switch be operated at the same time prevents an inadvertent actuation.

.2 Manual Blocking of SIS allows the SIS signal to be blocked during normal plant cooldown.

.3 Manual Resetting of SIS or LOP/LOB is accomplished at the Remote Surveillance Panel by depressing the Reset pushbutton and turning the Trip/Reset switch to Reset for the appropriate actuation signal and Sequencer. The requirement that both the pushbutton and the switch be operated at the same time prevents an inadvertent reset.

2.0 DESCRIPTION (Continued)

2.1.3 **Safeguard Load Sequencing System Manual Functions** (Continued)

.4 Testing the Safeguard Load Sequencing System is accomplished at the Sequencer Test Panel and/or the Input Buffer Modules in the Sequencer Cabinet Card Racks, for the appropriate Sequencer.

The Sequencer Logic is designed such that an output from both Subchannel X and Y is required for Sequencer operation. Thus the design, for each Sequencer, creates a dual path for all input signals and requires an AND Logic of both subchannels for the final Sequencer actuation signal. Because both subchannels are required for Sequencer actuation, this design allows for Online Testing of an individual subchannel without an actual actuation and prevents a spurious actuation due to a subchannel failure.

Testing a Sequencer does not prevent the Sequencer from performing its main function. If an actuation signal occurs while in Test, the actuation signal will perform the required function, essentially overriding the test signal.

2.2 Components

The Safeguard Load Sequencing System utilizes two Sequencer Systems, Sequencer 1 and Sequencer 2. Each Sequencer System is made up of one Logic Cabinet, one Termination Cabinet, two Cable Assemblies and one Remote Surveillance Panel. The Logic and Termination Cabinets are bolted together and are referred to as a Sequencer Cabinet. The Sequencer Cabinets are located behind the Main Control Room South Vertical Board.

2.2.1 **Logic Cabinet**

The Logic Cabinet, right hand cabinet of the Sequencer Cabinet, contains: four Power Supply Assemblies; the Card Rack which contains the Input Buffer Cards, the Logic Cards and the Relay Driver Cards for Subchannels X and Y; the Sequencer Test Panel and a Ventilation Fan.

.1 Power Supply Assemblies (Figure 10) - located in the bottom of the cabinet, receive 125 VDC input and converts it to the 15 VDC and 48 VDC necessary for the operation of the Safeguard Load Sequencing System.

2.0 DESCRIPTION (Continued)

2.2.1 **Logic Cabinet** (Continued)

.2 Card Rack (Figure 11) - located above the Power Supply Assemblies, is made up of two rows of modules with 16 modules per row. The Card Rack is split vertically between slots 8 and 9 which is the division between Subchannel X and Subchannel Y. A sliding lexan door, 8 slots wide, makes inadvertent simultaneous access to both Subchannel X and Subchannel Y impossible.

.2.1 Input Buffer Cards (Figure 12) - receive the following input signals: Pressurizer Pressure, Containment Pressure, 4160 V Bus Undervoltage, Diesel Generator Volts & Freq., Diesel Generator Output Breaker Status, and Sequencer in Test Conditions, and Sequence Block Status.

The Input Buffer Cards isolate the Safeguard Load Sequencing System from voltage spikes, filters out noise and false signals, and provides an output signal to the logic circuitry indicative of the status for the input parameters.

Each Input Buffer Card is equipped with pushbuttons to provide test capability of the individual Input Buffer Relays.

Each Input Buffer Card has solid state LED Test Lamp indication which will extinguish when the buffer contacts are not in their normal condition.

The Input Buffer Cards occupy slots 1 through 6 (Subchannel X) and 9 through 14 (Subchannel Y) in the Card Racks' upper row.

.2.2 Logic Cards (Figure 13) - receive the various outputs from the Input Buffer Cards, determine the logic input and supply appropriate outputs to the Relay Driver Cards. The Logic Cards also provide the instantaneous outputs or the timing outputs to the Relay Driver Cards.

The Logic Cards occupy slots 7 (Subchannel X) and 15 (Subchannel Y) in the Card Racks' upper row.

.2.3 Relay Driver Card (Figure 14) - receive the logic command from the Logic Cards to drive the Relay Driver 48 VDC Relays which provide actuation of some component function. The Relay Driver Cards maintain isolation between the input from the Logic Cards and the 48 VDC Relay Circuitry. It de-energizes the 48 VDC Relays regardless of the input logic state when the 15 VDC voltage decreases below a minimum value, and current limits each Relay Driver Circuit. Each Relay Driver Card has four independent circuits, each circuit can drive up to five 48 VDC Relays.

2.0 DESCRIPTIONS (Continued)

2.2.1 **Logic Cabinet** (Continued)

.2.3 (continued)

The Relay Driver Cards occupy slots 8 (Subchannel X) and 16 (Subchannel Y) of the Card Racks' upper row and Slots 1-8 (Subchannel X) and 9-16 (Subchannel Y) of the Card Racks' lower row.

.3 Sequencer Test Panel (Figure 9) - located above the Card Rack, is equipped with one Normal/Test toggle switch, two Test Select switches and one Reset/Operate/Test switch.

.3.1 Reset-Operate-Test Switch: This switch is used for overall control of testing the Subchannels. There is one common switch for each Sequencer.

Once a test on a particular Sequencer has been performed, this switch must be placed in the Reset position. If not, the trip stays latched, and when the next Subchannel is tested a SIS or LOP may be initiated.

.3.2 Test Select Switch: This switch selects which of the Sequencer inputs is tested. There is a separate switch for each subchannel in the Sequencer with following positions:

Operate - Normal position

SIS-PRPZ - Simulates 2/3 Low Pressurizer Pressure

SIS-CONT - Simulates 2/3 High Containment Pressure

SIS-PRPZ and CONT - Simulates 2/3 Low Pressurizer Pressure and 2/3 High Containment Pressure

LOB-1C - Simulates Undervoltage on 4160 V Bus 1C

LOB-2C - Simulates Undervoltage on 4160 V Bus 2C

LOP - Simulates Undervoltage on 4160 V Buses 1C and 2C

SIS and LOP - Simulates SIS and LOP inputs

.3.3 Normal-Test Toggle Switch: This switch is common for each Sequencer. The function of this switch is to change the normal logic circuitry of the Sequencer for Safetv Injection Actuation from a two out of three Pressurizer Pressure "OR" two out of three Containment Pressure to a two out of three Pressurizer Pressure "AND" two out of three Containment Pressure inputs.

2.0 DESCRIPTIONS (Continued)

2.2.1 **Logic Cabinet** (Continued)

This feature allows testing the Containment Isolation System Actuations Signal without initiating a SIS signal. This may occur since the Pressure Transmitters for Containment Pressure are common to SIS and CIS.

.4 Ventilation Fan - located in the top of the Logic Cabinet provides ventilation for the Logic and Termination Cabinets.

The fan is not required for Sequencer operation, however, it will improve electronic component life by reducing internal cabinet temperatures.

2.2.2 **Termination Cabinet**

The Termination Cabinet, left hand cabinet of the Sequencer Cabinet, contains all the Input/Output Terminal boards for the Sequencer Cabinet.

The Termination Cabinet also contains the two 48 VDC Relay Panels.

The upper 48 VDC Relay Panel contains Subchannel X and Y Relay Drivers which cause or prevent some actions, Subchannel X and Y Test Lamps, and the Load Monitoring Lamps (Section 2.3.3.1) for Load Group A.

The lower 48 VDC Relay Panel contains Subchannel X and Y Relay Drivers which cause or prevent some actions, Subchannel (X and Y) Test Lamps, and the Load Monitoring Lamps (Section 2.3.3.1) for Load Groups B through F.

The 48 VDC Relays, for Subchannels X and Y, each have two sets of contacts (see Figure 10). One set of contacts is for the Control Circuit, the other set of contacts is for the Amber Test Lamps.

2.2.3 **Remote Surveillance Panel (Figure 8)**

The two Remote Surveillance Panels, one for each Sequencer, are mounted in the Main Control Room on their associated Diesel Generator Control Board (SPG).

Each Remote Surveillance Panel contains the SIS Manual Initiation and Reset pushbuttons and switch, the LOP Manual Initiation and Reset pushbuttons and switch, and eight Status Lamps as described in Section 2.3.5.

2.0 DESCRIPTION (Continued)

2.2.4 Safety Injection System Block Switch

The two Safety Injection System Block Switches, one for each Sequencer, are mounted in the Main Control Room on the Nuclear Control Auxiliary Panel (North Main Vertical Board).

If 2 out of 3 Pressurizer Pressure Bistables are $\leq$ 1900 psig, placing the switch in the Block position prior to a SIS actuation will prevent the SIS latch from being set on that Sequencers' Subchannels, thus preventing the SIS actuation.

If the SIS actuation occurs prior to placing the switch in the Block position, then placing the switch in the Block position will have no effect on the logic (see Section 3.1).

2.3 Detailed Logic and Indications

2.3.1 Safeguard Load Sequencing System Summary

Each Sequencer will respond to certain combinations of input signals reaching their respective setpoints. These combinations, logics and setpoints are summarized below:

NOTE: Each Sequencer has its own set of bistable inputs.

Event	Signal/Logic/Setpoint	Basic Response
Safety Injection System (SIS) Actuation	Low Pressurizer Pressure/ 2 out of 3 channels/1735 psig or High Containment Pressure/ 2 out of 3 channels/1.4 psig	Reactor Trips, D/Gs start but their Output Breakers do not close onto the 4160 V Buses and all Sequencer outputs for Safety Injection Loads are initiated without time delay.

NOTE: With the Normal - Test Toggle Switch in Test, the logic changes, requiring both a 2 out of 3 Pressurizer Pressure Signal AND a 2 out of 3 Containment Pressure Signal to cause an actuation.

The Normal - Test Toggle Switch is placed in Test when testing both the High Containment Pressure and the Low Pressurizer Pressure signals at the same time (using simulated signals), and when testing the Containment Isolation System using the Containment Pressure Transmitters.

22.0 DESCRIPTION (Continued)

2.3.1 **Safeguard Load Sequencing System Summary** (Continued)

Event	Signal/Logic/Setpoint	Basic Response
Safety Injection Signal and Loss of Offsite Power (SIS/LOP) Actuation	SIS from either of the preceding AND Undervoltage on 1 out of 2 Relays for both 4160 V Buses 1C AND 2C.	Reactor Trips, D/Gs start and their Output Breakers close onto the 4160 V Buses, Safety Injection Loads are initiated in a timed sequence and non-vital equipment is Locked Out.
Loss of Offsite Power (LOP) Actuation	Undervoltage on 1 out of 2 Undervoltage Relays for 4160 V Buses 1C AND 2C.	Reactor Trips, D/Gs start but their Output Breakers do not close onto the 4160V Buses. The operator has the capability to manually close the D/G Output Breakers and operate components as required (Certain interlocks must be met).
Loss of 4160 V Bus 1C or 2C (LOB) Actuation Actuation	Undervoltage on 1 out of 2 Undervoltage Relays for 4160 V Bus 1C (Sequencer 1 only) OR Undervoltage on 1 out of 2 Undervoltage Relays for 4160 V Bus 2C (Sequencer 2 only)	No Reactor Trip, Associated D/G starts but the Output Breaker does not close onto the 4160V Bus. The operator has the capability to manually close the D/G Output Breaker and operate components as required (certain interlocks must be met).
SIS Unblock	Pressurizer Pressure/ 2 out of 3 Channels/ > 1900 psig	Automatically reinstates the SIS actuation capability of the Safeguards Load Sequencing System for Low Pressurizer Pressure.
SIS Block Permissive Alarm	Pressurizer Pressure/ 2 out of 3 Channels/ $\leq$ 1900 psig	Enables Operator to Block the SIS actuation signal, only.
SIS Alert Block Alarm	Pressurizer Pressure/ 2 out of 3 Channel/ 1800 psig	Alerts the Operator of an impending SIS actuation if it is not Blocked.

2.0 DESCRIPTION (Continued)

2.3.2 Basic Sequencer Controls

NOTE: If only one Sequencer functions, an unusual combination of equipment running or tripped may be observed.

TIME	OPERATION	EVENT
Load Group A Sequence 0 sec.	Trip Reactor Trip Breakers	LOP/SIS/SISLOP
	De-energize Reactor Trip Breaker Undervoltage Relays	LOP/SIS/SISLOP
	Energize Lockout Relays for Switchgears 1, 2 and 3	SISLOP
	Energize Lockout Relays for MCC's 1, 1C, 2, 2A and 3	SISLOP
	Trip 4160 V Bus 1C and 2C Tie Breakers	SISLOP
	Trip Diesel Generator 1 and 2 Circuit Breakers	LOB/LOP/SIS/ SISLOP
	Block Diesel Generator 1 and 2 Excitation Shutdown Ckts	LOB/LOP/SIS/ SISLOP
	Reset Diesel Generator Field	SISLOP
	Trip Lighting Transformer	SISLOP
	Lockout Motor Heater Panels	SIS/SISLOP
	Start Diesel Generator 1 and 2 (2 Circuits per Diesel)	LOB/LOP/SIS SISLOP
	Close Feedwater Bypass/Control Valves (CV-142, 143 and 144/FCV-456, 457 and 458)	SIS/SISLOP
	Open Safety Injection Hdr. Isolation Valves (HV-851 A&B, HV-853 A&B)	SIS/SISLOP
	Close HP & LP Feedwater Hdr. Isolation Valves (HV-852 A&B, HV-854 A&B)	SIS/SISLOP
	First Out Annunciators, Auto Alert System & TSC	SIS/SISLOP
	Trip Heater Drain Pumps	SIS/SISLOP
	Trip Condensate Pumps	SIS/SISLOP
	Initiate Event Recorder	SIS/SISLOP
	Trip Feedwater Pumps	SIS/SISLOP
	Actuate Containment Isolation System	SIS/SISLOP
	Open Safety Injection Loop Isolation Valves (MOV-850A, B & C)	SIS/SISLOP
	Close Letdown Orifice Isolation Valves (CV-202, 203 & 204)	SIS/SISLOP
	Close 480 V Bus 2 and 3 Tie Breakers	SIS/SISLOP
	Signal to Feedwater Pump Control Circuit Starts Feedwater Pump after an 11 Second Time Delay	SIS/SISLOP
	Trip Turbine Plant Cooling Water Pumps	SISLOP

2.0 DESCRIPTION (Continued)

2.3.2 Basic Sequencer Controls (Continued)

TIME	OPERATION	EVENT
Load Group A Sequence 10 sec.	Close Diesel Generator 1 and 2 Circuit Breakers (Note: Breaker closure will occur when the DG is at rated voltage and frequency, 10 secs. is the maximum allowable time.)	SISLOP
Load Group B Sequence 11 sec.	Open Charging Line Flow Control Valve (FCV-1112) Start Safety Injection Pumps Open Feedwater Recirc. System Valves (CV-875 A&B) Open Refueling Water to Charging Pump Suction Valves (MOV-1100 B&D) Start Emergency Siren Close Main Feedwater Isolation Valves (MOV-20, 21 & 22) Block Overload Trips for Safety Injection Pumps and Feedwater Pumps Trip Reactor Coolant Pumps "A", "B" & "C" (NOTE: occurs 1 sec. after DG Breaker closes)	SIS/SISLOP SIS/SISLOP SIS/SISLOP SIS/SISLOP SIS/SISLOP SIS/SISLOP SIS/SISLOP SIS/SISLOP
Load Group C Sequence 12 sec.	Close Feedwater Pump Miniflow Valves Valves (CV-36 & 37) (Note: occurs 2 secs. after DG Breaker closes)	SIS/SISLOP
Load Group D Sequence 21 sec.	Start Charging Pumps Start Component Cooling Water Pumps Start Saltwater Cooling Pumps Safety Injection Signal to Containment Spray System (NOTE: occurs 11 secs. after DG Breaker closes)	SIS/SISLOP SIS/SISLOP SIS/SISLOP SIS/SISLOP
Load Group E Sequence Variable	Spare	SIS/SISLOP
Load Group F Sequence Variable	Spare	SIS/SISLOP

2.0 DESCRIPTION (Continued)

2.3.3 **Termination Cabinet Indications**

.1 Load Monitoring Lamps: These normally ON white neon lights monitor the Subchannel X and Y 48 VDC Relays for circuits having series contacts.

If Subchannels X and Y are not actuated there will be a small trickle of current through the lamp keeping it illuminated.

If Subchannels X and Y actuate the lamp will extinguish.

NOTE: The Load Monitoring Lamps are controlled by both the component circuitry and the Sequencer Subchannel.

These neon lights will not be on if there is another contact in the circuit that is not closed, such as; a switch that is normally in automatic but is not, or a breaker that is open or racked out.

The 48 VDC Relay circuits having parallel contacts do not have Load Monitoring Lamps.

.2 Subchannel "X" and "Y" Test Lamps: These normally ON Amber neon lights monitor the Subchannel X and Y 48 VDC Relay Status. They are used to ensure each Subchannel is performing its desired function when performing tests on the Sequencer Subchannels.

These neon lights will extinguish when an actuation signal (Test or Actual) is present.

2.3.4 **Logic Cabinet Indications**

.1 Input Buffer Cards: The Red neon light indications are illuminated when the buffer contacts are in their normal condition, and extinguish when an actuation signal is present.

.2 Logic Cards (Modules): Have the same type Red neon indication as the Input Buffer Cards. These indicate which Load Group A-F has received an initiation signal, and if SIS, LOP, SISLOP and/or LOB is latched in; and which 2/3 high Containment Pressure or 2/3 low Pressurizer Pressure signals have come in.

2.0 DESCRIPTION (Continued)

2.3.4.3 There are power supply lights in the power supply portion of this cabinet. These lights will extinguish when power is removed and an annunciator will illuminate in the Main Control Room.

2.3.5 **Remote Surveillance Panel Indications**

.1 The Remote Surveillance Panel has a load sequencing light indication for each load group. The lights are normally illuminated and will extinguish when their respective group is sequenced on.

.2 Also, there is a normally illuminated lamp indicating power available. If this lamp extinguishes, it is an indication of power supply failure.

.3 The other indication for the Sequencer is a "Door Closed" indication. If any of the four (4) Sequencer doors are opened, this light will extinguish.

2.3.6 **Remote Surveillance Panel Controls**

.1 SIS Trip - This function is performed by holding the SIS "Trip/Reset Switch" in the "Trip" position while at the same time depressing the "SIS Manual Trip" button.

This manually sets the SIS latches on Subchannels X and Y. This signal is processed by the logic regardless of the current logic or system status.

.2 SIS Reset - This function is performed by holding the SIS "Trip/Reset Switch" in the "Reset" position while at the same time depressing the "SIS Manual Reset" button.

This resets the SIS latches on Subchannels X and Y. It is locked out until the End of Sequence latch is set. It is independent of the accident inputs returning to normal.

.3 LOP Trip - This function is performed by holding the "LOP Trip/Reset Switch" in the "Trip" position while at the same time depressing the "LOP Manual Trip" button.

This manually sets the LOP latches on Subchannels X and Y. This signal is processed by the Logic regardless of the current logic or system status.

2.0 DESCRIPTION (Continued)

2.3.5 **Remote Surveillance Panel Indications** (Continued)

.4 LOP Reset - This function is performed by holding the "LOP Trip/Reset Switch" in the "Reset" position while at the same time depressing the "LOP Reset" button.

This Resets the LOP latches on Subchannels X and Y. It is locked out until the End of Sequence latch is set. It is independent of the accident inputs returning to normal.

2.4 Power Supplies

COMPONENT	BREAKER	LOCATION
Sequencer 1	72-124	125 VDC Bus No. 1
Sequencer 2	72-212	125 VDC Bus No. 2
Ventilation Fan	No. 4	L06 (120 VAC)

The power supplies to the Sequencers are train-separated as shown. Loss of a 125 VDC Bus will result in the inability of the associated Sequencer to perform its intended function, however, the design of the SLSS is that one operable Sequencer is sufficient to operate the necessary components to place the Plant in a safe condition.

NOTE: Opening and then reclosing these breakers may start the associated Diesel Generator (see yellow placard on Diesel Generator Bus).

3.0 OPERATION

3.1 Normal Operations

During Plant Startup, the Safeguard Load Sequencing System (the SIS actuation remains Blocked) is placed in service prior to increasing RCS temperature above 200°F. When the RCS pressure reaches 1900 psig the SIS actuation is automatically Unblocked as indicated by the Block Permissive annunciators extinguishing and the SIS Override LEDs illuminating in the Card Rack.

During Plant cooldown, the Automatic Safety Injection System Signal due to Low Pressurizer Pressure is manually blocked, prior to reducing pressure below the SIS setpoint. This prevents an inadvertent actuation of Safety Injection. Activation of the Block signal is indicated by annunciators and the extinguishing of the SIS Override LED's in the Card Rack.

The permissive to allow blocking the SIS signal is enabled when 2 out of 3 Pressurizer Pressure bistables are < 1900 psig.

The Pressurizer Pressure Bistables generate an alarm signal which illuminates the SI Block Permissive annunciator (1900 psig) and the Alert Block annunciator (1800 psig) in the Main Control Room, to advise the operator that the Safety Injection System should be manually blocked as pressure is intentionally reduced. If no manual block occurs, there will be an inadvertent actuation of the Safety Injection System. Should system actuation be required after blocking, manual actuation of both Safety Injection trains is possible by the manual initiation switches and pushbuttons on both Remote Surveillance Panels. The individual components will be under operator control after the Sequencer is reset by using the manual Reset Switch and pushbuttons on the Remote Surveillance Panel.

The Block signal only blocks the SIS signal, it has no effect on the LOP or LOB signals.

3.2 Safety Injection Signal (SIS) with 220 kV Source of Offsite Power Available (See Figure 3)

The Safety Injection Signal (SIS) is derived from Low Pressurizer Pressure or High Containment Pressure bistable elements as described in Section 2.3.1. Each Sequencer has its own bistable channel inputs and the contacts from each of the bistable output relays are supplied to its Sequencer X and Y Subchannels.

Under normal conditions (Normal/Test Toggle Switch in Normal), the Sequencer will generate a Safety Injection Signal when any two out of three Pressurizer Pressure bistable output relays are actuated, "OR" when any two out of three Containment Pressure bistable output relays are actuated. The two out of three logic function for Pressurizer Pressure and Containment Pressure signals is performed within each Sequencer on a Subchannel basis.

3.0 OPERATION (Continued)

3.2 (Continued)

During certain testing of pressure inputs and Sequencer Channel tests, the Sequencer logic is manually changed to generate a Safety Injection Signal when any two out of three Pressurizer Pressure bistable output relays are actuated in coincidence with actuation of any two out of three Containment Pressure bistable output relays. This feature is accomplished via a toggle switch located on each Sequencer Test Panel. The test switch changes the Sequencer "OR" logic to an "AND" logic.

3.2.1 Safety Injection SLSS Actions

.1 Initiation of the Safety Injection Signal will result in a Reactor Trip and a Unit Trip.

.2 The Safety Injection Signal will also initiate the starting of the Emergency Diesel Generators of both trains. The Diesel Generators will be running in a standby mode (output breakers open).

.3 The Safety Injection Signal will cause the Sequencer to actuate all of the Safety Injection loads without any timing sequence.

3.3 Loss of Offsite Power (LOP) From the 220 kV System (See Figure 4)

Each Sequencer monitors the availability of offsite power by means of the input signals it receives from redundant undervoltage relays associated with each of the 4160 V Buses 1C and 2C. Each Sequencer had its own Auxiliary UV Relays and generates a reliable undervoltage signal for its internal use by combining signals from Buses 1C and 2C in an "AND" configuration.

LOP occurs when 1 out of 2 UV Relays on 1C AND 1 out of 2 UV Relays on 2C show both 4160 V Buses have a loss of power supply.

3.3.1 Loss of Offsite Power SLSS Actions

.1 The Loss of Power signal will result in a Reactor Trip and a Unit Trip.

.2 The LOP signal will also initiate starting of the Emergency Diesel Generators for both trains. The Diesel Generators will be running in a standby mode. The operator will have the capability to manually close the Diesel Generator output breakers, if required.

3.0 OPERATION (Continued)

3.4 Loss of 4160 V Bus (LOB) (See Figure 6)

Loss of Bus signal to each Sequencer is generated by its associated 4160 V Bus Undervoltage Relay input signal.

An LOB occurs when 1 out of 2 UV Relays (same Relays as used for LOP) show its 4160 V Bus to have lost power.

3.4.1 Loss of Bus SLSS Actions

.1 Loss of Bus signal will initiate the starting of its associated Emergency Diesel Generator unit. The Diesel Generator will be running in a standby mode.

3.5 Simultaneous Occurrence of Safety Injection and Loss of Offsite Power from 220 kV System (SISLOP) (See Figures 3 and 4)

3.5.1 Safety Injection Signal with Loss of Offsite Power Signal

.1 Upon initiation of the SISLOP Signal, the Reactor and Unit will Trip.

.2 The SISLOP also initiates the starting of the Emergency Diesel Generators.

.3 A SISLOP signal will result in tripping 4160 V and 480 V loads.

.4 The SISLOP will place the Emergency Diesel Generators online by automatically closing the output breakers when rated voltage and frequency are reached and initiates load sequencing as described in 2.3.2 and 3.5.2.

3.5.2 Load Sequencing (See Figure 7)

Load sequencing will be initiated automatically, as soon as the Emergency Diesel Generators are online. The Safety Injection loads will be sequentially actuated in groups as specified below. During load sequencing, the operator will not be able to select the loads. Manual load selection may resume, up to 4725 Kw, when sequencing is completed and the Sequencers are reset by the operator.

SAFEGUARD LOAD SEQUENCING SYSTEM

3.0 OPERATION (Continued)

3.5.2 Load Sequencing (See Figure 7) (Continued)

.1 Load Group A - Time 0 secs. - This load group performs its function immediately and it is not connected to any timing circuitry.

NOTE: There is a 10 second allowance for the Diesel Generators to reach rated volts and frequency before 3.5.3.2, 3, 4 & 5 can take place.

.2 Load Group B - Time 11 secs. - This Load Group is designed to come on one second after the Diesel Generator has reached proper speed and voltage with the Diesel Generator Output Breaker closed.

.3 Load Group C - Time 12 secs. - This Load Group is designed to come on 2 secs. after the Diesel Generator Output Breaker is closed to limit the starting current strain on the Diesel Generators.

.4 Load Group D - Time 21 secs. - This Load Group is designed to come on 11 secs. after the Diesel Generator Output Breaker is closed to limit the starting current strain on the Diesel Generator.

.5 Load Groups E and F are spares and are not used.

3.6 Safety Injection with Safety Injection Signals (SIS) Returning to Normal, Followed by Loss of Offsite Power from 220 kV System (See Figures 3 and 4)

3.6.1 Safety Injection Signal

.1 After reaching their associated setpoints, the Pressurizer Pressure or Containment Pressure initiate Safety Injection and the Sequencer functions normally as in 3.2 above.

.2 If Pressurizer Pressure and/or Containment Pressure return to normal levels or fluctuate about their Safety Injection setpoints, the Safety Injection System will continue to function normally (unless reset and rearmed).

Once reset by the Operator, SI would reactivate if armed and the setpoint is reached.

3.0 OPERATION (Continued)

3.6.2 Loss of Power Signal

.1 A Loss of Power signal following actuation of normal SIS results in Sequencer operation as if a simultaneous Safety Injection System and Loss of Offsite Power (SISLOP) has occurred as in 3.5 above.

.2 If the Sequencers have been Reset by the operator after Safety Injection initiation but prior to the occurrence of the Loss of Offsite Power, and Pressurizer Pressure or Containment Pressure are restored to normal, the Sequencer will operate as if Loss of Offsite Power (LOP) only had occurred.

3.7 Safety Injection Followed by Safety Injection Block Initiation Followed by Loss of Offsite Power from 220 kV System (See Figures 3 and 4)

3.7.1 Safety Injection Signal

.1 After reaching their associated setpoints, the Pressurizer Pressure or Containment Pressure initiates Safety Injection. The Sequencer functions normally as in 3.2 above.

.2 After Safety Injection initiation, the Sequencer Safety Injection Block Signal is initiated per station procedures. The Safety Injection System will continue to function normally.

3.7.2 Loss of Power Signal

.1 Upon occurrence of a Loss of Offsite Power, the Sequencer will neglect the Safety Injection Block and operate as if a simultaneous Safety Injection Signal and Loss of Offsite Power (SISLOP) had occurred.

3.8 De-energizing and Energizing the Sequencer

3.8.1 De-energizing the Sequencer(s)

The Sequencer(s) are normally de-energized by opening both Subchannel Y power supply breakers and then opening both Subchannel X power supply breakers. This allows the Sequencer(s) to be properly re-energized as described below.

The Sequencer(s) can also be de-energized by opening the main power breaker at the appropriate 125 VDC Panel, however, if this is done the individual breakers should then be opened to prevent an inadvertent SIS actuation when the main breaker is reclosed.

3.0 OPERATION (Continued)

3.8.2 Energizing the Sequencer(s)

When Subchannels X and Y, for each Sequencer, are energized they may be in a TRIPPED condition, therefore failure to properly energize or failure to Reset the Tripped condition as required may result in an advertent SIS actuation.

Sequencer 1 is energized by first verifying that both Subchannel X power supply breakers are open and that both Subchannel Y power supply breakers are open and then closing the 125VDC main power supply breaker. Subchannel Y is energized by closing both power supply breakers, then Subchannel Y is Reset to remove any Trip condition. Subchannel X is now energized by closing both power supply breakers, then Subchannel X is Reset to remove any Trip condition.

Sequencer 2 is energized in the same manner as Sequencer 1.

When actually performing the above, the LED's in the Card Rack and the annunciators in the Main Control Room should be checked to verify proper system indications.

4.0 REFERENCES

4.1 Elementaries

4.1.1 5149180, Sequencer Logic Diagram
1542 Sheet 137M

4.1.2 5149957, Safety Injection Sequencer No.1
1542 Sheet 139

4.1.3 5150875, Safety Injection, Sequencer No. 2
1542 Sheet 137A

4.1.4 5149170, Load Sequence Schedule Load Train No. 1
1542 Sheet 140

4.1.5 5149179, Load Sequence Schedule Load Train No. 1
1542 Sheet 141

4.1.6 5149181, Load Sequence Schedule Load Train No. 2
1542 Sheet 143

4.1.7 5149182, Load Sequence Schedule Load Train No. 2
1542 Sheet 144

4.1.8 5150158, SIS/SP Lockout Relays
1545 Sheet 54

4.0 REFERENCES (Continued)

4.1 Elementaries (Continued)

4.1.9 5102173, 125 VDC System No. 1
1540 Sheet 17

4.1.10 5149348, 125 VDC System No. 2
1540 Sheet 17B

4.2 Technical Manuals

4.2.1 Consolidated Controls Corp. Technical Manual 9N33, Safeguard Load Sequencing System

4.3 Procedures

4.3.1 S01-4-17, Safety Injection System Operations

4.3.2 S01-1.0-12, SI Termination following Spurious SI

4.3.3 S01-1.0-21, SI Termination following Loss of Reactor Coolant

4.3.4 S01-1.0-31, SI Termination following Loss of Secondary Coolant

4.3.5 S01-3-1, Plant Startup from Cold Shutdown to Hot Standby

4.3.6 S01-3-5, Plant Shutdown from Hot Standby to Cold Shutdown

4.3.7 S01-12.0-4, Operations Surveillance Requirements for Mode Changes

4.3.8 S01-12.3-7, Monthly Sequencer Test

4.3.9 S01-13-5, Permissive Information Display Annunciator

4.3.10 S01-13-6, Reactor Plant First-Out Annunciator

4.3.11 S01-13-7, Reactor Plant Matrix Partial Trip Annunciator

4.3.12 S01-13-10, Electrical Annunciator

4.4 Technical Specifications

4.4.1 Section 3.5.5

4.4.2 Section 4.1.4

4.4.3 Section 3.7.I.A.5

4.4.4 Section 4.4.E and F

FIGURE 12: INPUT BUFFER CARD

(Slots 1-6, 9-14 Upper Row)

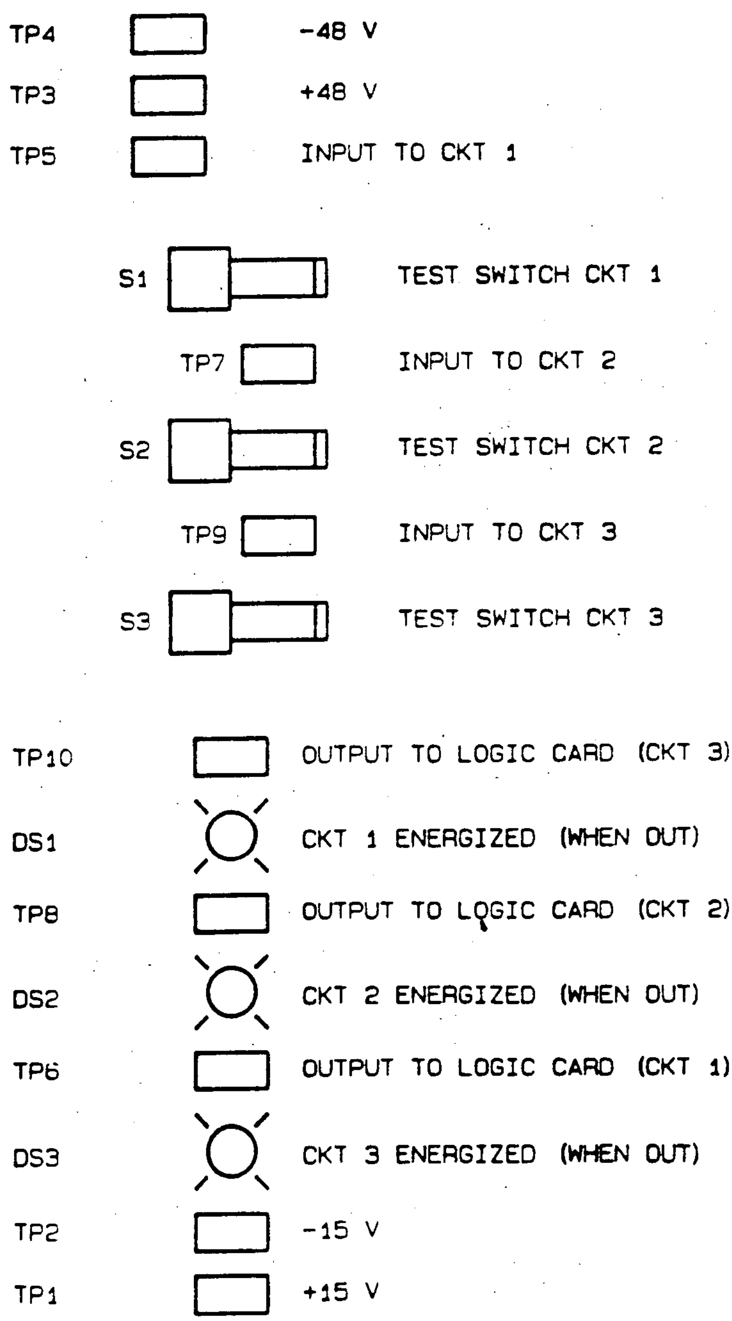
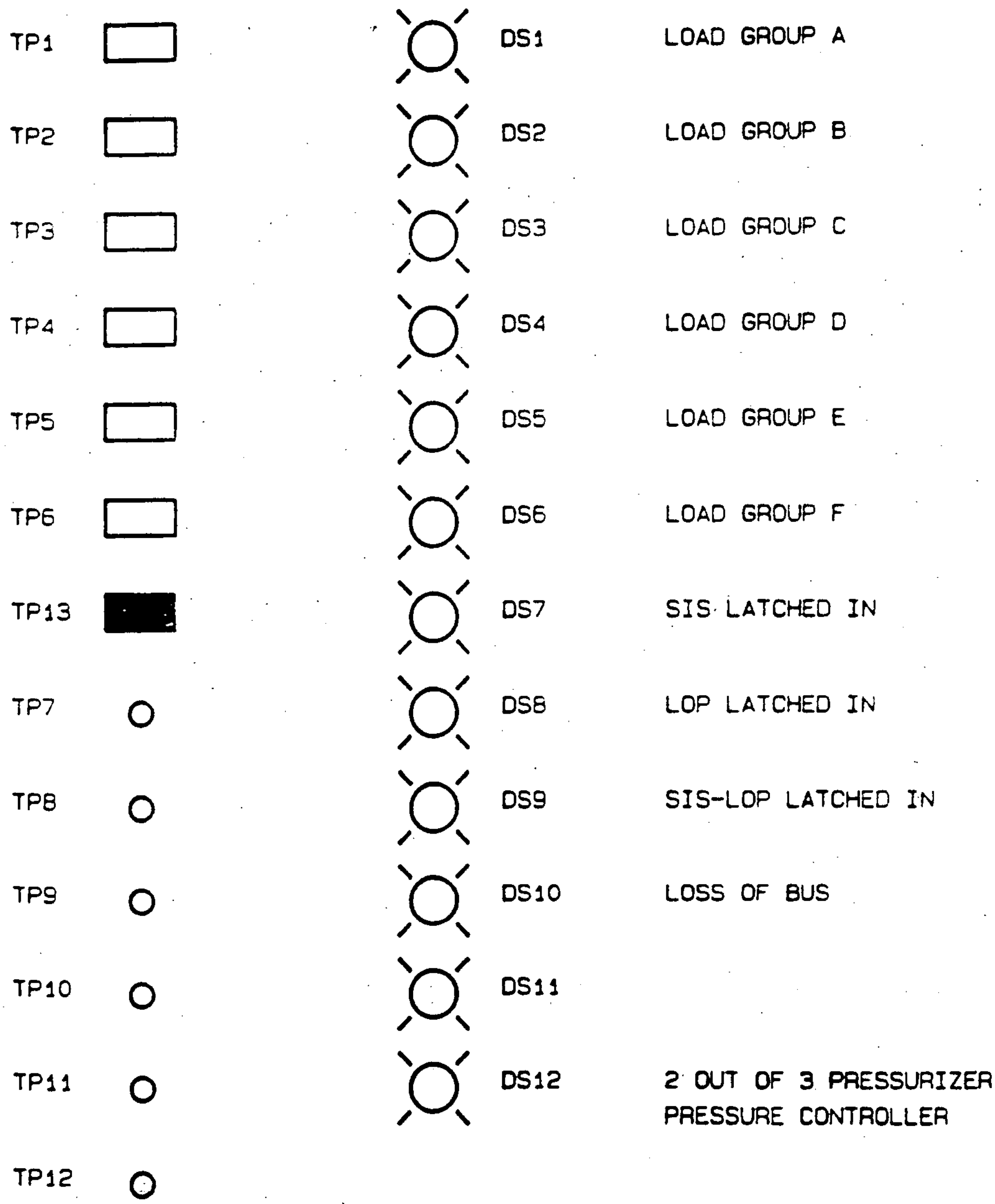


FIGURE 13: LOGIC CARD

(Slots 7 and 15 Upper Row)



NOTES:
1. TP-13 IS COMMON (NEGATIVE)
2. THIS IS A TEST POINT STUD
3. THIS IS A TEST POINT JACK
4. THIS IS AN LED

FIGURE 14: RELAY DRIVER CARD

(Slots 8 and 16 Upper Row, Slots 1-16 Lower Row)

TP2	-48 V
TP1	+48 V
TP16	OUTPUT SIGNAL TO RELAY CKT
TP13	OUTPUT SIGNAL TO RELAY CKT
TP10	OUTPUT SIGNAL TO RELAY CKT
TP7	OUTPUT SIGNAL TO RELAY CKT
TP15	OUTPUT SIGNAL OF U1 CKT
TP14	INPUT SIGNAL CKT
TP12	OUTPUT SIGNAL OF U1 CKT
TP11	INPUT SIGNAL CKT
TP9	OUTPUT SIGNAL OF U1 CKT
TP8	INPUT SIGNAL CKT
TP6	OUTPUT SIGNAL OF U1 CKT
TP5	INPUT SIGNAL CKT
TP3	+15 V
TP4	-15 V

NOTES: 1. THIS IS A TEST POINT JACK

APPENDIX A

SAFEGUARD LOAD SEQUENCING SYSTEM SIGNALS

Inputs to each Sequencer

.1 Pressurizer Pressure

a.

Sequencer No. 1	Sequencer No. 2
PC-430G	PC-3000A
PC-431E	PC-3000B
PC-432C	PC-3000C

.2 Containment Pressure

PC-1120A	PC-1121A
PC-1120B	PC-1121B
PC-1120C	PC-1121C

.3 Undervoltage Signal from 4160 V Bus 1C and 4160 V Bus 2C.

.4 Safety Injection Block

.5 Emergency Diesel Generation "Voltage Frequency Signal" and "Output Breaker Position Signal"

.6 Test Switch

Sequencers 1 and 2 output to:

.1 4160 V Breakers

.2 480 V Breakers

.3 480 V Motor Control Centers

.4 Lockout Relays

.5 Emergency Diesel Generators

.6 Safety Injection System

.7 Containment Spray System

.8 Containment Isolation System

APPENDIX B

SAFEGUARD LOAD SEQUENCING SYSTEM ALARMS

PERMISSIVE ANNUNCIATOR ALARMS

WINDOW NAME (Number)	INPUT	SETPOINT
S.I. Block Permissive LO Pressure Channel I, II, III (13, 14, 15)	2 out of 3 Pressurizer Pressure Transmitters	$\leq$ 1900 psig
Automatic Safety Injection "A", "B" Circuit Blocked (9, 10)	Safety Injection Block Switch	Switch in "BLOCK" position

REACTOR PLANT FIRST OUT ANNUNCIATOR ALARMS

WINDOW NAME (Number)	INPUT	SETPOINT
Safety Injection (2)	2 out of 3 Pressurizer Pressure Transmitters OR 2 out of 3 Containment Pressure Transmitters	$\leq$ 1735 psig OR 1.4 psig
Alert Block Auto Safety Injection (36)	2 out of 3 Pressurizer Pressure Transmitters	$\leq$ 1800 psig

APPENDIX B

SAFEGUARD LOAD SEQUENCING SYSTEM ALARMS

(Continued)

REACTOR PLANT MATRIX PARTIAL TRIP ANNUNCIATOR ALARMS

WINDOW NAME (Number)	INPUT	SETPOINT
Pressurizer LO Pressure Safety Injection Train A, B Channel I (14, 4)	PT-430G, PT-3000A	≤ 1735 psig
Pressurizer LO Pressure Safety Injection Train A, B Channel II (15, 5)	PT-431E, PT-3000B	≤ 1735 psig
Pressurizer LO Pressure Safety Injection Train A, B Channel III (16, 6)	PT-432C, PT-3000C	≤ 1735 psig

ELECTRICAL ANNUNCIATOR ALARMS

WINDOW NAME (Number)	INPUT	SETPOINT
Sequencer In Test (36)	NORMAL/TEST Toggle Switch	Switch in TEST
Sequencer Cooling Fan Power Failure (33)	K1-S02 & S03	Loss of Power to Either Cooling Fan
Sequencer Power Supply Trouble (35)	Sequencer 1 or 2 Power	Loss of Power in or to Sequencer 1 or 2

APPENDIX C

DEVELOPMENTAL RESOURCES

Elementaries

5149180, Sequencer Logic Diagram
1542 Sheet 137M

5149957, Safety Injection Sequencer No.1
1542 Sheet 139

5150875, Safety Injection, Sequencer No. 2
1542 Sheet 137A

5149170, Load Sequence Schedule Load Train No. 1
1542 Sheet 140

5149179, Load Sequence Schedule Load Train No. 1
1542 Sheet 141

5149181, Load Sequence Schedule Load Train No. 2
1542 Sheet 143

5149182, Load Sequence Schedule Load Train No. 2
1542 Sheet 144

5150158, SIS/SP Lockout Relays
1545 Sheet 54

5102173, 125 VDC System No. 1
1540 Sheet 17

5149348, 125 VDC System No. 2
1540 Sheet 17B

Technical Manuals

Consolidated Controls Corp. Technical Manual 9N33, Safegurad Load Sequencing System.

Procedures

SO1-4-17, Safety Injection System Operations

SO1-1.0-12, SI Termination following Spurious SI

SO1-1.0-21, SI Termination following Loss of Reactor Coolant

SO1-1.0-31, SI Termination following Loss of Secondary Coolant

SO1-3-1, Plant Startup from Cold Shutdown to Hot Standby

SO1-3-5, Plant Shutdown from Hot Standby to Cold Shutdown

APPENDIX C
DEVELOPMENTAL RESOURCES
(Continued)

Procedures

S01-12.0-4, Operations Surveillance Requirements for Mode Changes

S01-12.3-7, Monthly Sequencer Test

S01-13-5, Permissive Information Display Annunciator

S01-13-6, Reactor Plant First-Out Annunciator

S01-13-7, Reactor Plant Matrix Partial Trip Annunciator

S01-13-10, Electrical Annunciator

Technical Specifications

Section 3.5.5

Section 4.1.4

Section 3.7.1.A.5

Section 4.4.E and F

Others

Final Safety Analysis Report

Student Handout for Safeguard Load Sequencing System

Study Guide 18, Safeguard Load Sequencing System

CONTAINMENT ISOLATION

Drawing No.	Title
5178110	Reactor Coolant Pump Seal Water System
5178111	Reactor Coolant Pump Seal Water System
5178115	Safety Injection System
5178120	Containment Spray & Recirculation System
5178130	Letdown & Residual Heat Removal Systems
5178135	Volume Control & Charging System
5178136	Volume Control & Charging System
5178140	Letdown Demineralizer System
5178150	Reactor Cycle Sampling System
5178158	Radwaste Liquid Collection System
5178205	Feedwater System
5178206	Feedwater System
5178220	Auxiliary Feedwater System
5178221	Auxiliary Feedwater System
5178225	Main Steam System
5178260	Feedwater Sampling System
5178270	Secondary Chemical Feed System
5178320	Turbine Plant Cooling Water System
5178370	Primary Plant Make-up Water System
5178381	Service & Domestic Water System
5178400	Gaseous Nitrogen System
5178402	Gaseous Nitrogen System
5178404	Gaseous Nitrogen System
5178405	Gaseous Nitrogen System
5178442	Instrument & Service Air System
5178444	Instrument & Service Air System
5178449	Instrument & Service Air System
5178600	Containment Ventilation System
5178601	Containment Ventilation System
SD-SO1-630	System Desc - Containment & Containment Isolation

CONTAINMENT AND CONTAINMENT ISOLATION SYSTEM

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This System Description is approved per SO123-0-44, System Description Revision and Approval. Contact CDM to verify revision information.

PREPARED BY: Dale Riffey for Art Morris — Author — 12/6/85 — Date

APPROVED BY: [signature] — Manager, Operations — 12/6/85 — Date

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CONTAINMENT AND CONTAINMENT ISOLATION SYSTEM

1.0 FUNCTIONS/DESIGN BASES

1.1 Main Function:

The main function of the containment at SONGS Unit 1 is to protect the health and welfare of the general public by creating a barrier to the release of radioactive materials and by limiting radiation dose rates coming from the facility to within applicable limits.

1.2 Additional Functions:

1.2.1 Limit radiation dose rate to personnel inside of the Sphere.

Radiation shielding is provided within the Sphere limiting the radiation dose rate to personnel to within the limits of 10CFR20 (Standards For Protection Against Radiation); such that access to the Sphere is allowed in all modes of reactor operation. (see Section 2.2.5, Personnel Access).

1.2.2 Provide Reactor Coolant System (RCS) leak detection capabilities.

RCS leakage monitoring is provided by the Sphere HVAC and liquid radioactive waste collection system. For a discussion of RCS leak detection see the following system descriptions:

- ORMS SD-SO1-550
- RCS SD-SO1-280
- HVAC System SD-SO1-450

1.3 Design Basis:

Containment and associated systems shall provide an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and assure that the containment design pressure, temperature and leakage are not exceeded during the design basis Loss-of-Coolant Accident (LOCA).

The leakage and direct radiation exposure from containment during the worst accident cannot expose the general public to more than 25 REM whole body dose and no more than 300 REM thyroid dose (from radioactive Iodine) in the following two exposure areas:

1.0 FUNCTIONS/DESIGN BASES (Continued)

1.3 Design Basis (Continued)

1) Standing at the boundary of the area surrounding the reactor which is directly controlled by SCE, for two hours (Exclusion Area limit)

- and -

2) Standing at the boundary of the area surrounding the reactor which is not directly controlled by SCE but can be reasonably evacuated, for the entire period of the release of radioactivity (Low Population Zone limit).

2.0 DESCRIPTION (Continued)

2.1 Overview

The containment is referred to as the last barrier for the release of radioactive material to the environment. The other three barriers, the fuel pellet, the fuel cladding and the Reactor Coolant System (RCS) are all within the containment.

The containment at SONGS Unit One consists of a steel sphere which, along with the containment process line isolation system, is the barrier to the release of radioactive material; and the concrete Sphere Enclosure Building (SEB) which, with the interior sphere structures, reduces the total whole body penetrating radiation dose rate to the public to within allowable limits.

This system description breaks the containment system into component parts by function. The basis of all design functions is found in Title 10, Code of Federal Regulations (CFR), primarily Part 50, Domestic Licensing of Production Facilities and Part 100, Reactor Site Criteria.

These design functions are defined in the facility FSA and implemented through the Technical Specifications.

This system description contains or references information from the CFRs, the Final Safety Analysis (FSA), and the Technical Specifications required by the reader to understand the Containment System Design.

Containment Integrity:

The implementation of the containment requirements at SONGS Unit 1 is accomplished through adherence to the Technical Specifications. The Technical Specifications strive to maintain a condition of containment integrity. Containment Integrity is defined in the Unit 1 Technical Specifications Section 1, Definitions.

The integrity of containment is of importance when a threat to the barriers to the release of radioactive material is present. The Technical Specifications Section 3.6 defines the plant conditions requiring the integrity of containment.

The variable considered to determine the need for integrity is the extent to which the other barriers to the release of radioactive material are threatened:

- If the threat of an inadvertent criticality is high then the threat to fuel cladding breach is high.

- If the Reactor Coolant System (RCS) pressure is high then the threat to a breach of the RCS boundary is high.

- If the RCS is to be opened for maintenance extra guarantees must be made to keep the fuel cladding and/or the containment intact.

2.0 DESCRIPTION (Continued)

2.1 Overview (Continued)

The Containment and Containment Isolation System (CIS) requirement is as follows:

The containment, including access openings, penetrations, and the heat removal system shall be designed so that the containment and its internal compartments can accommodate, without exceeding the design leakage rate, the calculated pressure and temperature conditions resulting from any (LOCA). This margin shall reflect consideration of the effects of all credible energy sources.

This criteria contains the following major elements:

2.1.1 **The Containment Structure**

The containment structure at SONGS Unit 1 consists of the Sphere Enclosure Building (SEB) and the Sphere.

This system description covers the containment structure in two component parts.

- SEB
- Sphere - including internal shielding

2.1.2 **The Containment Penetrations**

The containment penetrations at SONGS Unit 1 is pertinent to the Sphere only.

This system description presents containment (Sphere) penetrations in four component parts:

- Piping penetrations
- Containment isolation valves - including the CIS control panel
- Sphere electrical penetrations
- Personnel access penetrations

2.0 DESCRIPTION (Continued)

2.1.3 **General Control Scheme** (see Table 1 for Sphere isolation valve requirements)

Those containment isolation valves required to close automatically receive a signal from the Emergency Safeguards Feature, Containment Isolation logic scheme (see Figure 5). The Containment Isolation signal is initiated from either:

- A Safety Injection Signal (SIS)
- A containment pressure of $\geq$ 1.4 psig as sensed on at least two of the three Sphere pressure detectors.
- Manual pushbutton operation from the Control Board

For redundancy the CIS is divided into two trains; Train A or F and Train B or G, each train has a separate power supply.

2.0 DESCRIPTION (Continued)

2.2 Components

The following components of the Containment and Containment Isolation System will be presented in this section:

- Containment structure
  - SEB
  - Sphere
- Sphere piping penetrations
- Containment isolation valves and CIS control panel
- Sphere electrical penetrations
- Personnel access penetrations

All other components of the containment and containment isolation systems are covered in Section 2.1 of this system description or are covered in these other system descriptions:

- Safety Injection and Containment Spray System SD-SO1-500
- Operational Radiation Monitoring System SD-SO1-550
- Area Radiation Monitoring System SD-SO1-540
- Reactor Coolant System SD-SO1-280
- Component Cooling System SD-SO1-330
- Hydrogen Monitoring and Recombiner System SD-SO1-670
- HVAC System SD-SO1-450
- Turbine Plant Cooling Water System SD-SO1-500
- Fuel Transfer, Handling and Storage System SD-SO1-350
- Cathodic Protection System SD-SO1-490
- Meteorological Systems/Seismic SD-SO1-440

2.0 DESCRIPTION (Continued)

2.2.1 Containment Structure - Sphere Enclosure Building (SEB)

SPHERE ENCLOSURE BUILDING (SEB)	
PURPOSE:	Biological shield, reducing radiaion dose rates to the general public to within design limits.
DIMENSIONS:	Cyl radius = 72'6" Height = 114'8" Wall Thickness = 3' min. Arched composite roof thickness 1½' min.
MATERIAL OF CONSTRUCTION:	Reinforced concrete
DESIGN PRESSURE:	Open to atmosphere

The SEB, a Seismic Category A, reinforced concrete structure, surrounding the Sphere.

The cylindrical wall is continuous except for openings from grade to elevation 54 to accommodate the turbine deck and from grade to elevation 40 to accommodate the piping penetration building. Smaller penetration openings are provided for electrical cable, piping, and the personnel access lock. The wall is continuous from elevation 54 to elevation 105. At elevation 105 a ring girder is provided for roof support.

Also included in the SEB design are the building auxiliary systems. These systems, which have no safety function, include two supply and two exhaust fans for ventilation, lighting, fire detection, fire protection, cathodic protections, and grounding systems.

The purpose of the SEB is to attenuate post-accident direct radiation dose rates. Since the building is open to atmosphere, it does not function to contain or reduce post-accident pressure temperature, or radioactivity release. The SEB functions to mitigate dose rates at the exclusion area boundary and low population zone to less than 10CFR100 limits (defined in Section 1.3 Design Basis).

2.0 DESCRIPTION (Continued)

2.2.1 Containment Structure - Sphere

SPHERE	
PURPOSE:	See Main and Additional Functions Sections 1.1 and 1.2
DIMENSIONS:	140 ft. DIA (40 ft below grade) 1" thick
*DESIGN PRESSURE:	53.3 psig 2.0 psig vacuum
*DESIGN TEMPERATURE:	391.5°F (200°F max. temp. rise)
*CALCULATED ACCIDENT PRESSURES:	46.0 psig LOCA 51.0 psig secondary break 1.7 psig vacuum
OPERATING PRESSURE LIMIT:	0.4 psig
MATERIAL OF CONSTRUCTION:	ASME SA212 carbon-silicon Grade B steel of fire box quality
GROSS VOLUME:	1.44×10^6 ft^3
FREE VOLUME:	1.21×10^6 ft^3

* See letter from K. P. Baskin (SCE) to A. Schwencer (NRC) dated 1/19/77, "Containment Post-Accident Pressure Reanalysis".

The Sphere, enclosing the nuclear reactor and its related equipment, is designed to contain any accidental release of radioactivity from the reactor coolant system. The Sphere is the final barrier that guards against release of significant quantities of fission products and upon which reliance is placed under the conditions of maximum potential release (i.e., the hypothetical condition of major rupture of the reactor coolant system and gross failure of the fuel and fuel cladding).

The Sphere is designed to accommodate, without exceeding design leakage, those pressures and temperatures resulting from the largest credible energy release following a LOCA or steam break accident.

The Sphere and interior shielding (see Section 2.2.5 and Figure 6) are designed to limit the dose rate outside the Sphere to less than 1 mr/hr with the unit at full power.

2.0 DESCRIPTION (Continued)

2.2.1 Containment Structure - Sphere (Continued)

The bottom of the Sphere is protected to preclude contact between the metal Sphere and ground water. In addition, corrosion protection is provided by a cathodic protection system (see SD-S01-490, Cathodic Protection System).

Missile protection is provided by the Sphere interior structures such that any missile generated by the high pressure systems or components within the Sphere will not damage the Sphere itself or any of the safety related equipment within the Sphere.

The missile protection consists of three parts: (see Figure 6)

- An annular six foot thick concrete primary shield surrounding the reactor vessel.
- A two foot thick concrete and one inch thick steel slab missile shield located above the reactor vessel head. This shield protects the Sphere from missiles created by reactor control rod ejection and reactor vessel head bolt failure.
- A one and one-half foot thich concrete auxiliary shield located adjacent and perpendicular to the slab missile shield above the reactor vessel. The auxiliary shield is south of the reactor vessel.

Sphere systems annunicators can be found in Appendix A.

Sphere instrumentation can be found in Appendix C.

2.2.2 Sphere Piping Penetrations (see Tables 1 and 2)

Sphere penetration requirements:

Piping systems penetrating the Sphere are to be provided with leak detection, isolation, and containment capabilities, and have redundancy, reliability, and performance capabilities which reflect the importance to safety of isolating these piping systems.

The piping penetrations are defined at SONGS Unit 1 by first grouping the types of Sphere penetrations as follows:

- Group A. Lines which penetrate the Sphere and normally carry radioactive fluids shall have two valves in series, one of which will be located within the Sphere and the other outside the Sphere shell. These valves shall be remotely operated whenever necessary to prevent outward flow in the event of an accident.

2.0 DESCRIPTION (Continued)

2.2.2 **Sphere Piping Penetrations (see Tables 1 and 2)** (Continued)

Incoming lines will be provided with a check valve inside the Sphere and will be either backed up with a closed piping system outside the Sphere or by a remotely operated valve, if necessary.

- Group B. Lines which penetrate the Sphere and open to the free volume of the Sphere have two valves in series to prevent outward flow in the event of an accident. One valve closes automatically, the other can be closed from the control room.

- Group C. Lines which penetrate the Sphere and open to the turbine cycle are equipped with one isolation valve. In the main steam lines, the turbine stop valves serve this purpose.

- Group D. Lines which penetrate the free volume of the Sphere but which are normally closed during operation of the reactor are equipped with a single isolation valve. Depending on the service, a lock, interlock or operating procedures ensure that these valves are closed whenever the integrity of the Sphere is required. The ventilation penetrations are included in this category.

The following notes pertain to the above penetration groups:

NOTES: 1. Lines which enter and leave the Sphere but are not open to the Sphere free volume or the outside atmoSphere may not be provided with isolation valves. These lines are either part of separate, closed systems or are not subject to damage as a result of a LOCA.

2. Safety injection lines must remain open in the event of an accident.

SONGS Unit 1 uses six different types of piping penetrations to the Sphere.

- Type A - Cold Process Line Penetration

Type A penetration is used for all cold process lines. Cold process lines are uninsulated carbon steel pipes which contain fluids at temperatures between 50°F and 200°F. Piping in this temperature range will not cause appreciable temperature stresses at the penetrations.

2.0 DESCRIPTION (Continued)

2.2.2 **Sphere Piping Penetrations (see Tables 1 and 2)** (Continued)

- Type B - Austenitic Stainless Steel Pipe Penetrations

  The type B Sphere penetration is used for all stainless steel process lines, hot or cold. The process piping passes through a sleeve in the Sphere wall which is designed to withstand the cyclic stress conditions resulting from movements imposed by the corresponding piping system.

- Type C - Hot Process Line Penetrations

  The type C penetrations are used for hot process lines operated above 200°F. The type C penetration is designed, constructed, and tested in the same manner as the type B penetration except that the process line is carbon steel.

- Type D - Main Steam Line Penetration

  Type D penetration through the Sphere is accomplished by means of a bellows-type expansion joint which provides a flexible penetration through the Sphere.

- Type E - Sphere Ventilation Line Penetrations

  The type E penetrations are used for the Sphere ventilation pipes. The ventilation pipe spools containing the necessary valves and expansion joints are bolted to the penetration sections in the Sphere wall.

- Type F - Spent Fuel Transfer Tube

  The spent fuel transfer tube penetrates the Sphere through a sleeve provided in the Sphere wall. The end of the spent fuel transfer tube inside the Sphere is sealed with a blind flange which is equipped with leak test provisions to monitor the integrity of the seal.

The following notes pertain to the above penetration types.

NOTES: 1. The Sphere ventilation purge valves are required to be isolated under locked control in Modes 1 through 4 of plant operations (see Technical Specifications Section 1.0, Table 1.2 for Operating Modes).

2. For the main steam lines a turbine trip signal is relied upon to isolate containment since the turbine stop and control valves are considered as containment isolation valves.

2.0 DESCRIPTION (Continued)

2.2.3 Containment (Sphere) Isolation Valves and Control Panel

All of the containment (Sphere) isolation valves and actuators, located on specific lines penetrating the Sphere, are standard types except for two actuators; the Contromatic-pneumatic and the Paul-Monroe- pneumatic-hydraulic valve actuators. Both of these actuators are found on ball type valves and are described here. (see Table 1 for specific valve/penetration application).

CONTROMATIC VALVE (Figure 3)	
PURPOSE:	To operate containment isolation ball type valves providing a passive spring driven "fail-safe" valve closure stroke.
OPERATOR TYPE:	Air open - spring close
SIZE:	on lines of 2" or less
CONTROL:	Solenoid operated 3-way valve on the instrument air supply lines

Contromatic-valve actuator (see Figure 3):

The actuator consists of a body, one long cylinder (the spring side), one short cylinder (on the pneumatic side), a piston for each cylinder, a connecting rod, and a lever which turns the valve stem when operated by the connecting rod.

The connecting rod is common to both pistons. On the connecting rod are two small tabs or "sliding blocks" which run in slots in the lever. As the connecting rod moves back and forth the lever will turn the valve stem as shown in Figure 3.

Actuator Operation:

- The actuator is air operated in the non-safeguards direction by energizing the solenoid valve admitting instrument air to the short cylinder, stroking the actuator and compressing the spring.

- The actuator strokes to the safeguards position when the solenoid valve is de-energized and air is vented from the short cylinder, the spring forces the valve to stroke.

As installed, all Contromatic valves are spring closed on either a loss of control power or loss of instrument air pressure.

2.0 DESCRIPTION (Continued)

2.2.3 Containment (Sphere) Isolation Valves and Control Panel (Continued)

PAUL-MONROE VALVES (Figure 4)

PURPOSE:	To operate safeguards valves and containment isolation valves, providing a passive, oil accumulator driven, "fail-safe" valve stroke
OPERATOR TYPE:	Hydraulic
SIZE:	2" to 8" valves
CONTROL:	Solenoid hydraulic actuated system for: Non-safeguards movement - hydraulic pressure is supplied by an air-driven oil pump. Safeguards movement - hydraulic pressure is supplied by a N_2 preloaded accumulator.

Paul Monroe pneumatic-hydraulic valve actuators (See Figure 4)

The Paul Monroe pneumatic-hydraulic actuator is a self-contained unit consisting of a valve actuating cylinder, a rack-and-pinion valve driver, an instrument air driven hydraulic pump, an air supply air pilot switch, a solenoid actuating valve, a 1400 psig N_2 preloaded accumulator (for fail-safe operations), a filter, piping and miscellaneous valves to complete the system.

Actuator Operation:

- The operating sequence for valve stroke to the non-safeguards position is as follows:
  - The solenoid valve is energized (closed) and the hydraulic pump is started when low pressure is sensed by the air pilot switch.
  - The hydraulic pump draws oil from the reservoir and pumps oil through the filter, ball check and flow control valve to the rotary actuator.
  - As the rotary actuator strokes to the non-safeguards position oil is forced into the nitrogen loaded accumulator at the upper right of Figure 4, preparing the valve for a passive (no power) valve stroke.

    To maintain the valve in the non-safeguards position the hydraulic pump cycles to maintain hydraulic pressure between 2700 and 2800 psig.

2.0 DESCRIPTION (Continued)

2.2.3 **Containment Isolation Valves and Control Panel** (Continued)

- The operating sequence for valve stroke to the safeguards (fail-safe) position is as follows:

  - The solenoid valve is de-energized (opened) to port oil from the non-safeguards side of the rotary actuator through the flow control valve to the reservoir.

    The flow control valve is adjusted to allow a 10 to 30 second stroke time.

  - Oil from the nitrogen loaded accumulator provides the motive force to position the actuator to the safeguards position.

    The hydraulic pump is prevented from continuous operation during this fail-safe stroke by a solenoid in the air supply line to the hydraulic pump air motor.

    Accumulator low pressure is annunciated on the Auxiliary Feed Water Panel at 1060 to 1600 psi depending on the actuator type (see Appendix A, Annunciator Listing).

As installed all Paul-Monroe valve's fail-safe position is closed except CV-737A and B-CCW to the recirculation HXs. (See SD-S01-330 CCW System for details.)

.1 **Containment Isolation System Control Panel (CIS Panel) (Figures 1 and 2)**

The CIS panels are located in the Control Room on the Control Board, North Vertical Board (NVB) East end. There are two panels located together. One panel is for Train A (upper) and one is for Train B (lower).

The following controls are available on the CIS panel:

- Open and close pushbuttons for valves associated with the containment isolation system

- Manual CIS initiate pushbuttons, one for each train.

- Reset pushbuttons, one for each train.

- Override pushbuttons, eleven for Train A and nine for Train B.

2.0 DESCRIPTION (Continued)

2.2.3.1 **Containment Isolation System Control Panel (CIS Panel) (Figures 1 and 2)** (Continued)

The following indication are available on the CIS panel:

- Open valve indications, red lights illuminated in associated open pushbutton
- Close valve indications, green lights illuminated in associated close pushbutton
- White mounting barriers on pushbuttons indicate the associated valve is located outside the Sphere
- Black mounting barriers on pushbuttons indicate the associated valve is located inside the Sphere
- Gray mounting barriers indicate the pushbutton is a control function such as reset, override or initiate.
- CIS Relay Failure light, illuminates red if one of the CIS relays fails. (See Figure 5.)
- Red light illuminated in Override push-button when override condition is actuated.
- Red light illuminated in Initiate push-button when CIS is initiated.
- Green light illuminated in Reset pushbutton when CIS is reset.

Refer to Section 3.0 operations for CIS Panel operating details.

2.2.4 **Sphere Electrical Penetrations**

The high voltage, general power, and control and instrumentation cables required for the operation of the reactor and auxiliary equipment enter the Sphere through Sphere penetration nozzles. The seal between the nozzles and the individual copper conductors is accomplished by the use of canisters which are welded or bolted to the nozzles.

The canisters are cylindrical steel shells with silicone "O" ring internal seals. The canister internals are held in place by pins and retaining rings.

2.0 DESCRIPTION (Continued)

2.2.4 Sphere Electrical Penetrations (Continued)

The electrical conductors penetrate the end plates of the canister through glass seals which are chemically bonded to the plates and the solid electrical conductor pins.

There are forty electrical type penetrations (including spares). The details for these penetrations can be found in the Breaker Book in the Containment Eletrical Penetration section.

The electrical penetrations are equipt with thermal detectors to indicate overheating as part of the station fire detection system (see SD-SO1-460 Fire Protection System).

2.2.5 Personnel Access

To provide personnel access to the Sphere during all modes of operation the Sphere is equipped with two double door Personnel Locks, used when integrity is required; and an Equipment Hatch, used when integrity is not required.

All Sphere access openings have double gasket seals for leak testing.

The Personnel Locks have two doors, such that one door can be left closed at all times if required to assure the integrity of the Sphere (Containment Integrity) (see SO123-0-26 Containment access control for Sphere access control).

The Equipment Hatch, a single 15 foot diameter hatchway, is opened only when the integrity of the Sphere is not required. This large opening is generally required for equipment used during plant outages.

In addition, a four fan Sphere Cooling and Filtration System is provided to reduce airborne radioactivity prior to personnel entry (see SD-SO1-450 Airborne Radioactivity Control HVAC System).

A Sphere purge system is also supplied to purge the Sphere with air from outside the Sphere reducing airborne radioactivity prior to personnel entry (see SD-SO1-450 Airborne Radioactivity Control HVAC System).

Temperature control for personnel habitability in the Sphere is accomplished by the Sphere HVAC systems. (See SD-SO1-450 Airborne Radioactivity Control HVAC Systems).

The last provision to allow access to the Sphere in all operating modes is shielding to reduce direct radiation dose rates to personnel. Shielding for this purpose is divided into two categories; the primary shield and the secondary (see Figure 6).

2.0 DESCRIPTION (Continued)

2.2.5 **Personnel Access** (Continued)

- The primary shield, which circumferentially surrounds the reactor vessel, attenuates radiation from the reactor core to a level which prevents activation of the primary system components during operation, and permits access during plant maintenance periods. The shield is composed of ordinary concrete, with cooling coils, cooled by CCW to prevent excessive heating of the concrete.

- The concrete secondary shield envelops the RCS, RCS loops and pumps, Steam Generators and pressurizer within the Sphere.

  The working floor above the RCS compartment serves as shielding to attenuate radiation during full power operation.

  Shielded penetrations are provided in the primary and secondary shields for piping and instrumentation.

- The missile shield, composed of concrete and steel, above the Reactor Vessel head also reduces the radiation level at the top of the Sphere.

  All shielding is designed to meet the limits of 10CFR20 Standards for Protection Against Radiations.

2.0 DESCRIPTION (Continued)

2.3 Detailed Control Scheme

The only detailed control scheme for Containment and Containment Isolation that is not covered in another system description is the Containment Isolation control scheme. The following is a discussion of containment isolation controls.

A Containment Isolation Signal (CIS) is caused by: (see Figure 5)

- Sphere pressure $\geq$ 1.4 psig.
- Any Safety Injection Signal (SIS)
- Manual pushbuttons on the CIS panel, one for each train of CIS (located on the Control Board (NVB) in the Control Room).

The Containment Isolation System is divided into two trains providing the required redundancy for a safeguards related system. These trains are referred to as Train A or F and Train B or G interchangably.

Power Supplies

A. Train A (F) - Generally powered from 125 VDC Bus 1

B. Train B (G) - Generally powered from 125 VDC Bus 2

When actuated all Containment (Sphere) isolation valves shown on the containment isolation panels (Figures 1 and 2) will close except:

CV 525 & 526 Letdown Line valves (valve inside and outside Sphere)

CV 527 & 528 RCP Seal Water Return valves (valve inside and outside Sphere)

CV 532 Nitrogen to the PORV's (valve outside Sphere)

CV 515 & 516 Turbine Plant Cooling Water (TPCW) supply and return valves (valves outside Sphere)

CV 2145 Charging Line sample valve (valve outside Sphere)

The above eight valves must be closed manually if required.

After initiation of a CIS, manual action is required to open any automatically closed valve (see Section 3.0, Operations for details).

2.0 DESCRIPTION (Continued)

2.4 Power Supplies

Power Supplies for containment isolation valves are as follows:

I. Valves that close on CIS

Actuator Type	Valve No.	Description	*Location	CIS Panel	Bkr
AOV	POV 9	Sphere purge supply	OC	(1)	8-101
AOV	POV 10	Sphere purge exhaust	OC	(1)	8-101
AOV	CV 40	Inst. header vent	IC	(2)	8-3001V
AOV	CV 116	Sphere equalization valve	IC	(2)	8-3001V
AOV	CV 10	Sphere vent	OC	(1)	8-101
AOV	CV 147	ORMS sample supply	IC	(2)	72-221
SV	SV1212-9	ORMS sample supply	OC	(1)	72-123
AOV	CV 146	ORMS sample return	IC	(2)	72-221
SV	SV1212-8	ORMS sample return	OC	(1)	72-123
Contromatic	CV 537	Sphere service water	IC	(1)	72-122
AOV	CV 115	Sphere service water	OC	(2)	72-220
AOV	CV 106	RCDT Vent	IC	(2)	72-221
AOV	CV 107	RCDT Vent	OC	(1)	72-123
AOV	CV 104	RCDT Discharge	IC	(2)	72-221
AOV	CV 105	RCDT Discharge	OC	(1)	72-123
AOV	CV 102	Sphere sump discharge	IC	(1)	72-221
AOV	CV 103	Sphere sump discharge	OC	(2)	72-123
Contromatic	CV 533	Primary make-up	IC	(1)	72-122
Contromatic	CV 534	Primary make-up	OC	(2)	72-220
SV	SV702A	SI Loop 'C' Vent	OC	(2)	8-30021
SV	SV702B	SI Loop 'C' Vent	IC	(1)	8-1112V

* OC outside Sphere
IC inside Sphere

2.0 DESCRIPTION (Continued)

2.4 **Power Supplies** (Continued)

I. Valves that close on CIS
(Continued)

Actuator Type	Valve No.	Description	*Location	CIS Panel	Bkr
SV	SV702C	SI Loop 'B' Vent	OC	(2)	8-3002V
SV	SV702D	SI Loop 'B' Vent	IC	(1)	8-1112V
Contromatic	CV 535	N_2 to Drain Tank	OC	(2)	72-221
Contromatic	CV 536	N_2 to Drain Tank	IC	(1)	72-123
SV	SV 2004	H_2 Calib. Gas	OC	(1)	8-2210V
SV	SV 3004	H_2 Calib. Gas	IC	(2)	8-2905V
SV	SV 125	Sphere Service Air	OC	(1)	72-123
SV	SV 119	SG 'A' Steam Spl.	OC	(1)	72-123
SV	SV 120	SG 'B' Steam Spl.	OC	(1)	72-123
SV	SV 121	SG 'C' Steam Spl.	OC	(1)	72-123
SV	SV 122	SG 'B' Blowdown Spl.	OC	(1)	72-123
SV	SV 123	SG 'A' Blowdown Spl.	OC	(1)	72-123
SV	SV 124	SG 'C' Blowdown Spl.	OC	(1)	72-123
AOV	CV 992	PZR Sample	OC	(2)	8-3001V
AOV	CV 949	PRT Gas Sample	OC	(2)	8-3001V
SV	SV 3302	PASS RC Loop Sample	IC	(2)	
SV	SV 3303	PASS RC Returns Line	OC	(2)	8-3003V
AOV	CV 957	Aux Cooling (RHR) Sample	OC	(2)	8-3001V

* OC outside Sphere
IC inside Sphere

2.0 DESCRIPTION (Continued)

2.4 Power Supplies (Continued)

II. Valves that do not close on a CIS

A. Valves that are indicated on the CIS panel

Actuator Type	Valve No.	Description	*Location	CIS Panel	Bkr
P.M. P/H	CV 515	TCW out	OC	(1)	8-1114V
P.M. P/H	CV 516	TCW In	OC	(2)	8-2909V
P.M. P/H	CV 525	Letdown	IC	(1)	8-1111V
P.M. P/H	CV 526	Letdown	OC	(2)	8-2909
P.M. P/H	CV 527	Seal Water Return	IC	(1)	8-1111V
P.M. P/H	CV 528	Seal Water Return	OC	(2)	8-2909V
SV	CV 2145	Charging Line Sample	OC	(2)	8-3004
Contromatic	CV 532	PZR PORV N_2	OC	(2)	72-220

B. Valves that are not indicated on the CIS panel

Actuator Type	Valve No.	Description	*Location	Bkr
AOV	CV 951	PZR Liquid Spl	IC	8-3311V
AOV	CV 953	PZR Vapor Spl	IC	8-3311V
AOV	CV 948	PZR Gas Spl	IC	8-3311V
AOV	CV 955	RCS Loop Spl	IC	8-3314V
AOV	CV 956	RCS Loop Spl	IC	8-3314V
AOV	CV 962	RHR Sample	IC	8-3311V
AOV	FCV 1112	Charging	OC	72-130
AOV	FCV 1115A	Seal Supply 'A' RCP	OC	8-1428
AOV	FCV 1115B	Seal Supply 'B' RCP	OC	8-1428
AOV	FCV 1115C	Seal Supply 'C' RCP	OC	8-1428

* OC outside Sphere
IC inside Sphere

2.0 DESCRIPTION (Continued)

2.4 **Power Supplies** (Continued)

II Valves that do not close on a CIS

B. Valves that are not indicated on the CIS panel (Continued)

Actuator Type	Valve No.	Description	*Location	Bkr
P/H	HV-8514A	SIS to RCS	OC	72-211
P/H	HV-8514B	SIS to RCS	OC	72-211
AOV	Turb Stop East		OC	EH
AOV	Turb Stop West		OC	EH
AOV	PCV-40	Inst. Air	OC	NA
AOV	FCV-456	Feed Water to 'A' SG	OC	72-130
AOV	FCV-457	Feed Water to 'B' SG	OC	72-130
AOV	FCV-458	Feed Water to 'C' SG	OC	72-130
AOV	CV-100	SG Blowdown to BDT	OC	
AOV	CV-100A	SG Blowdown to Outfall	OC	
AOV	CV-100B	SG Blowdown to Outfall	OC	
AOV	CV 92	Refueling Supply to CS	IC	8-1102V
AOV	CV 114	Refueling Supply to CS	IC	8-1214V
AOV	CV 82	Refueling Supply to CS	IC	8-1111V
CIS Panel A				Vital Bus 1
CIS Panel B				Utility Vital Bus

* OC outside Sphere
IC inside Sphere

3.0 OPERATION

3.1 Normal Operation

When a CIS is received from the safeguards actuation system all valves indicated on the CIS panel close except for valves in the letdown, CCW, charging sample, RCP seal return and N_2 to PZR PORVs.

After automatic closure of any containment isolation valve manual action is required to reopen them.

There are two possible manual actions available to the operator (see Figures 1 and 2).

First, if the initiating signal for CIS has cleared, the CIS can be reset using the reset pushbuttons (one for each train) on the CIS panel right section (Figure 1). A green light will illuminate in the pushbutton when reset is activated.

After reset, the valves associated with the auto CIS may be operated individually at the CIS panels, left section (Figure 2), via the pushbuttons provided.

Second, if the initiating signal for CIS is still present, but valve operation is necessary, override pushbuttons are provided on the CIS panel, right section (Figure 1).

The override pushbuttons are alternate action type switches. This means that if the pushbutton is depressed it stays locked in the Override position until it is depressed a second time, when the switch reverts to its normal position, (no override). When the pushbutton is in the override position a red light in the pushbutton is illuminated.

Each isolation valve may not have a separate override pushbutton (see Figures 1 & 2). Many of the override pushbuttons are associated with groups of isolation valves. The isolation valves are labeled directly on the pushbutton window.

After depressing the override pushbutton the individual valve pushbutton on the CIS panel, left section (Figure 2), must also be depressed to open the valve.

4.0 REFERENCE

4.1 P&IDs

5178110	RCP Sealwater System	P0001
5178111	RCP Sealwater System	P0001
5178115	Safety Injection System	P0001
5178120	Containment Spray and Recirculation System	P0001
5178121	Containment Spray and Recirculation System	P0001
5178130	Letdown and RHR System	P0001
5178135	Volume Control and Charging System	P0001
5178140	Letdown Demineralizer System	P0001
5178150	Reactor Cycle Sampling System	P0001
5178158	Radwaste Liquid Collection System	P0001
5178206	Feedwater System	P0001
5178225	Main Steam System	P0001
5178226	Main Steam System	P0001
5178260	Feedwater Sampling System	P0001
5178312	CCW System	P0001
5178320	Turbine Plant Cooling Water	P0001
5178370	Primary Plant Make-up	P0001
5178381	Service and Domestic Water	P0001
5178406	Gaseous Nitrogen System	P0001
5178442	Instrument and Service Air	P0001
5178444	Instrument and Service Air	P0001
5178449	Instrument and Service Air	P0001
5178600	Containment Ventilaiton	P0001
5178601	Containment Ventilaiton	P0001

4.0 REFERENCE (Continued)

4.1 P&IDs (Continued)

5178940	Mechanical Containment Penetrations	P0001
5178941	Mechanical Containment Penetrations	P0001
5178942	Mechanical Containment Penetrations	P0001
5180769	P.A.S.S.	P0001

4.2 Elementaries

064356	CV-82, 114 Containment Spray Vlv Cont.	N1542-87
064358	CV 537, 533, 539	N1542-89A
064359	CV 536, SV-600	N1542-088
064360	CV 532, 534, 535	N1542-089
064362	CV 525, 527	N1542-091
064363	CV 517	N1542-092
064364	CV 515, 737A	N1542-093A
064369	CV 737B, CV 518	N1542-094
064371	CV 526, 528	N1542-095
0449408	FCV-456, 457, 458	N1543-026
0455373	HV-851, A & B SIS	N1542-034
0455455	CV-538, PRT Make-up	N1542-067
0455456	CV-542, PRT Drain	N1542-83A
0455457	FCV 112, Charging Line FCV	N1542-125
0455461	PCV 115, A, B, C RCP Seal Return	N1542-063
5149857	Sphere Purge Press. Eq. Isol Vlv	N1542-026
5159756	CV-949, 957, 992, 116, 40 CIV	N1542-169
5159757	SV-720 B & D, B/D Sample	N1542-166
5159758	SV-702 A & C, SIS Vents	N1542-166A
5159759	Cont Isol Vlv DC Power Supply	N1542-153

4.0 REFERENCE (Continued)

4.2 Elementaries (Continued)

5159760	Cont Isol Sys Train-A	N1542-155
5159761	Cont Isol	N1542-151
5159776	Cont Isol Sys Train-B	N1542-154
5159802	PASS SV-3002, 3003	N1542-187
5167841	CV 2145, Chg Ln Sump.	N1542-189
5180605	CV-951, 963, 948, 962, CIV	N1540-008C
5180714	CV-955, 956 CIV	N1542-175

4.3 Technical Manuals

PA89570 Paul Monroe Installation, Operation and Maintenance Manual

4.4 Procedures

No.	Title
SO1-1.5-1	Response to High Containment Pressure
SO1-1.5-2	Response to High Containment Sump Level
SO1-1.5-3	Response to High Containment Radiation
SO1-1-12.2-15	Electrical Penetration Nitrogen Pressurization
SO1-1-12.3-43	Containment Integrity Verification
SO1-1-13-1 through 7,15, 17, 19	Annunication Procedures
SO123-0-26	Containment Locking and Unlocking
SO1-14-17	Valve Operations

4.0 REFERENCE (Continued)

4.5 Technical Specifications

Section	Title
1.5	Definitions
3.5.5	CI Instrumentation
3.5.6	Accident Monitoring Instrumentation
3.6	Containment Systems
4.3	Containment Systems
5.2	Containment

4.6 Other

Amendment 52 to the Final Safety Analysis

Letter from K. P. Baskin (SCE) to A. Schwencer (NRC) dated 1/19/77 "Containment Post-Accident Pressure Reanalysis".

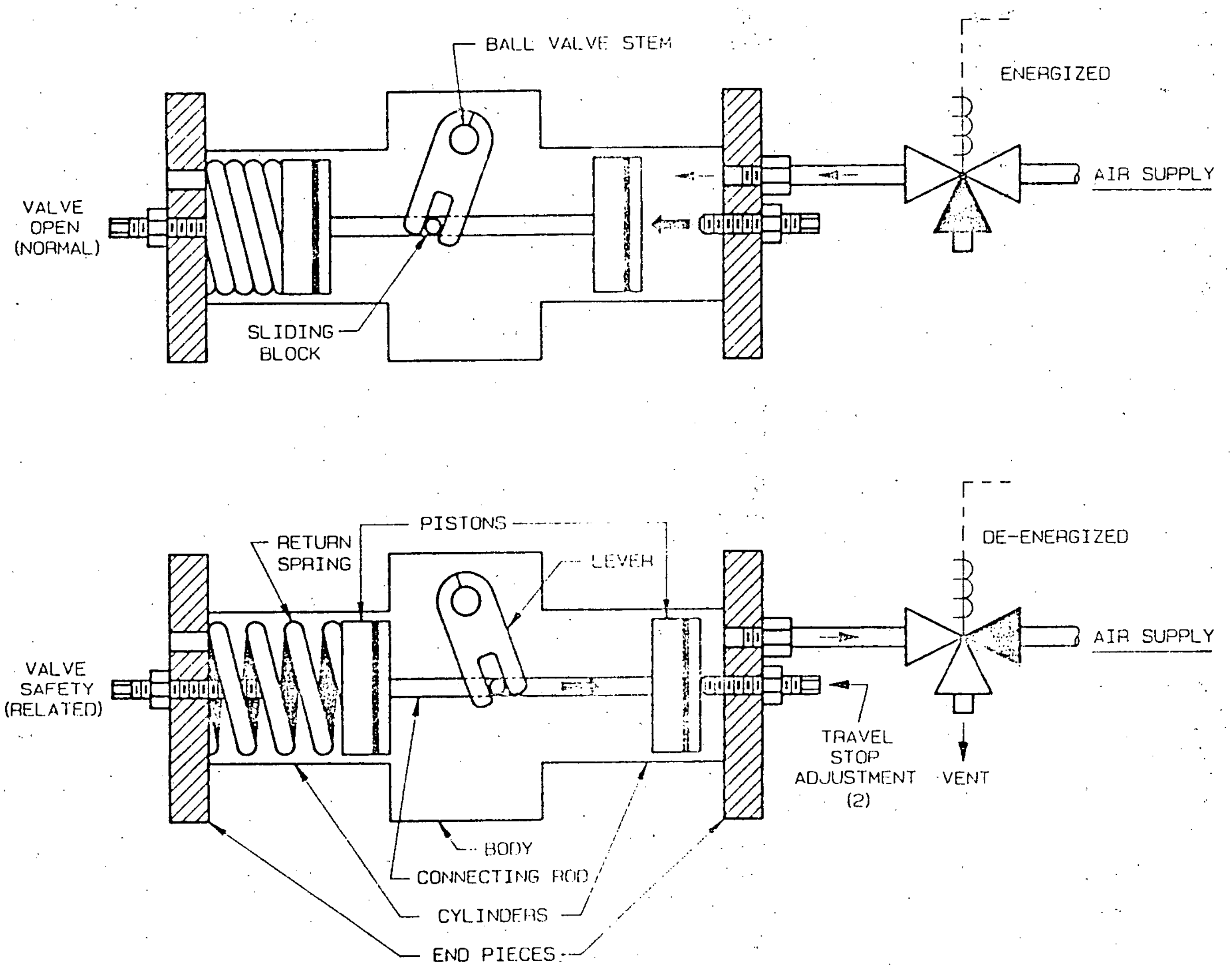
FIGURE 1: CIS PANEL
(RIGHT SECTION)

(65)	(69)	(73)	(77)
CONTAINMENT ISOLATION INITIATE	CONTAINMENT ISOLATION RESET		CIS RELAY FAILURE
(66)	(70)	(74)	(78)
CIS OVERRIDE POV-8 POV-10	CIS OVERRIDE CV-103	CIS OVERRIDE CV-105 107, 536	CIS OVERRIDE SV-119 TO SV-124
(67)	(71)	(75)	(79)
CIS OVERRIDE SV-125	CIS OVERRIDE CV-537	CIS OVERRIDE SV-702B SV-702D	
(68)	(72)	(76)	(80)
CIS OVERRIDE SV-2004	CIS OVERRIDE CV-533	CIS OVERRIDE CV-10	CIS OVERRIDE SV-1212-9 SV-1212-8

☐ Gray Mounting Barriers
(Test/Manual Initiation and Override)

(65)	(69)	(73)	(71)
CONTAINMENT ISOLATION INITIATE	CONTAINMENT ISOLATION RESET		CIS RELAY FAILURE
(66)	(70)	(74)	(78)
CIS OVERRIDE CV-949, 957, 992, SV-3302,03	CIS OVERRIDE CV-115	CIS OVERRIDE CV-104 106, 535	
(67)	(71)	(75)	(78)
	CIS OVERRIDE CV-115	CIS OVERRIDE SV-702A SV-702C	
(68)	(72)	(76)	(80)
CIS OVERRIDE SV-3004	CIS OVERRIDE CV-534	CIS OVERRIDE CV-46 CV-48	CIS OVERRIDE CV-147 CV-146

FIGURE 3: CONTROMATIC VALVE ACTUATOR



CONTAINMENT ISOLATION
"CONTROMATICS" VALVE ACTUATOR OPERATION
TOP VIEW

FIGURE 4: PAUL MONROE VALVE ACTUATOR

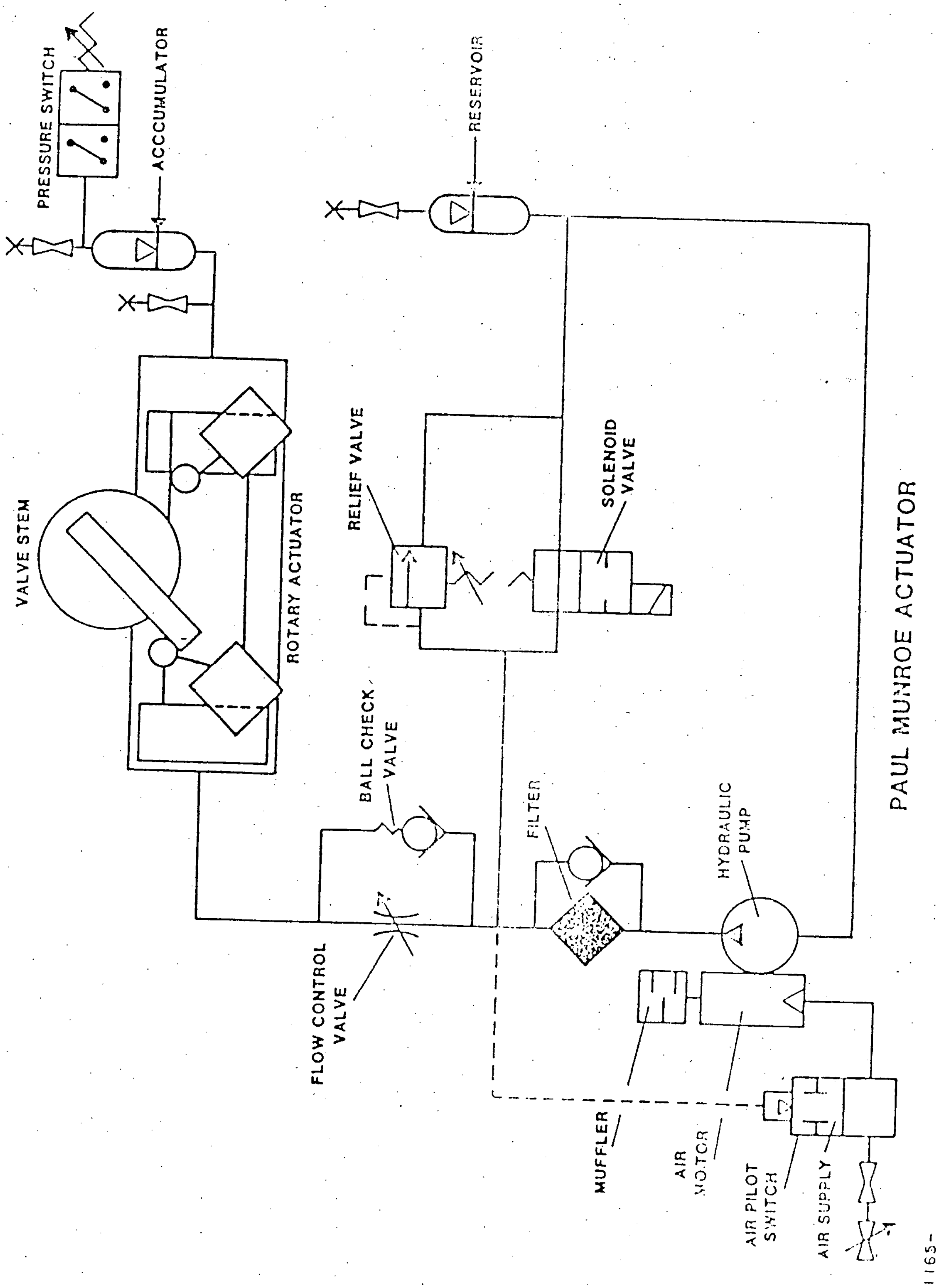
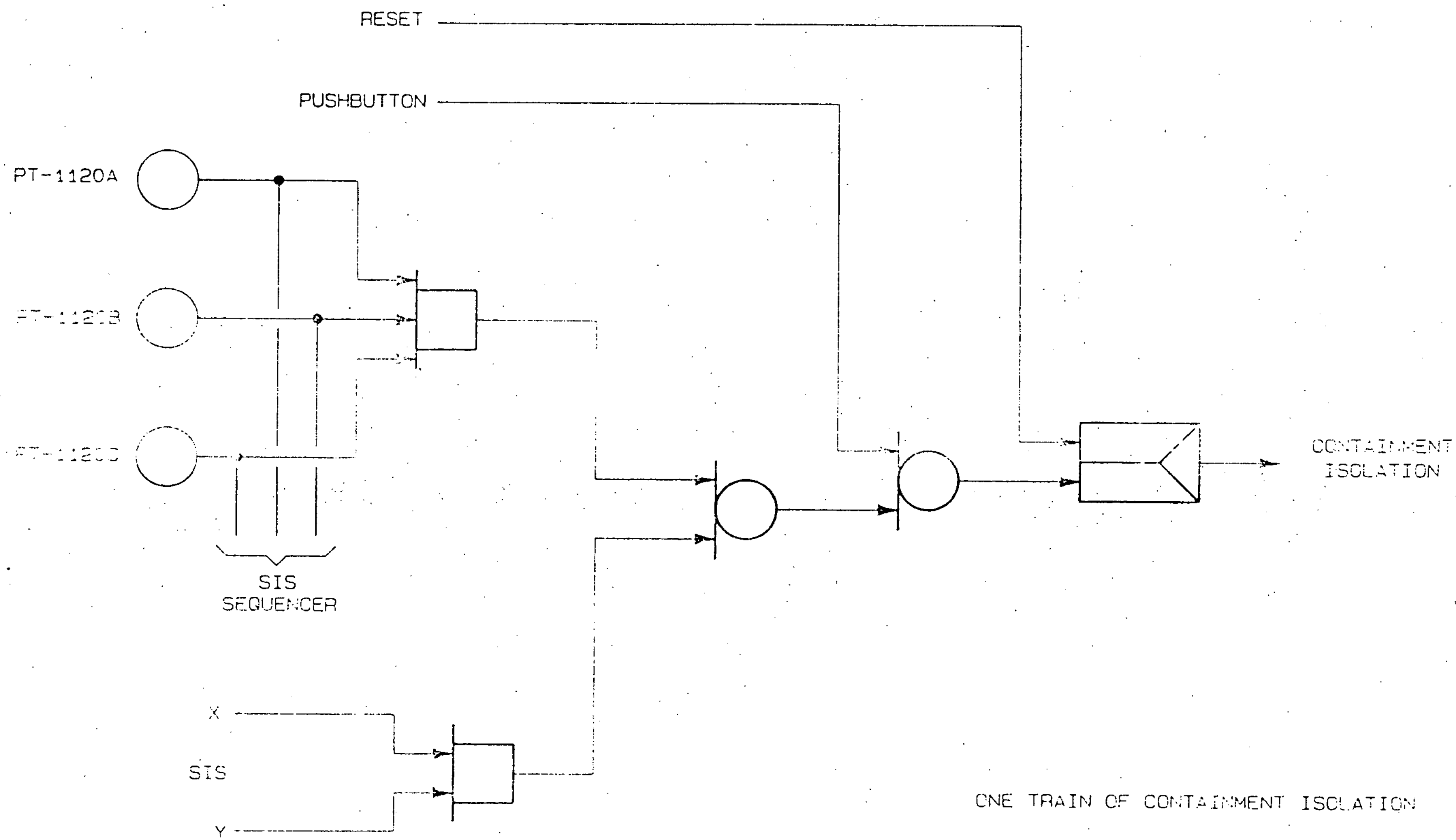
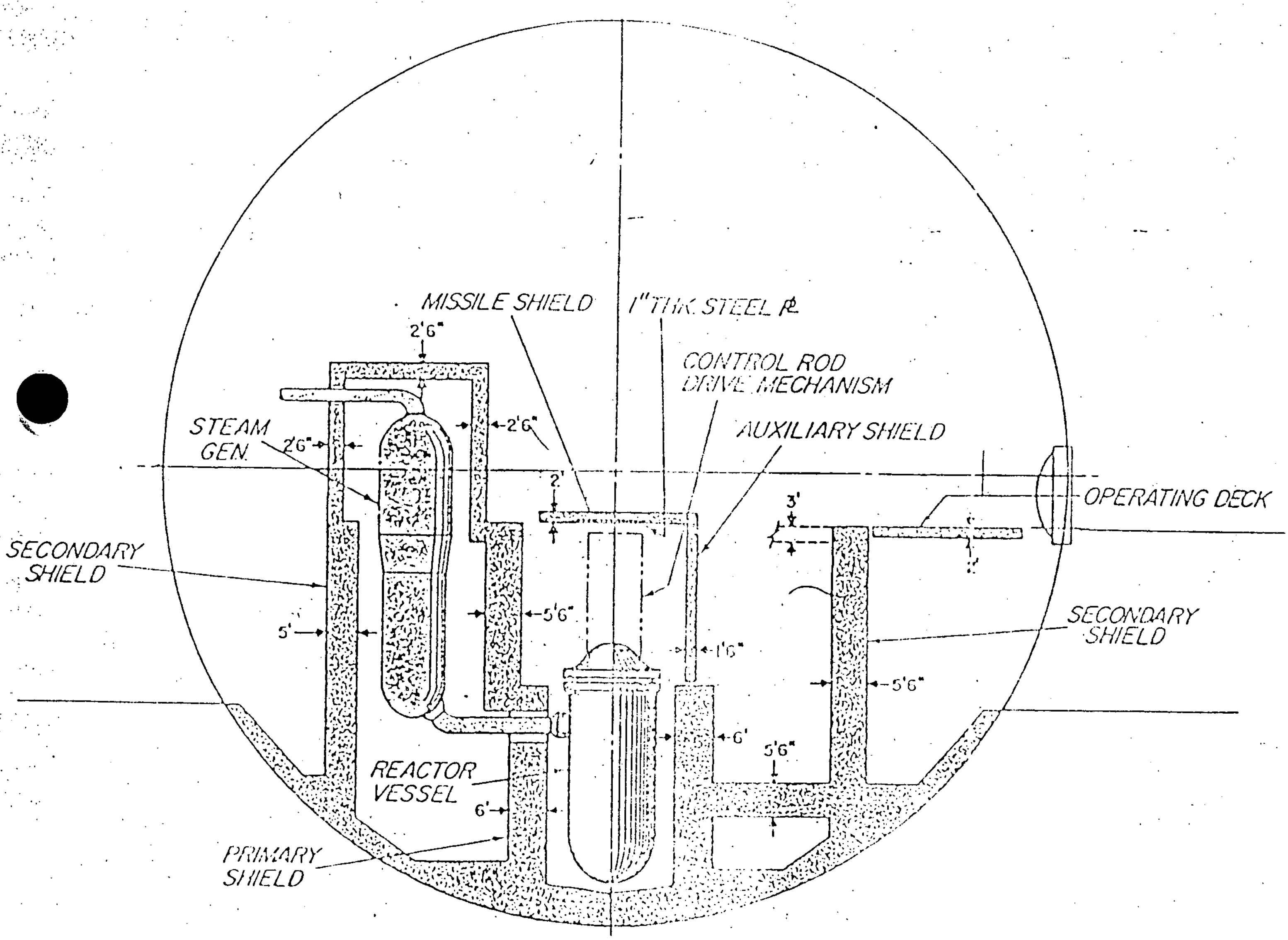


FIGURE 5: CI LOGIC



ONE TRAIN OF CONTAINMENT ISOLATION

FIGURE 6: SPHERE SHIELDING



APPENDIX A

ANNUNCIATORS

Annunciator	Alarm Board	Window	Set Point	Auto Action	Source
CIS Iniated	Aux. Board	5	-	-	CIS Logic
Sphere Vent Valves Open	"	8	-	-	POV9 POV10
Sphere Hi Humidity	"	9	80%	-	HX Relay
Sphere Hi Pressure	"	10	+0.4 psig -1.7 psig	-	PS-24
Sphere Sump Hi Level	"	12	4'3" from top of sump	Actuates sump pump	LS-82
Reactor Cavity Sump Hi Level	"	13	4'5" from top of sump	Actuates sump pump	LS-35
Sphere Access Equalizing Valve open	"	29	-	-	-
Sphere Reactor cavity sump pumps operating	"	30	-	-	sump pump breakers
Sphere sump Hi Hi Level	"	33	3' from top of sump	Manual initiation of sump recirculation	-
CSAS Train A	Reactor Plant Matrix	10	10 psig	CSA	CS Logic
CSAS Train B	"	20	10 psig	CSA	CS Logic
Cont. Press High Trip	"	21	10 psig	-	PIS511
Cont. Press High Trip	"	22	10 psig	-	PIS512
Cont. Press High Trip	"	23	10 psig	-	PIS513

APPENDIX A

ANNUNCIATORS
(Continued)

Annunciator	Alarm Board	Window	Set Point	Auto Action	Source
RCP Motor or Sphere Area Hi Temp	Sphere HVAC	2	120°F	-	Recorder R-95W4 Points: 7(Te79) 8(Te80) 9(Te81) 15(Te87)
CV515 actuator failure	Aux. Feedwater	10	1060 psig	-	PS2515
CV516 actuator failure	"	20	1060 psig	-	PS3516
Cont. % H_2 Hi	"	23	3%	-	AE-H_2-2001
Cont. % H_2 Hi	"	28	3%	-	AE-H_2-3001
CV517 actuator failure	"	30	1600 psig	-	PS2517
Cont. Water level Hi	"	33	-3' below grade	-	LT2002
CV518 actuator failure	"	40	1600 psig	-	PS3518
CV525 actuator failure	"	50	1250 psig	-	PS2525
CV526 actuator failure	"	60	1250 psig	-	PS3516
CV527 actuator failure	"	70	1250 psig	-	PS2527
CV528 actuator failure	"	80	1250 psig	-	
CV737A actuator failure	"	90	1250 psig	-	PS2737A
CV737B actuator failure	"	100	1250 psig	-	PS2737B

APPENDIX B

DEVELOPMENTAL RESOURCES

Videotape "Paul-Monroe Pneumatic-Hydraulic Valves"

Containment Isolation Lesson Plan

P&IDs

5178110	RCP Sealwater System	P0001
5178111	RCP Sealwater System	P0001
5178115	Safety Injection System	P0001
5178120	Containment Spray and Recirculation System	P0001
5178121	Containment Spray and Recirculation System	P0001
5178130	Letdown and RHR System	P0001
5178135	Volume Control and Charging System	P0001
5178140	Letdown Demineralizer System	P0001
5178150	Reactor Cycle Sampling System	P0001
5178158	Radwaste Liquid Collection System	P0001
5178206	Feedwater System	P0001
5178225	Main Steam System	P0001
5178226	Main Steam System	P0001
5178260	Feedwater Sampling System	P0001
5178312	CCW System	P0001
5178320	Turbine Plant Cooling Water	P0001
5178370	Primary Plant Make-up	P0001
5178381	Service and Domestic Water	P0001
5178406	Gaseous Nitrogen System	P0001
5178442	Instrument and Service Air	P0001
5178444	Instrument and Service Air	P0001

APPENDIX B

DEVELOPMENTAL RESOURCES
(Continued)

P&IDs (Continued)

5178449	Instrument and Service Air	P0001
5178600	Containment Ventilation	P0001
5178601	Containment Ventilation	P0001
5178940	Mechanical Containment Penetrations	P0001
5178941	Mechanical Containment Penetrations	P0001
5178942	Mechanical Containment Penetrations	P0001
5180769	P.A.S.S.	P0001

Elementaries

064356	CV-82, 114 Containment Spray Vlv Cont.	N1542-87
064358	CV 537, 533, 539	N1542-89A
064359	CV 536, SV-600	N1542-088
064360	CV 532, 534, 535	N1542-089
064362	CV 525, 527	N1542-091
064363	CV 517	N1542-092
064364	CV 515, 737A	N1542-093A
064369	CV 737B, CV 518	N1542-094
064371	CV 526, 528	N1542-095
0449408	FCV-456, 457, 458	N1543-026
0455373	HV-851, A & B SIS	N1542-034
0455455	CV-538, PRT Make-up	N1542-067
0455456	CV-542, PRT Drain	N1542-83A
0455457	FCV 112, Charging Line FCV	N1542-125
0455461	PCV 115, A, B, C RCP Seal Return	N1542-063
5149857	Sphere Purge Press. Eq. Isol Vlv	N1542-026

APPENDIX B

DEVELOPMENTAL RESOURCES
(Continued)

Elementaries (Continued)

5159756	CV-949, 957, 992, 116, 40 CIV	N1542-169
5159757	SV-720 B & D, B/D Sample	N1542-166
5159758	SV-702 A & C, SIS Vents	N1542-166A
5159759	Cont Isol Vlv DC Power Supply	N1542-153
5159760	Cont Isol Sys Train-A	N1542-155
5159761	Cont Isol	N1542-151
5159776	Cont Isol Sys Train-B	N1542-154
5159802	PASS SV-3002, 3003	N1542-187
5167841	CV 2145, Chg Ln Sump.	N1542-189
5180605	CV-951, 963, 948, 962, CIV	N1540-008C
5180714	CV-955, 956 CIV	N1542-175

Technical Manuals

PA89570 Paul Monroe Installation, Operation and Maintenance Manual

Procedures

No.	Title
SO1-1.5-1	Response to High Containment Pressure
SO1-1.5-2	Response to High Containment Sump Level
SO1-1.5-3	Response to High Containment Radiation
SO1-1-12.2-15	Electrical Penetration Nitrogen Pressurization
SO1-1-12.3-43	Containment Integrity Verification
SO1-1-13-1 through 7, 15, 17, 19	Annunication Procedures
SO123-0-26	Containment Locking and Unlocking
SO1-14-17	Valve Operations

APPENDIX B

DEVELOPMENTAL RESOURCES
(Continued)

Technical Specifications

Section	Title
3.5.5	CI Instrumentation
3.5.6	Accident Monitoring Instrumentation
3.6	Containment Systems
4.3	Containment Systems
5.2	Containment

Other

Amendment 52 to the Final Safety Analysis

Letter from K. P. Baskin (SCE) to A. Schwencer (NRC) dated 1/19/77
"Containment Post-Accident Pressure Reanalysis".

APPENDIX C

INSTRUMENT LISTING

Instrument Number	Function	C.B. Location	Range	Power Supply	Normal Reading
PT-2001	(Indication) (Wide range Pressure) PI-2001	NVB West end	-5 - +245psig	8-3310V	~0
PT-3001	" PI-3001	"	"	8-2903V	~0
PT-501	(Indication) (Containment Spray) (Pressure) PI-511	WVB North end	0 - 60 psig	8-1116V	~0
PT-502	PI-512	"	0 - 60 psig	8-15--V	~0
PT-503	PI-513	"	0 - 60 psig	8-14--V	~0
PT-1120A	(SI Sequencer/CIS) Train A	No Indication on Control Board			-
PT-1120B					-
PT-1120C					-
PT-1121A	Train B			8-2901	-
PT-1121B				8-2901	-
PT-1121C				8-2901	-
PT-6	(Indication) N.R. Pressure PI160	NVB East end	-2 - +2psig		~0
PT-7	(Indication) Pressure PI161	NVB East end	0 - 75psig		0
LI-2002	(Indication) Sump Level LIS-2002	NVB West end	-10'- +12' (bottom of containment to 600,000 gal level)	VB3A	0
LI-3002	LIS-3002	"	-10' - +12'	8-2903	0

APPENDIX C

INSTRUMENT LISTING
(Continued)

Instrument Number	Function	C.B. Location	Range	Power Supply	Normal Reading
LI-2001	(Indication) Sump Level LIS-2001	NVB West end	15'-6½ to 9'-6½" (bottom to top of containment sump)	VB3A	0
LI-3001	LIS-3001	"		VB1	0
-	Sphere sump pump A running indication	NVB West end	On Off	-	-
-	Sphere sump pump B running indication	NVB West end	On Off	-	-
-	Reactor cavity sump pump running indctn.	NVB West end	On Off	-	-
$AI-H_2-2001$	(Hydrogen) $AI-H_2-2001$	NVB West end		8-3310V	0
$AI-H_2-3001$	$AI-H_2-3001$	"		8-2905V	0
RT-1232	(Sphere area Rad) R-1232	WVB South end	$0-10^4$ mR/hr		10-20 mR/hr (100% power)
RT-1255	Sphere Hi area Rad R-1255	WVB South end	10^0-10^8 R/hr	8-3308V	~0
RT-1257	R-1257	"	10^0-10^8 R/hr	8-2907V	
RT-1111	Sphere Particulate R-1111	WVB South end	0^0-10^6 cps		~100K
RT-1112	Sphere Gas R-1112	"	0^0-10^6 cps		~100K

MAIN FEEDWATER ISOLATION

Drawing No.	Title
5178211	First, Second & Third Point Feedwater Heater
5178213	First, Second & Third Point Feedwater Heater
5178201	Condensate System
5178206	Feedwater System
5149918	Elementary - Heater Drain Pump G36A&B
5149970	Elementary - Condensate Pumps G-1A,G-1B,G-1C&G-1B
449408	Elementary - Sol Valves FCV-456,7&8;FW Control
455379	Elementary - Feedwater MOV-20,21&22;FW Block Valves
5150874	Elementary - Safety Injection Sequencer #1
5150875	Elementary - Safety Injection Sequencer #2
5146828	One Line Diag - Main
SD-SO1-120	System Desc - 4160 V
SD-SO1-220	System Desc - Heater Vent & Drain
SD-SO1-210	System Desc - Condensate & Feedwater
SD-SO1-260	System Desc - Feedwater Control
SD-SO1-590	System Desc - Safeguard Load Sequencing

HEATER VENTS AND DRAINS SYSTEMS

TABLE OF CONTENTS

This System Description is approved per SO-123-0-44, System Description Revision and Approval. Contact CDM to verify revision information.

PREPARED BY: ____________ Author ____________ Date

APPROVED BY: ____________ Manager, Operations 5/14/87 Date

NOT QA PROGRAM AFFECTING

HEATER VENTS AND DRAINS SYSTEMS

1.0 FUNCTIONS/DESIGN BASES

1.1 The Heater Vents and Drains System has the following main functions.

1.1.1 To provide continuous removal of air and non-condensable gases from feedwater heater shells.

1.1.2 To provide for the continuous removal of condensed vapor from the five stages of feedwater Heaters.

1.1.3 To improve steam cycle efficiency by regenerative heating of feedwater.

1.2 The Heater Vents and Drains System has the following additional function:

1.2.1 To receive drains from reheaters.

1.3 The Heater Vents and Drains System has the following design bases:

1.3.1 The Heater Vents are designed to adequately remove air and non-condensables under all conditions of operations.

1.3.2 The Heater Drains are designed to handle drainage from the feedwater heaters under all conditions of operation.

2.0 DESCRIPTION

2.1 System Overview

2.1.1 **Main Flowpath** (See Figures 1A and 1B)

Feedwater Heater Operating Vents are cascaded from a higher pressure heater shell to the next lower pressure heater shell and ultimately to the main condensers. The order of flow is from the first point heater to second point, second point to third point, third point to fourth point, fourth point to fifth point, and fifth point to the main condensers. Drain Cooler Start-up Vents from the first, second, fourth and fifth point Heater Drain Coolers discharge into the continuous vent line of the associated heater.

The Feedwater Heater shells are supplied extraction steam through Bleeder Trip Valves (BTV's) with the exception of the fifth point heater. The highest pressure extraction point is from the High Pressure Turbine and supplies the first point heater. The next highest pressure extraction point is from the High Pressure Turbine Exhaust and supplies the second point heater. Extraction steam for the third, fourth, and fifth point Low Pressure heaters is supplied from the fourth, seventh, and ninth stages of the Low Pressure Turbine respectively. See SD-SO1-200, MAIN TURBINE SYSTEMS.

Feedwater heater drains are cascaded from higher pressure to lower pressure. Drains from the first point heaters are cascaded to the second point heaters which in turn are cascaded to the third point heaters. Drains from the third point heaters are returned to the condensate flowpath between the second and third point heaters by the heater drain pumps. For information about the condensate and feedwater side of feedwater heaters see SD-SO1-210, CONDENSATE AND FEEDWATER SYSTEMS. Drains from the fourth point heaters are cascaded to the fifth point heaters, through the external fifth point heater drain coolers and to the condensers.

Feedwater heaters (with the exception of the fourth and fifth point heaters) are protected from overpressure due to tube rupture by relief valves, their relief flowpath is to the blowdown tank and ultimately to the stack where they can be monitored for potential contamination. The fifth point heater is prevented from overpressure by design in that it is vented directly to the condenser. In turn the forth point heater vents and normal drain goes to the fifth point heater relying on this flowpath for overpressure protection.

2.1.2 **Additional Flow Paths** (see Figure 1A)

The first and third point feedwater heaters receive input via Bleeder Trip Valves from the Reheater Drain Receivers and the Reheater shell side drains. For information about the Moisture Separator Reheaters see SD-SO1-190, MAIN STEAM SYSTEM.

2.0 DESCRIPTION (Continued)

2.2 Components

2.2.1 **Bleeder Trip Valves, BTV-1 through BTV-14** (See Figure 3)

BLEEDER TRIP VALVES	
LOCATION:	Adjacent to Feedwater Heaters (above and below East and West Heater Decks)
PURPOSE:	Prevent reversal of steam flow in extraction steam lines and reduce overspeed and water introduction into the Turbine.
SIZE:	Various
OPERATOR TYPE:	Air Piston
VALVE TYPE:	Air assisted stop check
AUTOMATIC ACTIONS:	BTV-1 through 6 close on high level in the associated Feedwater Heater and Turbine Trip. BTV-7 through 14 close on Turbine Trip.

The Bleeder Trip Valves are straight through flow, swing disc, and air assisted, non-return type.

A swing disc is secured to an arm which is keyed to a shaft. The shaft is supported at both ends by bearings in the valve body. The shaft extends through a stuffing box on one side of the valve body.

A lever is fastened to the outside end of the shaft, and the lever rotates with the shaft. On one end of the lever is a weight, which acts to balance the torque of the disc on the shaft. The other end of the lever is secured by a pin to a slotted link, with the pin free to slide in the link.

The link is securely attached by a pin to an air piston rod. The piston moves inside an air cylinder which is attached to the valve body.

Air pressure at the bottom of the cylinder forces the piston upwards and compresses a spring in the top of the cylinder. With the piston in the up position the disc can freely rotate the shaft, lever and weight, as required by the direction of steam flow. The lever pin slides freely in the links slot.

2.0 DESCRIPTION (Continued)

2.2.1 **Bleeder Trip Valves, BTV-1 through BTV-14** (See Figure 3) (Continued)

In the event of a turbine trip the solenoid valve vents air from below the piston, and the spring forces the piston down. The link pulls the lever pin down, which rotates the shaft and disc into the steam flow. The spring holds the disc onto its seat when closed. The valve disc remains on its seat until air pressure is re-established below the piston, and moves the piston and link up. The disc is then free to swing open when steam flows from the turbine.

A test valve in the vent line from the cylinder top allows verification of valve operation. During testing a local manually operated 3-way valve admits air to the top of the cylinder. This equalizes air pressure on both sides of the piston which allows the spring to force the piston down. The piston rod pulls the link and lever down, which rotates the shaft and disc into the steam flow. The spring pressure is not sufficient to force the disc completely closed while steam flows from the turbine through the extraction steam line.

Testing is done each shift to verify bleeder valve operability.

BTV-1	Supplies East 1st Point Heater from the HP Turbine
BTV-2	Supplies West 1st Point Heater from the HP Turbine
BTV-3	Supplies East 2nd Point Heater from the HP Turbine
BTV-4	Supplies West 2nd Point Heater from the HP Turbine
BTV-5	Supplies East 3rd Point Heater from the LP Turbine
BTV-6	Supplies West 3rd Point Heater from the LP Turbine
BTV-7	Supplies East 4th Point Heater from the LP Turbine
BTV-8	Supplies West 4th Point Heater from the LP Turbine
BTV-9	Supplies East 4th Point Heater from the LP Turbine
BTV-10	Supplies West 4th Point Heater from the LP Turbine
BTV-11	Supplies East 1st Point Heater from the Reheater Drain Receiver
BTV-12	Supplies East 1st Point Heater from the Reheater Drain Receiver
BTV-13	Supplies West 1st Point Heater from the Reheater Drain Receiver
BTV-14	Supplies West 1st Point Heater from the Reheater Drain Receiver

2.0 DESCRIPTION (Continued)

2.2.2 **1st Point High Pressure Heaters, E-6A and 6B**

1st POINT HIGH PRESSURE HEATERS (SHELL SIDE)	
LOCATION:	East and West Heater Decks
PURPOSE:	Condense and collect H.P. Turbine Extraction Steam and Reheater Drain Receiver drains
TYPE:	Horizontal - Shell and U-tube
GAGE GLASS:	LG-1 (LG-2)
SHELL SIDE FLOW:	427,373 lb/hr
DESIGN PRESSURE:	400 psig
DESIGN TEMPERATURE:	650°F
NOMINAL PRESSURE:	250 psig
NOMINAL TEMPERATURE:	340°F
OVERPRESSURE PROTECTION:	Relief valve, setpoint 400 psig

.1 Supporting Components (West Components in parenthesis)

1st POINT LEVEL CONTROL VALVE CV-7 (CV-8)	
PURPOSE:	Control 1st Point High Pressure Heater Level
SIZE:	4"
OPERATOR TYPE:	Air Diaphragm
FAIL POSITION:	Open
CONTROLLER:	LC-7 (LC-8)
AUTOMATIC ACTIONS:	Maintains level approximately mid gage glass, level setpoint can be manually adjusted to maintain any level at the controller. HI-LO LEVEL annunciated on Auxiliary Annunciator, window 40, by LS-1 (LS-3) HI and LS-2 (LS-4) LO. HI-LO LEVEL annunciated on Feedwater Heater Annunciator, NVB, by LLH-1001 (LLH-1003) HI and LLL-1002 (LLL-1004) LO.

2.0 DESCRIPTION (Continued)

2.2.3 2nd Point Low Pressure Heaters, E-7A and E-7B

2nd POINT LOW PRESSURE HEATERS (SHELL SIDE)	
LOCATION:	East and West Heater Decks
PURPOSE:	Condense and collect H.P. Turbine Exhaust Steam
TYPE:	Horizontal - Shell and U-tube
GAGE GLASS:	LG-3 (LG-4)
SHELL SIDE FLOW:	650,163 lb/hr
DESIGN PRESSURE:	150 psig
DESIGN TEMPERATURE:	400°F
NOMINAL PRESSURE:	90 psig
NOMINAL TEMPERATURE:	270°F
OVERPRESSURE PROTECTION:	Relief valve, setpoint 150 psig

.1 Supporting Components (West Components in Parenthesis)

2nd POINT LEVEL CONTROL VALVES CV-43 (CV-44)	
PURPOSE:	Control 2nd Point Low Pressure Heater Level
SIZE:	6"
OPERATOR TYPE:	Air Diaphragm
FAIL POSITION:	Open
CONTROLLER:	LC-33 (LC-34)
AUTOMATIC ACTIONS:	Maintains level approximately mid gage glass, level setpoint can be manually adjusted to maintain any level at the controller. HI-LO LEVEL annunciated on Auxiliary Annunciator, window 40, by LS-5 (LS-6) HI and LS-13 (LS-14) LO. HI-LO LEVEL annunciated on Feedwater Heater Annunciator, NVB, by LLH-1005 (LLH-1006) HI and LLL-1013 (LLL-1014) LO.

2.0 DESCRIPTION (Continued)

2.2.4 3rd Point Low Pressure Heaters, E-8A and 8B

3rd POINT LOW PRESSURE HEATERS (SHELL SIDE)	
LOCATION:	East and West Heater Decks
PURPOSE:	Condense and collect No. 1 and No.2 L.P. Turbine Extraction Steam
TYPE:	Horizontal - Shell and U-tube
GAGE GLASS:	LG-5 (LG-6)
SHELL SIDE FLOW:	956,694 lb/hr
DESIGN PRESSURE:	50 psig
DESIGN TEMPERATURE:	400°F
NOMINAL PRESSURE:	21 psig
NOMINAL TEMPERATURE:	250°F
OVERPRESSURE PROTECTION:	Relief valve, setpoint 50 psig

.1 Supporting Components (West Components in Parenthesis)

3rd POINT LEVEL CONTROL VALVE CV-52 (CV-53)	
PURPOSE:	Control 3rd Point Low Pressure Heater Level
SIZE:	8"
OPERATOR TYPE:	Air Diaphragm
FAIL POSITION:	Closed
CONTROLLER:	LC-31 (LC-32)
AUTOMATIC ACTIONS:	Maintains level approximately mid gage glass, or can be manually controlled by bypassing the controller and using the manual regulator installed adjacent to the control valve. HI-LO LEVEL annunciated on Auxiliary Annunciator, window 40, by LS-7 (LS-9) HI and LS-8 (LS-10) LO. HI-LO LEVEL annunciated on Feedwater Heater Annunciator, NVB, by LLH-1007 (LLH-1009) HI and LLL-1008 (LLL-1010) LO.

2.0 DESCRIPTION (Continued)

2.2.4 **3rd Point Low Pressure Heaters, E-8A and 8B** (Continued)

.1 (Continued)

3rd POINT HIGH LEVEL DUMP VALVE CV-17 (CV-18)	
PURPOSE:	Direct 3rd Point Low Pressure Heater Drains to the Main Condensers if Normal Level control fails or tube leakage exceeds the capacity of the Normal Level control valve.
SIZE:	12"
OPERATOR TYPE:	Air Diaphragm
FAIL POSITION:	Open
CONTROLLER:	LC-5 (LC-6)
AUTOMATIC ACTIONS:	CV-17 (CV-18) opened on 3rd Point Heater High Level, setpoint can be manually adjusted to maintain any level at the controller.

2.0 DESCRIPTION (Continued)

2.2.5 **Heater Drain Pumps, G-36A and 36B** (see Figure 2)

HEATER DRAIN PUMPS	
LOCATION:	East, Northeast corner of Condensate Bay. West, Northwest corner of Condensate Bay.
PURPOSE:	Provide the motive force to deliver 3rd Point Heater Drains to the Feedwater Flowpath.
PRIME MOVER:	4160V, 3Ø, 600 HP induction motor
TYPE:	Single stage centrifugal (horizontal)
DESIGN FLOW RATE:	2300 gpm
DESIGN Δ P:	950 ft
NPSH REQUIREMENT:	20 ft
NORMAL FLOWRATE:	1600 gpm
MINIMUM FLOWRATE:	250 gpm
PUMP SEAL TYPE:	Mechanical
SEAL COOLING:	Turbine Plant Cooling Water, 2 gpm
DESIGN FEATURES:	Designed to operate under frequent cavitating conditions.
CONTROLLER LOCATION:	Pushbuttons on 'J' Console
INDICATIONS:	Amp meters above pushbuttons Red Light - Motor Breaker Closed Green Light - Motor Breaker Open Bright Green Light - Motor Breaker Open on overload Neon Light @ MCC1, East Mtr Htr Energized MCC2, West Mtr Htr Energized
AUTOMATIC ACTIONS:	Breaker trips on overcurrent, loss of bus voltage, SIS, respective Feed Pump Breaker open and Low Level in the 3rd Point Feedwater Heater.
INTERLOCKS:	Feed Pump Breaker Open and associated Heater Drain Pump Breaker can not be closed.

2.0 DESCRIPTION (Continued)

2.2.5 **Heater Drain Pumps, G-36A and 36B (see Figure 2)** (Continued)

.1 Supporting Components (West Components in Parenthesis)

MINI-FLOW REGULATOR CV-5 (CV-6)	
PURPOSE:	Maintain minimum flow of 250 gpm through Heater Drain Pump G-36A (G-36B)
SIZE:	2"
OPERATOR TYPE:	Air Diaphragm
FAIL POSITION:	Open
CONTROLLER:	FC-3B (FC-4B)
AUTOMATIC ACTIONS:	Opens to maintain flow at valve established by adjustment of FC-3B (FC-4B). Normally the controller is adjusted to maintain 1200 gpm.

The Heater Drain Pumps have local instrumentation to monitor: pump suction and discharge pressure, pump bearing lube oil pressure, pump bearing oil flow, and pump lube oil reservoir level. The Heater Drain Pump motor bearings are lubricated by external reservoirs and these can be monitored locally. Heater Drain Pump and Motor temperatures are recorded by R-4 located on the West Vertical Board.

2.0 DESCRIPTION (Continued)

2.2.6 4th Point Low Pressure Heaters, E-9A and 9B

4th POINT LOW PRESSURE HEATERS (SHELL SIDE)	
LOCATION:	East and West Heater Decks
PURPOSE:	Condense and collect No. 1 and No.2 L.P. Turbine Extraction Steam
TYPE:	Shell and U-tube
GAGE GLASS:	LG-7 (LG-8)
SHELL SIDE FLOW:	102,400 lb/hr
DESIGN PRESSURE:	15 psig
DESIGN TEMPERATURE:	300°F
NOMINAL PRESSURE:	6.5" Hg Vacuum
NOMINAL TEMPERATURE:	158°F
DESIGN FEATURES:	Integral with Flash Evaporator

.1 Supporting Components (West Components in Parenthesis)

4th POINT LEVEL CONTROL VALVE CV-54 (CV-55)	
PURPOSE:	Control 4th Point Low Pressure Heater Level.
SIZE:	6"
OPERATOR TYPE:	Air Diaphragm
FAIL POSITION:	Open
CONTROLLER:	LC-25 (LC-26)
AUTOMATIC ACTIONS:	Maintains level approximately mid gage glass, level setpoint can be manually adjusted to maintain any level at the controller. HI-LO LEVEL annunciated on Auxiliary Annunciator, window 40, by LS-11 (LS-12) HI and LS-61 (LS-62) LO. HI-LO LEVEL annunciated on Feedwater Heater Annunciator, NVB, by LLH-1011 (LLH-1012) HI and LLL-1061 (LLL-1062) LO.

2.0 DESCRIPTION (Continued)

2.2.6 **Point Low Pressure Heaters, E-9A and 9B** (Continued)

.1 Supporting Components (West Components in Parenthesis)

4th POINT HIGH LEVEL DUMP VALVE CV-11 (CV-12)	
PURPOSE:	Direct 4th Point Low Pressure Heater Drains to the Main Condenser if normal level control fails or tube leakage exceeds the capacity of the normal level control valve.
SIZE:	6"
OPERATOR TYPE:	Air Diaphragm
FAIL POSITION:	Open
CONTROLLER:	LC-11 (LC-12)
AUTOMATIC ACTIONS:	CV-11 (CV-12) opened on 4th Point Heater High Level, level setpoint can be manually adjusted to maintain any level at the controller.

2.0 DESCRIPTION (Continued)

2.2.7 5th Point Low Pressure Heaters, E-9A and 9B

5th POINT LOW PRESSURE HEATERS (SHELL SIDE)	
LOCATION:	East and West Heater Decks
PURPOSE:	Condense and collect No. 1 and No.2 L.P. Turbine Extraction Steam
TYPE:	Shell and U-tube
GAGE GLASS:	LG-9 (LG-10)
SHELL SIDE FLOW:	238,170 lb/hr
DESIGN PRESSURE:	15 psig
DESIGN TEMPERATURE:	300°F
NOMINAL PRESSURE:	22" Hg Vacuum
NOMINAL TEMPERATURE:	107°F
OVERPRESSURE PROTECTION:	Vented to condenser
DESIGN FEATURES:	Integral with Flash Evaporator

.1 Supporting Components (West Components in Parenthesis)

5th POINT LEVEL CONTROL VALVE CV-15 (CV-16)	
PURPOSE:	Control 5th Point Low Pressure Heater Level.
SIZE:	6"
OPERATOR TYPE:	Air Diaphragm
FAIL POSITION:	Open
CONTROLLER:	LC-27 (LC-28)
AUTOMATIC ACTIONS:	Maintains level approximately mid gage glass, level setpoint can be manually adjusted to maintain any level at the controller. HI-LO LEVEL annunciated on Auxiliary Annunciator, window 40, by LS-15 (LS-16) HI and LS-63 (LS-64) LO. HI-LO LEVEL annunciated on Feedwater Heater Annunciator, NVB, by LLH-1015 (LLH-1016) HI and LLL-1063 (LLL-1064) LO.

2.0 DESCRIPTION (Continued)

2.2.7 **5th Point Low Pressure Heaters, E-9A and 9B** (Continued)

.1 Supporting Components (West Components in Parenthesis)

5th POINT HIGH LEVEL DUMP VALVE CV-13 (CV-14)	
PURPOSE:	Direct 5th Point Low Pressure Heater Drains to the Main Condenser if normal level control fails or tube leakage exceeds the capacity of the normal level control valve.
SIZE:	10"
OPERATOR TYPE:	Air Diaphragm
FAIL POSITION:	Open
CONTROLLER:	LC-13 (LC-14)
AUTOMATIC ACTIONS:	CV-13 (CV-14) opened on 5th Point Heater High Level, level setpoint can be manually adjusted to maintain any level at the controller.

2.0 DESCRIPTION (Continued)

2.3 Power Supplies

POWER SUPPLIES

COMPONENT	BREAKER	LOCATION
East Heater Drain Pump (G-36A)	152-12C09	Bus 2C, 4KV Room
West Heater Drain Pump (G-36B)	152-11C09	Bus 1C, 4KV Room

HEATER VENTS AND DRAINS SYSTEMS

3.0 OPERATION

3.1 Startup

Prior to admitting steam to the Feedwater Heaters the startup vents are used to evacuate air and non-condensable gases from the heater shells. These startup vents vent the Drain Cooler sections of the first and second point heaters. The continuous vent lines for the third, fourth and fifth point heaters are utilized for venting during startup and normal operation. After the shells are vented and steam is admitted, the startup vents are closed and the continuous vents are used for removal of air and non-condensable gases.

Heater drains cascading to the 3rd Pt Heater shell are directed to the condensers until approximately 150 MWe, at which time the Heater Drain Pump is placed in service. Waiting until power is this high minimizes the time the Heater Drain Pump operates on mini-flow only and prevents flashing at the pump suction due to overheating.

3.2 Abnormal Operations

Feedwater Heaters may be taken out of service as necessary. Low Pressure Heaters (2nd, 3rd, 4th and 5th) have a single bypass, this requires the entire train to be removed from service even when a problem or maintenance is required on one of the low pressure heaters. The following load limits apply:

High Pressure Heaters - Both High Pressure Heaters (East and West 1st pt) can be removed from service and still maintain 450 MWe Gross (100%).

Low Pressure Heaters - One Low Pressure Heater train out of service, 382 MWe Gross (85%). Both Low Pressure Heater Trains out of service 315 MWe Gross (70%).

Heater Drain Pumps - One Heater Drain Pump out of service, 450 MWe Gross (100%). Both Heater Drain Pumps out of service, 378 MWe Gross (84%).

HEATER VENTS AND DRAINS SYSTEMS

4.0 REFERENCES

4.1 P&IDs

4.1.1	5178210	1st, 2nd, 3rd Point Feedwater Heaters Sh. 1
4.1.2	5178211	1st, 2nd, 3rd Point Feedwater Heaters Sh. 2
4.1.3	5178212	1st, 2nd, 3rd Point Feedwater Heaters Sh. 3
4.1.4	5178213	1st, 2nd, 3rd Point Feedwater Heaters Sh. 4
4.1.5	5178230	High Pressure Turbine System Sh. 1
4.1.6	5178231	High Pressure Turbine System Sh. 2
4.1.7	5178235	Low Pressure Turbine Sh. 1
4.1.8	5178236	Low Pressure Turbine Sh. 2
4.1.9	5178245	Condenser Vents and Drains
4.1.10	5178250	Condenser Air Removal System Sh. 1
4.1.11	5178251	Condenser Air Removal System Sh. 2
4.1.12	5178252	Condenser Air Removal System Sh. 3
4.1.13	5178275	Flash Evaporators Sh. 1
4.1.14	5178276	Flash Evaporators Sh. 2

4.2 Elementaries

4.2.1	N1541 Sh. 20	Reheater Control Valves
4.2.2	N1541 Sh. 21A	Reheater Drain Controls
4.2.3	5149918 (N1543 Sh. 004)	Heater Drain Pumps

4.3 Procedures

4.3.1	SO1-7-5	Heater Drain Pump Operations
4.3.2	SO1-7-15	Main and Extraction Steam System
4.3.3	SO1-7-17	Operation of Feedwater Heaters

APPENDIX A

DEVELOPMENTAL RESOURCES

A.1 P&IDs

A.1.1	5178210	1st, 2nd, 3rd Point Feedwater Heaters Sh. 1
A.1.2	5178211	1st, 2nd, 3rd Point Feedwater Heaters Sh. 2
A.1.3	5178212	1st, 2nd, 3rd Point Feedwater Heaters Sh. 3
A.1.4	5178213	1st, 2nd, 3rd Point Feedwater Heaters Sh. 4
A.1.5	5178230	High Pressure Turbine System Sh. 1
A.1.6	5178231	High Pressure Turbine System Sh. 2
A.1.7	5178235	Low Pressure Turbine Sh. 1
A.1.8	5178236	Low Pressure Turbine Sh. 2
A.1.9	5178245	Condenser Vents and Drains
A.1.10	5178250	Condenser Air Removal System Sh. 1
A.1.11	5178251	Condenser Air Removal System Sh. 2
A.1.12	5178252	Condenser Air Removal System Sh. 3
A.1.13	5178275	Flash Evaporators Sh. 1
A.1.14	5178276	Flash Evaporators Sh. 2

A.2 Elementaries

A.2.1	N1541 Sh. 20	Reheater Control Valves
A.2.2	N1541 Sh. 21A	Reheater Drain Controls
A.2.3	5149918 (N1543 Sh. 004)	Heater Drain Pumps

A.3 Procedures

A.3.1	S01-7-5	Heater Drain Pump Operations
A.3.2	S01-7-15	Main and Extraction Steam System
A.3.3	S01-7-17	Operation of Feedwater Heaters

APPENDIX A

DEVELOPMENTAL RESOURCES
(Continued)

A.4 Other References

A.4.1 Bechtel System Description 20, Feedwater and Condensate System

A.4.2 Bechtel System Description 21, Steam System

A.4.3 Bechtel System Description 25, Turbine Cyle Vent and Drain Systems

A.4.4 Bechtel Equipment Data 12, Turbine-Generator and Auxiliary Systems

A.4.5 Bechtel Equipment Data 16, Feedwater and Condensate System

A.4.6 Bechtel Equipment Data 21, Turbine Cycle Vent and Drain Systems

A.4.7 Lesson Plan OT-1067, Heater Vents and Drains

A.5 Plant Facility Changes

A.5.1 PFC-1-86-3400.01, East Flash Evaporator Modification

A.5.2 PFC-1-86-3400.05, West Flash Evaporator Modification N

APPENDIX B

INSTRUMENT LIST

INSTRUMENT	INSTRUMENT NAME	SETPOINT/ FUNCTION	OUTPUT (RANGE)
TE-42	East Heater Drain Pump Thrust Bearing Temp.	Recorder Output	R-4-13 (0-250°F)
TE-43	East Heater Drain Pump Outboard Sleeve Bearing Temp.	Recorder Output	R-4-14 (0-250°F)
TE-44	East Heater Drain Pump Inboard Sleeve Bearing Temp.	Recorder Output	R-4-15 (0-250°F)
TE-45	East Heater Drain Pump Motor Inboard Sleeve Bearing Temp.	Recorder Output	R-4-16 (0-250°F)
TE-46	East Heater Drain Pump Motor Outboard Sleeve Bearing Temp.	Recorder Output	R-4-17 (0-250°F)
TE-47	West Heater Drain Pump Bearing Thrust Bearing Temp.	Recorder Output	R-4-18 (0-250°F)
TE-48	West Heater Drain Pump Outboard Sleeve Bearing Temp.	Recorder Output	R-4-19 (0-250°F)

APPENDIX B

INSTRUMENT LIST
(Continued)

INSTRUMENT	INSTRUMENT NAME	SETPOINT/ FUNCTION	OUTPUT (RANGE)
TE-49	West Heater Drain Pump Inboard Sleeve Bearing Temp.	Recorder Output	R-4-20 (0-250°F)
TE-50	West Heater Drain Pump Motor Inboard Sleeve Bearing Temp.	Recorder Output	R-4-21 (0-250°F)
TE-51	West Heater Drain Pump Motor Outboard Sleeve Bearing Temp.	Recorder Output	R-4-22 (0-250°F)
TI-56 (E) IT-57 (W)	Drain Receiver Temp.	Local Indication	None
TI-5 (E) TI-66 (W)	HP Turbine Extraction Steam Temp.	Local Indication	None (50-550°F)
TI-43 (E) TI-44 (W)	1st Pt. Htr. Drain Temp.	Local Indication	None (50-550°F)
TI-7 (E) TI-8 (W)	HP Turbine Exhaust Steam Temp.	Local Indication	None (50-550°F)

APPENDIX B

INSTRUMENT LIST
(Continued)

INSTRUMENT	INSTRUMENT NAME	SETPOINT/ FUNCTION	OUTPUT (RANGE)
TI-45 (E) TI-46 (W)	2nd Pt. Htr. Drain Temp.	Local Indication	None (50-400°F)
TI-9 (E) TI-10 (W)	LP Turbine Extraction Steam Temp.	Local Indication	None (50-400°F)
TI-16 (E) TI-47 (W)	3rd Pt. Htr. Drain Temp.	Local Indication	None (50-300°F)
TI-11 (E) TI-12 (W)	4th Pt. Htr. Shell Temp.	Local Indication	None (0-200°F)
TI-48 (E) TI-49 (W)	4th Pt. Htr. Drain Temp.	Local Indication	None
TI-13 (E) TI-14 (W)	5th Pt. Htr. Shell Temp.	Local Indication	None (50-300°F)
TI-50 (E) TI-51 (W)	5th Pt. Htr. Drain Cooler Shell Temp.	Local Indication	None (20-220°F)

APPENDIX B

INSTRUMENT LIST
(Continued)

INSTRUMENT	INSTRUMENT NAME	SETPOINT/ FUNCTION	OUTPUT (RANGE)
TI-52 (E) TI-53 (W)	5th Pt. Htr. Drain Cooler Outlet Temp.	Local Indication	None
PI-3 (E) PI-4 (W)	HP Turbine Extraction Steam Press.	Local Indication	None (0-600 psig)
PI-5 (E) PI-6 (W)	HP Turbine Exhaust Steam Press.	Local Indication	None (0-200 psig)
PI-7 (E) PI-8 (W)	LP Turbine Extraction Steam Press.	Local Indication	None (0-60 psig)
PI-1840 (E) None (W)	4th Pt. Heater Shell Press.	Local Indication	None (30" Hg Vac - 15 psig)
PI-13 (E) PI-14 (W)	5th Pt. Htr. Shell Press.	Local Indication	None (30" Hg Vac - 15 psig)
PI-276 (E) PI-282 (W)	No. 1 LP Turbine Extraction Steam Press.	Local Indication	None (0-30" Hg Vac)

APPENDIX B

INSTRUMENT LIST
(Continued)

INSTRUMENT	INSTRUMENT NAME	SETPOINT/ FUNCTION	OUTPUT (RANGE)
PI-277 (E) PI-283 (W)	No. 2 LP Turbine Extraction Steam Press.	Local Indication	None (0-30" Hg Vac)
PI-278 (E) PI-284 (W)	No. 1 LP Turbine Extraction Steam Press.	Local Indication	None (0-30" Hg Vac)
PI-279 (E) PI-285 (W)	No. 1 LP Turbine Extraction Steam Press.	Local Indication	None (0-30" Hg Vac)
PI-280 (E) PI-286 (W)	No. 2 LP Turbine Extraction Steam Press.	Local Indication	None (0-30" Hg Vac)
PI-281 (E) PI-287 (W)	No. 2 LP Turbine Extraction Steam Press.	Local Indication	None (0-30" Hg Vac)

APPENDIX C

ANNUNCIATOR LIST

Auxiliary Annunciator

WINDOW NAME (NUMBER)	INPUT	SETPOINT
East or West Heater HI-LO Level (40)	LS-1 through LS-16 and LS-61 through LS-64	High and Low Level

APPENDIX C

ANNUNCIATOR LIST
(Continued)

Feedwater Heater Annunciator

WINDOW NAME (NUMBER)	INPUT	SETPOINT
East 1st Pt. Htr. HI Level (Red)	LLH-1001	East 1st Pt. Htr. HI Level
East 1st Pt. Htr. LO Level (Amber)	LLL-1002	East 1st Pt. Htr. LO Level
East 2nd Pt. Htr. HI Level (Red)	LLH-1005	East 2nd Pt. Htr. HI Level
East 2nd Pt. Htr. LO Level (Amber)	LLL-1013	East 2nd Pt. Htr. LO Level
East 3rd Pt. Htr. HI Level (Red)	LLH-1007	East 3rd Pt. Htr. HI Level
East 3rd Pt. Htr. LO Level (Amber)	LLL-1008	East 3rd Pt. Htr. LO Level
East 4th Pt. Htr. HI Level (Red)	LLH-1011	East 4th Pt. Htr. HI Level

R

APPENDIX C

ANNUNCIATOR LIST
(Continued)

Feedwater Heater Annunciator

WINDOW NAME (NUMBER)	INPUT	SETPOINT
East 4th Pt. Htr. LO Level (Amber)	LLL-1061	East 4th Pt. Htr. LO Level
East 5th Pt. Htr. HI Level (Red)	LLH-1015	East 5th Pt. Htr. HI Level
East 5th Pt. Htr. LO Level (Amber)	LLL-1063	East 5th Pt. Htr. LO Level

APPENDIX C

ANNUNCIATOR LIST
(Continued)

Feedwater Heater Annunciator

WINDOW NAME (NUMBER)	INPUT	SETPOINT
West 1st Pt. Htr. HI Level (Red)	LLH-1003	West 1st Pt. Htr. HI Level
West 1st Pt. Htr. LO Level (Amber)	LLL-1004	West 1st Pt. Htr. LO Level
West 2nd Pt. Htr. HI Level (Red)	LLH-1006	West 2nd Pt. Htr. HI Level
East 2nd Pt. Htr. LO Level (Amber)	LLL-1014	West 2nd Pt. Htr. LO Level
West 3rd Pt. Htr. HI Level (Red)	LLH-1009	West 3rd Pt. Htr. HI Level
West 3rd Pt. Htr. LO Level (Amber)	LLL-1010	West 3rd Pt. Htr. LO Level
West 4th Pt. Htr. HI Level (Red)	LLH-1012	West 4th Pt. Htr. HI Level

APPENDIX C

ANNUNCIATOR LIST
(Continued)

Feedwater Heater Annunciator

WINDOW NAME (NUMBER)	INPUT	SETPOINT
West 4th Pt. Htr. Lo Level (Amber)	LLL-1062	West 4th Pt. Htr. Lo Level
West 5th Pt. Htr. HI Level (Red)	LLH-1016	West 5th Pt. Htr. HI Level
West 5th Pt. Htr. LO Level (Amber)	LLL-1064	West 5th Pt. Htr. LO Level

CONDENSATE AND FEEDWATER

TABLE OF CONTENTS

This System Description is approved per SO123-0-44, System Description Revision and Approval. Contact CDM to verify revision information.

PREPARED BY: _______________ 6/16/87
Author — Date

APPROVED BY: _______________ 6/17/87
Manager, Operations — Date

NOT QA PROGRAM AFFECTING

0256W

CONDENSATE AND FEEDWATER

1.0 FUNCTIONS/DESIGN BASES

1.1 The Condensate and Feedwater System has the following main function:

1.1.1 To transfer deaerated condensate from the Condenser Hot Wells through two parallel trains of Feedwater Heaters to the Steam Generators.

1.2 The Condensate and Feedwater System has the following additional functions:

1.2.1 To isolate sources of unborated water to RCS when Feedwater Pumps are being used for Safety Injection System Operation (see SD-SO1-580, Safety Injection, Recirculation and Containment Spray Systems). N

1.2.2 To isolate portions of the Condensate and/or Feedwater System to allow for maintenance during operations and provide cooling for the air ejectors and gland exhaust condensers.

1.2.3 To isolate sections of the condensers, during inleakage of sea water, and permit discharging of the contaminated hotwell condensate to waste, without tripping the unit. R

1.2.4 To maintain sufficient storage capacity, for feed quality water, to ensure water inventory of the feed system and steam generators is preserved during plant transients. N

1.3 The Condensate and Feedwater System has the following design bases:

1.3.1 The Condensate and Feedwater System is designed to supply feedwater to the Steam Generators at a pressure of 720 psig with a flow of 5,706,000 pounds per hour.

1.3.2 Portions of the system are shared with Reactor Coolant Systems Safety Injection System. Design provisions enable proper fluid separation, of the Feed Water and Safety Injection Water, during all modes of plant operation, and assures maintenance of water chemistries. The design also prevents overpressurization of the RCS by the feed pumps. R

CONDENSATE AND FEEDWATER

2.0 DESCRIPTION

2.1 System Overview

2.1.1 **Main Flowpath** (See Figure 1A-1B)

Condensate Pumps take suction from Hotwell sections of condensers (E-2A and E-2B), and discharge through two similar parallel trains (East and West), of condensate heating equipment to the Feed Pump suction.

Flow from the Feed Pumps discharge through two similar parallel trains (East and West), of high pressure feedwater heaters. Discharge from the high pressure heaters join together in a common header, which is used to equalize feedwater pressure and temperature from the two trains. Flow is then split into three lines, each penetrating the containment and feeding one of the three Steam Generators. R

Each of the Steam Generator feed lines contain the feed regulating equipment (see SD-S01-260 "Feedwater Control System"). N

Each Condensate/Feedwater heating train consist of the following equipment; Condensate Pumps, Condenser Air Ejector, Turbine Gland Seal Steam Condenser, fifth point heater drain cooler, Flash Evaporator Condenser (retired), fifth point heater, fourth point heater drain cooler, fourth point heater, third point heater, second point heater, Feed Pump and first point heater. The Feed Pumps are equipped with pneumatic hydraulic suction and discharge valves. R

2.1.2 **Additional Flowpaths**

A bypass line is provided to allow removal of each train of feedwater heaters. Flow is from the discharge of the East or West Gland Seal Steam Condenser (depending on which train is bypassed) through the normally closed manual bypass valve to the inlet side of the Feed Pump Suction Valves. The First Point Heaters are also equipped with a bypass line from the discharge of the Feed Pumps to the common header.

Each Steam Generator Feed regulator valve is bypassed by a remote manually operated low flow regulator valve (see SD-S01-260 "Feedwater Control System"), with remote reading low flow indication. A further bypass is also available with a locally operated flow control valve. N

Condensate is supplied to various plant subsystems, by a flow path from a common header which is connected between two of the Condensate Pump discharges.

2.0 DESCRIPTION (Continued)

2.1.2 Additional Flowpaths (Continued)

The condenser water inventory in the hotwells is maintained by a drawoff flow path from the common Condensate Pump discharge header to the Condensate Storage Tank, and two makeup flow paths to the Condenser Hotwells from the Condensate Storage Tank. N

A flow path allows contaminated hotwell condensate to be discharged to the Circulating Water System by the Condensate Pumps. D

Condensate pump/air ejector/gland steam condenser miniflow lines are provided, from the condensate flow path to the main condenser, to protect the equipment.

Feed pump miniflow paths from the feed pump discharges to the main condenser, or to the Refueling water Storage Tank, ensure protection of the pumps under the various operating modes. N

Third point heater drains are injected into the condensate train, after the third point heater.

Auxiliary Feedwater connects into the Main Feedwater System, downstream of the feed regulation station before the containment penetration and also at the inlet or outlet to the West 1st Point Heater and then through the normal feedwater flow path (see SD-S01-620, "Auxiliary Feedwater System").

2.0 DESCRIPTION (Continued)

2.2 Components

2.2.1 **Main Condensers E-2A (North) and E-2B (South)** (Figure 1A)

E-2A AND E-2B	
PURPOSE:	To condense Main Turbine exhaust steam
TYPE:	Divided water box, single pass
STEAM CONDENSED:	3,293,000 lb/Hr
CIRCULATING WATER INLET TEMP:	~ 62°F
TOTAL CIRC. WATER FLOW:	340,000 GPM
CONDENSER SHELL PRESS:	Full vacuum
HOTWELL WORKING VOLUME:	20,000 Ft^3
NUMBER OF TUBES:	22,016
TUBES DESIGN MATERIAL:	Titanium for the north half of 2A & 2B Copper nickel for the south half of 2A & 2B.
SHELL DESIGN MATERIAL:	Carbon Steel

At the bottom of each of the two hotwells is a divider plate approximately 2 feet high. This divides the collection of the condensed condensate into four sections with level indication for each. The two hotwell sections in the north condenser (E-2A) are called the north half of the north and the south half of the north or No. 1 and No. 2 hotwells respectively. The two hotwell sections in the south condenser (E-2B) are called the north half of the south and the south half of the south or No. 3 and No. 4 hotwells respectively. R

.1 Supporting Components and Indication:

Level is indicated locally by level glass 23 for Hotwell No. 1 and level glass 22 for Hotwell No. 2 of Condenser E-2A. Level glass 25 provides indication for Hotwell No. 3 and level glass 24 for Hotwell No. 4 of Condenser E-2B.

2.0 DESCRIPTION (Continued)

2.2.1.1 Supporting Components and Indication (Continued)

Hotwell Level is transmitted to the control room on the south "J" console by LT1 for Hotwell No. 1 and LT2 for Hotwell No. 2 of the Condenser E-2A. LT3 transmits level for Hotwell No. 3 and LT4 for Hotwell No. 4 of Condenser E-2B. Each level transmitter is provided with a seal water supply from the respective condensate pump discharge header to prevent air inleakage to the condenser. Local seal water flow indication is provided by FG19, 20, 21 and 22 respectively, at each Level Transmitter. R

2.2.2 **Hotwell Level Control Tank C-9** (Figure 1A)

HOTWELL LEVEL CONTROL TANK C-9	
PURPOSE:	To provide representative level of the hotwell and control condensate flow to and from the Condensate Storage Tank.
LOCATION:	Between hotwells in the Condensate Pump Pit.
DESIGN CAPACITY:	230 gallons
DESIGN PRESSURE:	15 psig

The Hotwell Level Control Tank is interconnected with the Main Condensers through crossties so that the level in the tank is representative of the average water level in the Condenser Hotwells.

Supporting components and indications:

Level Glass 16 is provided on the side of the Hotwell Level Control Tank for local indication.

Level Switch 17 provides a high level alarm at 2'10" and a low level alarm of 2'2" annunciated on the Auxiliary Annunciator Panel Window #34 in in the Control Room. N

Level Control 16T provides input for makeup and drawoff requirements between the Condensate Storage Tank and the Condenser Hotwells.

2.0 DESCRIPTION (Continued)

2.2.3 Normal Condensate Makeup (CV-20) (Figure 1A)

CV-20	
PURPOSE:	Provides normal makeup of Condensate from the CST to the Hotwell on low level.
LOCATION:	West wall of the Condenser Bay
OPERATOR TYPE:	Pneumatic
VALVE TYPE:	Gate Valve
VALVE SIZE:	6 inch
FAIL POSITION:	Closed
DESIGN MATERIAL:	Stainless Steel

CV-20 receives a signal from LC-16 that cascades from LC-16T on the Hotwell Level Control Tank. As the level decreases in the hotwell, CV-20 will modulate open to provide normal makeup from the Condensate Storage Tank to all four hotwells. N

2.0 DESCRIPTION (Continued)

2.2.4 Emergency Condenser Makeup Valve (CV-19) (Figure 1A)

CV-19	
PURPOSE:	To restore normal Hotwell Level in the event normal makeup fails.
LOCATION:	West wall of the Condenser Bay
OPERATOR TYPE:	Pneumatic
VALVE TYPE:	Butterfly Valve
VALVE SIZE:	8 inch
FAIL POSITION:	Closed
DESIGN MATERIAL:	Stainless Steel

CV-19 receives a signal from LC-16 as does CV-20. During large load changes or transients, if CV-20 does not have sufficient capacity to provide makeup water, CV-19 will modulate open to provide additional makeup to Hotwells 2 and 3. N

2.0 DESCRIPTION (Continued)

2.2.5 Condensate Draww Off Valve (CV-21) (Figure 1A)

CV-21	
PURPOSE:	Provides Condensate Pump discharge return to the CST on Hotwell High Level.
LOCATION:	West wall of the Condenser Bay
OPERATOR TYPE:	Pneumatic
VALVE TYPE:	Butterfly Valve
VALVE SIZE:	3 inch
FAIL POSITION:	Open
DESIGN MATERIAL:	Stainless Steel

CV-21 receives a signal from LT-17 that cascades from LC-16T on the Hotwell Level Control Tank. As the level increases in the hotwell, CV-21 will modulate open drawing off condensate from the Condensate Pump discharge header to the Condensate Storage Tank. N

2.0 DESCRIPTION (Continued)

2.2.6. Condensate Pumps (G-1A B, C and D)

G-1A, B, C AND D	
PURPOSE:	To pump condensate from the Condenser Hotwells through Condensate Heater Trains to the Main Feed Pumps.
PUMP TYPE:	Vertically mounted, centrifugal
PRIME MOVER:	4160V, Induction motor
NO. OF STAGES:	6
DESIGN CAPACITY:	2,900 GPM
DESIGN HEAD:	735 Ft.
DESIGN DISCHARGE PRESSURE:	316 psi
REQUIRED NPSH:	2 Ft.
DESIGN SPEED:	880 RPM
DESIGN H.P.	700 H.P.
BEARING LUBRICATION:	Water (pump)
DESIGN MATERIAL:	Chrome alloy steel
NORMAL MOTOR AMPS:	80

.1 Controls, interlocks and indications: (see Figure 2)

Each condensate pump is controlled by START-AUTO-STOP pushbuttons located in the Control Room on the south portion of the "J" console. Red-Start, Green-Stop and Amber-Auto status indicating lights are also provided. To place a condensate pump in Auto, the Auto Start pushbutton is depressed on the desired pump and an amber auto light will be lit. To remove from Auto the selected condensate pump stop pushbutton would be depressed and the amber auto light would extinguish indicating the condensate pump is out of Auto.

The pumps trip on overcurrent, undervoltage, and a Safety Injection Signal from the Sequencer. Auto start is initiated by Pressure Switch 79 on low condensate discharge pressure of 275 psig.

2.0 DESCRIPTION (Continued)

2.2.6.1 (Continued)

Each condensate pump motor is provided with upper and lower oil level sight glasses.

There is a normal operating vent supplied on the condensate pump suction used to remove non-condensible gases back to the condenser for removal by the condenser air removal system. A startup vent is provided at the condensate pump discharge to maintain it filled and vented while the pump is in standby or prior to startup. This vent is not needed during pump operation. R

2.2.7 **East and West Air Ejector Condensers (E-22A and E-22B)**

E-22A AND E-22B	
PURPOSE:	To condense steam contained in air and non condensible gasses removed from the main condenser by the air ejector.
LOCATION:	East and West platforms on the South side of the Main Condenser
CONDENSER TYPE:	Tube and shell
DESIGN CAPACITY (SHELL SIDE-AIR):	7.2 CFM
DESIGN CONDENSATE FLOW (TUBESIDE):	1000 - 3800 GPM

2.2.8 **East and West Gland Seal Steam Condensers (E-23A and 23B)**

E-23A AND E-23B	
PURPOSE:	To condense exhaust steam from the Turbine Gland Seals.
LOCATION:	East and West Platforms on the south side of the main condenser next to the air ejectors.
CONDENSER TYPE:	Tube and shell
DESIGN FLOW-STEAM (SHELL):	4500 lb/Hr
DESIGN CONDENSATE FLOW (TUBES):	700 - 3800 GPM

2.0 DESCRIPTION (Continued)

2.2.9 Condensate Miniflow Valves (CV-71 and CV-72)

See Figure 1A

CV-71 AND CV-72	
PURPOSE:	Condensate Pump Miniflows provide Condensate Pump Protection and ensure proper operation of Air Ejectors and Gland Seal Steam Condensers.
LOCATION:	East and West Mini Flow Platforms.
OPERATOR TYPE:	Pneumatic
VALVE TYPE:	Gate Valve
VALVE SIZE:	4 inch
FAIL POSITION:	Open
DESIGN MATERIAL:	Stainless Steel

The condensate miniflow valves are controlled from either direct instrument air or miniflow controlled output through 3 way solenoid valves SV-129 and 130 powered from the Condensate Pump Auto Start circuit at the switchgear. The solenoid valves are energized when all four condensate pumps are off (see Figure 2). This aligns instrument air to CV-71 and 72 and maintains them closed. When any one condensate pump is running the solenoid valves are de-energized providing miniflow controller input to CV-71 and 72 respectively. The miniflow controllers are located below the respective miniflow CV platform and are set for approximately 1000 gpm. This setpoint is the minimum required to ensure adequate cooling for the air ejector. (Gland Steam Condensers and Condensate Pump miniflow requirements are less.) R

2.0 DESCRIPTION (Continued)

2.2.10 Condensate Seal Pressure Control Valve (CV-73)

See Figure 1A

CV-73	
PURPOSE:	To regulate seal water flow and pressure to the Condensate Pump Seal Water Supply System.
LOCATION:	Near the southeast condensate pump in the Condensate Pump Pit.
OPERATOR TYPE:	Pneumatic
VALVE TYPE:	Gate Valve
VALVE SIZE:	1 inch
FAIL POSITION:	Open
DESIGN MATERIAL:	Stainless Steel

The Condensate Seal Water Supply System is fed from the common discharge of the condensate pumps and goes through CV-73 which is set by a local controller with a variable setpoint, normally set for 125 psig. The system supplies various components to prevent air inleakage to the condensers through valve packing and to provide cooling/lubrication for condensate pump seals. It also supplies Hotwell Level Transmitters to maintain them filled with water to prevent air inleakage. Low condensate pump seal water pressure is annunciated in the Control Room by PS-91.

N

2.0 DESCRIPTION (Continued)

2.2.11 **Fifth Point Heaters (E-9A and E-9B)**

E-9A AND E-9B	
LOCATION:	Heater deck adjacent to turbine
HEATER TYPE:	U-tube, integral with flash evaporator
TUBE SIDE	
FLUID CIRCULATED:	Condensate from Fifth Point Drain Cooler
DESIGN MATERIAL:	Copper-Nickel U-tubes
NUMBER OF TUBES:	644 tubes 3/4" diameter
DESIGN PRESSURE:	350 psig
FLOWRATE:	1,891,821 LB/Hr
NOMINAL INLET TEMPERATURE:	~99.8°F
NOMINAL OUTLET TEMPERATURE:	~103.2°F
ENTHALPY IN:	67.8 BTU/LB
ENTHALPY OUT:	121.1 BTU/LB
SHELL SIDE	
FLUID CIRCULATED:	Steam
DESIGN MATERIAL:	Carbon Steel
DESIGN PRESSURE:	15 psig
NOMINAL PRESSURE:	22" Hg vacuum
DESIGN TEMPERATURE:	300°F
NOMINAL TEMPERATURE:	107°F
ENTHALPY IN:	1090.9 BTU/LB (Steam)
ENTHALPY OUT:	126.2 BTU/LB (Condensate)

.1 Supporting Components and Indication:

Temperature is indicated at the heater inlets and outlets by local dial temperature indicators.

2.0 DESCRIPTION (Continued)

2.2.12 Drain Cooler for Fifth Point Heaters (E-9A and E-9B)

E-9A AND E-9B	
LOCATION:	Heater deck adjacent to turbine
TUBE SIDE	
FLUID CIRCULATED:	Condensate from Gland Seal Steam Condenser
DESIGN MATERIAL:	Copper-Nickel U-tubes
NUMBER OF TUBES:	108 U-tubes 1.5" diameter
DESIGN PRESSURE:	350 psig
DESIGN TEMPERATURE:	250°F
FLOWRATE:	1,891,821 LB/Hr
INLET TEMPERATURE:	93.3°F
OUTLET TEMPERATURE:	99.8°F
ENTHALPY IN:	61.3 BTU/LB
ENTHALPY OUT:	67.8 BTU/LB
SHELL SIDE	
FLUID CIRCULATED:	Heater drainage
DESIGN MATERIAL:	Carbon Steel
DESIGN PRESSURE:	15 psig
DESIGN TEMPERATURE:	250°F
INLET TEMPERATURE:	158.2°F
OUTLET TEMPERATURE:	107.3°F
ENTHALPY IN:	126.2 BTU/LB (Condensate)
ENTHALPY OUT:	75.2 BTU/LB (Condensate)

2.0 DESCRIPTION (Continued)

2.2.13 Fourth Point Heaters (E-9A and E-9B)

E-9A AND E-9B	
LOCATION:	Heater deck adjacent to turbine.
HEATER TYPE:	U-tube integral with flash evaporator.
TUBE SIDE	
FLUID CIRCULATED:	Condensate from 5th point heater
DESIGN MATERIAL:	Copper-Nickel U-tubes
NUMBER OF TUBES:	542 tubes 3/4" diameter
DESIGN PRESSURE:	350 psig
DESIGN TEMPERATURE:	300°F
FLOWRATE:	1,891,821 LB/Hr
NOMINAL INLET TEMPERATURE:	~103.2°F
NOMINAL OUTLET TEMPERATURE:	~190°F
ENTHALPY IN:	121.1 BTU/LB
ENTHALPY OUT:	173.7 BTU/LB
SHELL SIDE	
FLUID CIRCULATED:	Extraction steam
DESIGN MATERIAL:	Carbon Steel
DESIGN PRESSURE:	15.0 psig
NOMINAL PRESSURE:	6.5" Hg vacuum
DESIGN TEMPERATURE:	300°F
NOMINAL TEMPERATURE:	158°F
ENTHALPY IN:	1108.6 BTU/LB (Steam)
ENTHALPY OUT:	135.1 BTU/LB (Condensate)

.1 Supporting Components and Indication:

Temperature is indicated at the heater inlets and outlets by local dial temperature indicators.

2.0 DESCRIPTION (Continued)

2.2.14 Third Point LP Heaters (E-8A and E-8B)

E-8A AND E-8B	
LOCATION:	Heater deck adjacent to turbine
HEATER TYPE:	Horizontal U-tube and shell
TUBE SIDE	
FLUID CIRCULATED:	Condensate from 4th pt. heater
DESIGN MATERIAL:	Copper-Nickel U-tubes
NUMBER OF TUBES:	522 tubes 3/4" diameter
DESIGN PRESSURE:	350 psig
DESIGN TEMPERATURE:	300°F
FLOWRATE:	1,887,692 LB/Hr
NOMINAL INLET TEMPERATURE:	~205.9°F
NOMINAL OUTLET TEMPERATURE:	~259.9°F
ENTHALPY IN:	173.9 BTU/LB
ENTHALPY OUT:	228.5 BTU/LB
SHELL SIDE	
FLUID:	Extraction steam
DESIGN MATERIAL:	Carbon Steel
DESIGN PRESSURE:	50 psig
NOMINAL PRESSURE:	21 psig
DESIGN TEMPERATURE:	400°F
NOMINAL TEMPERATURE:	250°F
ENTHALPY IN:	1174.2 BTU/LB (Steam)
ENTHALPY OUT:	233.6 BTU/LB (Condensate)

.1 Supporting Components and Indications:

Temperature is indicated locally at the heater outlets by local dial temperature indicators.

2.0 DESCRIPTION (Continued)

2.2.15 2nd Point LP Heaters (E-7A and E-7B)

E-7A AND E-7B	
LOCATION:	Heater deck adjacent to turbine
HEATER TYPE:	Horizontal U-tube and shell
TUBE SIDE	
FLUID CIRCULATED:	Condensate from 3rd pt. heater
DESIGN MATERIAL:	Copper-Nickel U-tubes
NUMBER OF TUBES:	810 tubes 3/4" diameter
DESIGN PRESSURE:	350 psig
DESIGN TEMPERATURE:	400°F
FLOWRATE:	2,853,386 LB/Hr
NOMINAL INLET TEMPERATURE:	~245°F
NOMINAL OUTLET TEMPERATURE:	~327°F
ENTHALPY IN:	230.3 BTU/LB
ENTHALPY OUT:	308.3 BTU/LB
SHELL SIDE	
FLUID:	Extraction steam
DESIGN MATERIAL:	Steel
DESIGN PRESSURE:	150 psig
NOMINAL PRESSURE:	90 psig
DESIGN TEMPERATURE:	400°F
NOMINAL TEMPERATURE:	270°F
FLOWRATE:	222,790 LB/Hr
ENTHALPY IN:	1007.7 BTU/LB (Steam)
ENTHALPY OUT:	244.6 BTU/LB (Condensate)

2.0 DESCRIPTION (Continued)

2.2.15 **2nd Point LP Heaters (E-7A and E-7B)** (Continued)

.1 Supporting Components and Indications:

Temperature is indicated locally at the heater outlets by local dial temperature indicators.

2.0 DESCRIPTION (Continued)

2.2.16 Main Feedwater Pump Condensate Suction Valves HV-854 A & B

HV-854 A & B	
PURPOSE:	- Normal suction valves for the Main Feedwater Pumps. - To provide a positive isolation of the Condensate System from the Safety Injection System when the Main Feedwater Pumps are in the Safety Injection Mode.
LOCATION:	NW and SW corners of feed pumps
OPERATOR TYPE:	Pneumatic /Hydraulic
VALVE SIZE:	14"
VALVE TYPE:	Double Disc Gate Valves
FAIL POSITION:	Open
OPENING TIME:	5 minutes (Maximum)
CLOSING TIME:	7 seconds (Maximum)
DESIGN PRESSURE:	350 psig
DESIGN TEMPERATURE:	350°F
DESIGN DIFFERENTIAL:	350 psig
DESIGN MATERIAL:	Carbon Steel

Valve operator's pneumatic supply pump is normally fed from the Compressed Air Systems (see SD-SO1-420 Compressed Air Systems), with a common back-up supply from nitrogen bottles, which also supply valves HV-852 A & B (see SD-SO1-410 Compressed Gas Systems). For arrangement of Service Air and back-up Nitrogen supply see Figure 3.

CONTROL SEQUENCE, INDICATIONS AND INTERLOCKS: (See Figure 4)

To open HV-854 A or B: HV-851 A or B respectively must be closed or intermediate position with no Sequencer Signal and Control Room Handswitch to Open.

To close HV-854 A or B: Sequencer Signal or HV-851 A or B respectively open or Control Room Handswitch to Close.

There are four indicating lights associated with each valve: Red - Open, Green - Closed, White - Normal, and Blue - Safety Injection Signal from the Sequencer.

2.0 DESCRIPTION (Continued)

2.2.16 **Main Feedwater Pump Condensate Suction Valves (HV-854 A & B)** (Continued)

HV-854 A & B must be fully closed prior to HV-851 A & B being opened to prevent unborated water addition to the RCS. Signal is provided by Limit Switches in the Control Scheme of HV-854 A & B. For details of HV-851 and 853 see SD-SO1-580, Safety Injection, Recirculation, and Containment Spray.

2.0 DESCRIPTION (Continued)

2.2.17 **Main Feedwater Pump Feedwater Discharge Valves (HV-852 A & B)**

HV-852 A & B	
PURPOSE:	-Normal discharge valves for the Main Feedwater Pumps -To provide a positive isolation of the Feedwater System when the Main Feedwater Pumps are in the Safety Injection Mode.
LOCATION:	SE corners of Main Feedwater Pumps
OPERATOR TYPE:	Pneumatic/Hydraulic
VALVE SIZE:	12"
VALVE TYPE:	Double Disc Gate Valves
FAIL POSITION:	Open
OPENING TIME:	15 minutes (normally 2-3 minutes)
CLOSING TIME:	5 seconds
DESIGN PRESSURE:	1500 psig
DESIGN TEMPERATURE:	350°F
DESIGN DIFFERENTIAL:	1500 psig
DESIGN MATERIAL:	Carbon Steel
CONTROL SEQUENCE:	See Figure 4
OPEN:	No Sequencer Signal and Control Room Handswitch to Open
CLOSE:	Sequencer Signal or Control Room Handswitch to Close
INDICATIONS:	- Red Light - Open - Green Light - Closed - White Light - Normal - Blue Light - Safety Injection Signal (Sequencer)

Valve operator's pneumatic supply is normally from the Compressed Air Systems (see SD-S01-420 Compressed Air Systems), with a common back-up supply from nitrogen bottles, which also supply valves HV-854A & B (see SD-S01-410 Compressed Gas Systems). For arrangement of Service Air and back-up Nitrogen supply see Figure 3.

2.0 DESCRIPTION (Continued)

2.2.18 PNEUMATIC/HYDRAULIC CONTROL SYSTEM FOR HVs 852 AND 854 A & B

All of the pneumatic valves are normally operated by service air. High pressure nitrogen bottles supply backup Motive Force for the pumps. A Solenoid Valve at the bottles and a selector switch located in the Control Room on the north vertical board (one switch for A and one for B Train) allow for alignment when service air supply fails. R

To maintain proper oil viscosity for more reliable operation, each valve is equipped with Hydraulic Oil Heaters controlled by temperature controllers which maintain the temperature at 95°F ± 10°F.

The signal conditioning alarm systems (SCAS) utilizes pressure transducers, installed in the cylinder hydraulic system of each valve actuator to monitor system pressure.

For more details of HV heater controls and pressure monitoring see SD-SO1-580, Safety Injection, Recirculation and Containment Spray Systems. N

The Pneumatic/Hydraulic valves are designed to move to the safety-related position within approximately 7 seconds. This is accomplished by the use of a gas-charged accumulator, driving the piston to the required position. The valves are moved to the non-safety related position by pneumatic hydraulic pump operation which takes approximately 10 minutes. R R

HV-852 and HV-854 A and B Operation (See Figure 3

OPEN
- SV1 and SV2 de-energize and close
- SV525, 527, 529 and 531 de-energize and open (Pneumatic Drive to P/H Pumps)
- 70 to 1 (57 to 1 for HV-854) ratio Pneumatic/Hydraulic Pump Starts R
- Oil is forced into the bottom of piston cylinder, forcing piston up
- As piston moves up - valve closes and oil is forced back to Accumulator
- Accumulator is recharged by piston movement

CLOSE
- SV525, 527, 529 and 531 energize and close (Pneumatic Drive to P/H Pumps).
- Pneumatic/Hydraulic Pump motive force is removed
- SV1 and SV2 are energized and open
- Oil Ports off the bottom of the Actuator Piston
- Accumulator Oil Pressure forces Actuator Piston down
- Valve closes

2.0 DESCRIPTION (Continued)

2.2.19 **East and West Main Feedwater Pumps (G3A and G3B)**

	G3A AND G3B
PURPOSE:	-To pump feedwater from the condensate system to the steam generators -To pump borated water into the RCS during S.I. Mode
TYPE:	Two Stage, Double Volute, Centrifugal
PRIME MOVER:	4160 V, Induction Motor
DESIGN HORSEPOWER:	3500 HP
DESIGN SPEED:	3550 RPM
TEMPERATURE OF PUMPED FLUID:	351°F Feedwater 40°F - 90°F Safety Injection
ADDITIONAL DESIGN FEATURE:	The Main Feedwater pumps are designed to withstand a 300°F temperature drop in a 10 second interval. The requirement is necessary because of the dual function of the pumps.
DESIGN FLOWRATE:	7,000 gpm Feed Mode 10,500 gpm SI Mode
DESIGN HEAD:	790 psig
REQUIRED NPSH:	69 psig
SHUTOFF HEAD:	1200 psig
NPSH:	81 psig in SI Mode
DESIGN MATERIAL:	Chrome Alloy Steel
PUMP SEAL TYPE:	Stuffing Box Bushings

2.0 DESCRIPTION (Continued)

2.2.19 **East and West Main Feedwater Pumps (G3A and G3B)** (Continued)

CONTROLS AND INTERLOCKS: (See Figure 5)

Each Main Feedwater Pump can be started and stopped by pushbuttons located in the Control Room on the south side of the "J" Console.

The Main Feedwater Pumps can also be started by a Safety Injection Signal from the Safeguards load Sequencing system. (See SD-S01-580, Safety Injection, Recirculation and Containment Spray.)

On a sequencer signal the Main Feedwater Pump will trip (if running) and start 11 seconds later from the 162-1 Time Delay Relay. This is to allow for suction and discharge valve realignment to the SI Mode of operation.

Main Feedwater Pumps start interlocks also include:

186 Lockout Relay Reset (Overcurrent either time or instantaneous)
and 194 Lockout Relay (Undervoltage 4kV Bus)

Supporting Components and Instrumentation:

Recirculation failure is alarmed in the control room by a pressure switch (PS) placed on the output of each respective Main Feedwater Pump normal suction flow transmitter to recirculation flow control. As suction flow decreases the output from the flow transmitter to the flow controller decreases causing the recirculation valve to open, thereby reestablishing minimum suction flow. If this minimum flow is not maintained, the output pressure from the flow transmitter continues to decrease until the pressure switch initiates the recirculation failure alarm at an output pressure equivalent to 400 gpm. R

Low Suction Pressure is annunciated in the control room at 175 psi, if the respective feedwater pump is running. It is indicated in the control room on West Vertical Board circular recorder R-7 and locally at the Feed Pump suction pressure transmitter.

Suction Temperature is monitored by local temperature elements and recorded in control room on West Vertical Board circular recorder R-7.

Main Feedwater Pump Lube Oil System (see Figure 6)

The Main Feed Pump Lube Oil System consists of a mechanical shaft driven main oil pump, an electric motor driven auxiliary lube oil pump, an oil reservoir, an oil cooler cooled by Turbine Plant Cooling Water, an air cooled oil cooler, and associated piping and instrumentation.

2.0 DESCRIPTION (Continued)

2.2.19 **East and West Main Feedwater Pumps (G3A and G3B)** (Continued)

Main Feedwater Pump Lube Oil System (Continued)

The air cooled oil cooler is in service to comply with Technical Specification requirements defining operability of the Main Feedwater Pump. Turbine Plant Cooling Water (TPCW) is left isolated in the TPCW oil cooler during normal operation.

During pump startup the motor driven auxiliary oil pump takes suction from the lube oil reservoir and discharges to the feedwater pump and motor bearings through the air cooled oil cooler. The oil is returned to the oil reservoir.

Pushbutton manual start-stop switches for the auxiliary lube oil pump are located in the control room on the south portion of the "J" console.

Automatic start of the electric lube oil pump is initiated by following conditions:

Respective feedwater pump breaker closed

or

Condensate Pump discharge header pressure greater than 150 psig as sensed by PS-17.

and

Pressure on the lube oil system less than 4 psig as sensed by PS-46 (east pump) and PS-47 (west pump).

R

The auxiliary lube oil pump stops automatically when oil pressure is greater than 7 psig as sensed by PS-59 (east pump) and PS-60 (west pump). This would indicate that the oil pressure is being maintained by the shaft driven lube oil pump after the feedwater pump is started.

The shaft driven oil pump takes suction from the lube oil reservoir and discharges through a normally open manual valve to the air cooled oil cooler. From here flow is directed to the inboard and outboard pump and motor bearings. The oil is discharged to the lube oil reservoir.

2.0 DESCRIPTION (Continued)

2.2.19 **East and West Main Feedwater Pumps (G3A and G3B)** (Continued)

The oil cooler fan for each feedwater pump has a 3 position selector switch (On-Off-Auto) with On-Off indicating lights located at each respective Motor Control Center (MCC1A for west and MCC2 for east). Automatic start of the lube oil cooler is initiated by the following conditions:

Respective feedwater pump breaker closed

and

From TS-34 (east cooler) and TS-35 (west cooler) the fan will start at 110°F and stop at 100°F.

Oil temperature is indicated locally at the inlet to the air cooler by TI-157 and at the air cooler outlet by TI-1980. Oil pressure is indicated locally by PI-1980.

Main Feedwater Pump and Motor bearing temperatures are indicated and recorded on the West Vertical Board of the Control Room at Recorder R-4. The following is a list of indications and points recorded.

R

Pump/Motor	Bearing	R-4 Point Rec
West Pump	Inboard	37
West Pump	Outboard	35
West Pump	Outboard	36
East Pump	Inboard	32
East Pump	Outboard	30
East Pump	Outboard	31
West Motor	Inboard	38
West Motor	Outboard	39
East Motor	Inboard	33
East Motor	Outboard	34

Temperature recorder R-4 is equipped with high bearing temperature alarms.

Feedwater pump seal water is supplied from the Condensate Pump Discharge Header.

Seal bleedoff returns to the Condenser or can be routed to floor drains.

On occurrence of Safety Injection, or during a hot Safety Injection Test, seals must be manually secured to prevent borated water addition to the Condenser.

2.0 DESCRIPTION (Continued)

2.2.20 First Point High Pressure Heater (E-6A and E-6B)

E-6A AND E-6B	
LOCATION:	Heater deck adjacent to turbine
HEATER TYPE:	Horizontal Tube and Shell
TUBE SIDE	
FLUID CIRCULATED:	Feedwater from the Main Feed Pumps
DESIGN MATERIAL:	Copper-Nickel U-tubes
NUMBER OF TUBES:	904 tubes 3/4" diameter
DESIGN PRESSURE:	1367 psig
DESIGN TEMPERATURE:	450°F
FLOWRATE:	2,853,386 LB/Hr
NOMINAL INLET TEMPERATURE:	~339°F
NOMINAL OUTLET TEMPERATURE:	405°F
ENTHALPY IN:	311.8 BTU/LB
ENTHALPY OUT:	394.4 BTU/LB
SHELL SIDE	
FLUID CIRCULATED:	Extraction Steam
DESIGN MATERIAL:	Carbon Steel
DESIGN PRESSURE:	400 psig
NOMINAL PRESSURE:	250 psig
DESIGN TEMPERATURE:	650°F
NOMINAL TEMPERATURE:	340°F
ENTHALPY IN:	1134.4 BTU/LB (Steam)
ENTHALPY OUT:	321.1 BTU/LB (Condensate)

2.0 DESCRIPTION (Continued)

2.2.20 **First Point High Pressure Heater (E-6A and E-6B)** (Continued)

.1 Supporting Components and Indications: (See Figure 1A)

Temperature is indicated at the inlet, locally, by temperature indicator TI-21 for the East Heater and by TI-22 for the West Heater. Outlet temperatures are indicated by TI-41 and TI-42 respectively.

Pressure is indicated locally on the outlet of each heater by Pressure Indicators PI-47 (east) and PI-48 (west). Pressure Transmitter PT-4 transmits a discharge pressure signal to a recorder in the Control Room.

2.0 DESCRIPTION (Continued)

2.2.21 Main Feedwater Pump Normal Miniflow Valves (CV-36 and CV-37)

CV-36 AND CV-37	
PURPOSE:	Valves open to maintain adequate flow.
LOCATION:	NW and NE Corners of the Condenser in the Condenser Bay
OPERATOR TYPE:	Pneumatic
VALVE TYPE:	Drag Valves
VALVE SIZE:	3 inch
FAIL POSITION:	Open
DESIGN MATERIAL:	Stainless Steel

Valve operator's pneumatic supply is normally from the Compressed Air Systems (see SD-S01-420 Compressed Air Systems), with each valve having an independent back-up supply from local nitrogen bottles (see SD-S01-410 Compressed Gas Systems).

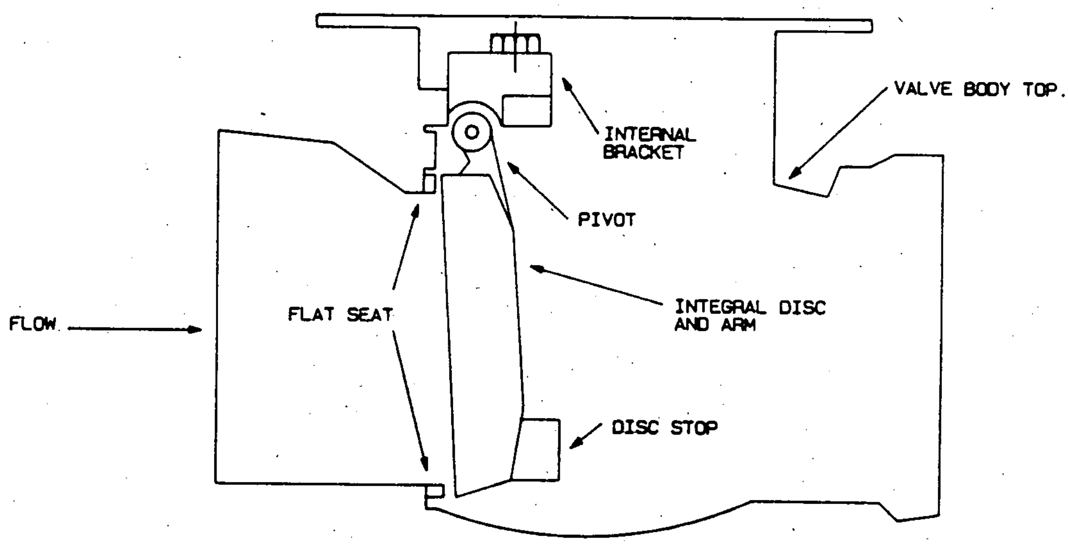
.1 Supporting Components and Indications:

Main Feedwater Pump Minimum Flow systems are provided for both feedwater pumps. Each system consists of a takeoff from the feedwater pump discharge (upstream of the shutoff valve) which returns to the condenser through Control Valves CV-36 and CV-37 and pressure breakdown orifices (RO-152 and RO-154). Minimum flowrate is approximately 1050 gpm.

2.0 DESCRIPTION (Continued)

2.2.22 Swing Check Valves

FIGURE 7: SWING CHECK VALVE



The check valves identified on the Condensate and Feedwater System are termed Swing Check Valves. They are opened by differential pressure in the normal direction of flow. As the differential pressure increases (as in starting a pump) the integral disk is forced up until the disk stop comes in contact with the top of the valve body while the disk pivots on the internal bracket. As the differential pressure decreases in the desired direction of flow the weight of the disk will allow it to pivot closed against the flat seal thus preventing any backflow into a lower pressure system. The higher the differential pressure is in the reverse direction the faster the integral disk will close and the tighter the seat rests against the flat seating surface.

2.0 DESCRIPTION (Continued)

2.3 Detailed Control Scheme

2.3.1 Main Feedwater Pump Minimum Flow

Control Valves CV-36 and CV-37, are modulated open or closed by Flow Transmitters FT-6 and FT-7 according to flow through the Feedwater Pumps. The valves modulate to maintain a minimum flow of 1050 gpm through each pump.

A signal from the Safety Injection System also operates the solenoid valves and closes the control valves (CV-36 and CV-37) to prevent borated water from entering the condensers during safety injection. Safety Injection System Feedwater pump miniflow valves 875 A & B controls are interlocked with the feedwater pump control circuit, and open on SIS signal to ensure miniflow protection for the feedwater pumps. (See System Description SD-SO1-580, Safety Injection, Recirculation, and Containment Spray.)

2.4 Power Supplies

COMPONENT	LOCATION	BREAKER
East Main Feedwater Pump	4KV Bus 2C	152-12C04
West Main Feedwater Pump	4KV Bus 1C	152-11C04
East MFP Lube Oil Pump	480 V MCC 2	42-1282
West MFP Lube Oil Pump	480 V MCC 1A	42-11A15
East Lube Oil Pump Fan	480 V MCC 2	42-1224
West Lube Oil Pump Fan	480 V MCC 1	42-1124
Condensate Pump NE	4KV Bus 2C	152-12C08
Condensate Pump SE	4KV Bus 2C	152-12C06
Condensate Pump NW	4KV Bus 1C	152-11C08
Condensate Pump SW	4KV Bus 1C	152-11C06

3.0 OPERATIONS

3.1 Start Up Operations

Steam generator water level is established initially, and during startup, by auxiliary feedwater supplied through the main feedwater regulator bypass control valves.

Condenser vacuum is established.

When main steam pressure reaches 300 psi, the second condensate pump and then one feedwater pump are manually started from the unit console. (The feedwater pump will not be started until two condensate pumps are running because of feedwater pump suction requirements). After the feedwater pump has come up to speed the auxiliary lube oil pump is stopped.

Feedwater pump minimum flow recirculation is established automatically by control valves CV-36 and CV-37 which, on low feedwater flow (600 gpm), open the 3 inch recirculation lines between the pump discharge and the condenser.

When the Unit has attained 10% of full load, the third condensate pump and the second feedwater pump are manually placed in service. The fourth condensate pump is positioned for automatic standby.

3.2 Normal Operations

Three one-third capacity condensate pumps are normally in operation, with the fourth pump on automatic standby. An 8 inch balancing crosstie interconnects the discharge side of the east train condensate pumps with the discharge side of the west train condensate pumps.

3.3 Abnormal Operations

Malfunction of any of the low pressure heaters will require isolating the entire low pressure heater group in the affected train. A by-pass from the condensate pump outlet to the feedwater pump suction is provided for this purpose. During operation, the first point heaters can be bypassed by opening their respective bypass isolation valve. One or both First Point Heaters may be bypassed without reducing unit load. In the event a low pressure heater train is required to be isolated, unit load must be reduced to approximately 382 MWe gross. If it becomes necessary to remove both low pressure heater trains from service, unit load must be reduced to approximately 315 MWe gross.

3.0 OPERATIONS (Continued)

3.3 Abnormal Operations (Continued)

Condensate overboarding to the Circulating Water System is performed manually to dispose of condensate contaminated by saltwater inleakage resulting from condenser tube leaks.

Each condensate pump takes suction from one of four hotwell sections. Conductivity is monitored in each hotwell section by conductivity elements (CE-17, 18, 19 and 20) and is recorded and alarmed in the control room. When conductivity increases (causing an alarm) saltwater inleakage is indicated.

Unit load is reduced and the affected hotwell section is isolated (this includes stopping the associated circulating water pump and the associated condensate pump.) Normal and emergency make-up is isolated to the affected half and the respective overboarding valve is opened.

After tube repair the affected hotwell is refilled and the system is realigned for normal operations.

3.4 Shutdown Operations

Following a Station shutdown, one feedwater pump and one condensate pump are shut down to reduce flow. The remaining pumps continue to operate to supply the steam generators during steam bypass operations for removal of residual heat from the reactor core. When main steam pressure has dropped to 350 psig, the second feedwater pump and the remaining condensate pumps may be shut down with steam generator make-up requirements supplied by the Auxiliary Feedwater System.

4.0 REFERENCES

4.1 P&IDs

4.1.1	5178200	Condensate System, Sheet 1
4.1.2	5178201	Condensate System, Sheet 2
4.1.3	5178202	Condensate System, Sheet 3
4.1.4	5178205	Feedwater System, Sheet 1
4.1.5	5178206	Feedwater System, Sheet 2
4.1.6	5178207	Feedwater System, Sheet 3
4.1.7	5178210	1st, 2nd, 3rd Pt. Feedwater Heat, Sheet 1
4.1.8	5178211	1st, 2nd, 3rd Pt. Feedwater Heat, Sheet 2
4.1.9	5178212	1st, 2nd, 3rd Pt. Feedwater Heat, Sheet 3
4.1.10	5178213	1st, 2nd, 3rd Pt. Feedwater Heat, Sheet 4
4.1.11	5178225	Main Steam System, Sheet 1

4.2 Elementaries

4.2.1	5149970	(N1543 SH3) Condensate Pumps
4.2.2	N1543021	(N1543SH21) Feedwater Htr. Level Annunciator System
4.2.3	N1543021A	(N1543SH21A) Feedwater Htr. Level Annunciator System, Sheet 2
4.2.4	0455517	(N1543 SH14) Feedwater Pump Lube Oil Pumps
4.2.5	N154300A	(N1543SHA) Feedwater and Condensate
4.2.6	5149189	(N1542SH35A) Feedwater Pump SI Valve Hydraulic Scheme
4.2.7	5149858	(N1543 SH1) Feedwater Pumps
4.2.8	5149265	(N1542SH35) HV851, 852, 853, 854 A & B Pneumatic Scheme
4.2.9	0455375	(N1543SH11) HV852 A & B Feedwater Pump Discharge Valves
4.2.10	0455372	(N1542SH33) HV853 A & B, Safety Injection Valves
4.2.11	0455374	(N1543SH8) HV854 A & B, Feedwater Pump Suction Valves

4.0 REFERENCES (Continued)

4.3 Procedures

Operating Instruction

S01-3-1, Plant Startup from Cold Shutdown to Hot Standby

S01-3-2, Plant Startup from Hot Standby to Minimum Load

S01-3-3, Plant Operation from Minimum Load to Full Power

S01-3-4, Plant Shutdown from Full Power to Hot Standby

S01-3-5, Plant Shutdown from Hot Standby to Cold Shutdown

S01-3-8, Power Operations

S01-7-2, Main Feedwater System Operation | 2

S01-7-4, Condensate System

S01-7-9, Condenser Operations

S01-7-15, Main and Extraction Steam System

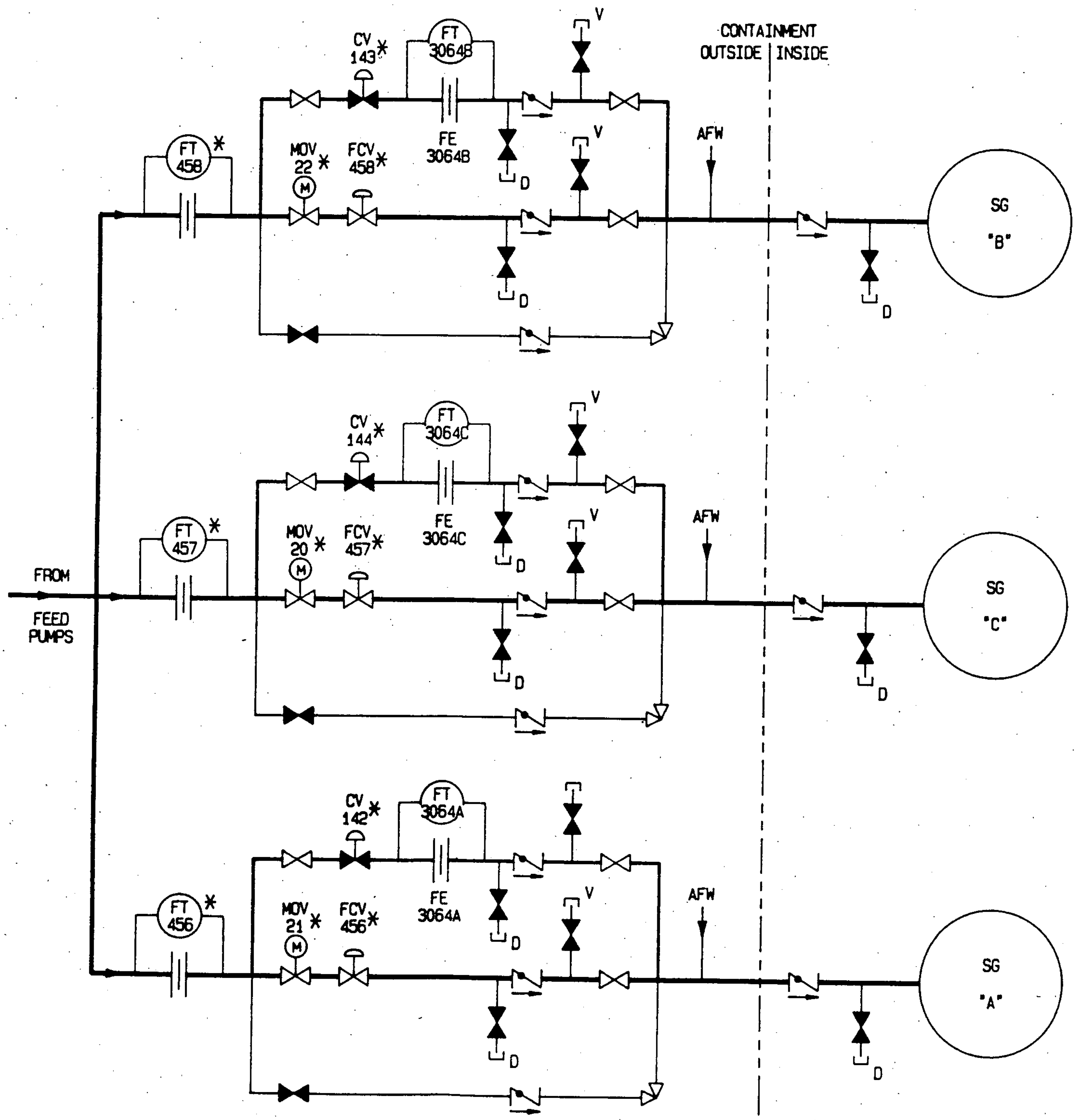
S01-7-17, Operation of Feedwater Heaters

S01-7-24, Steam Generation System Alignment

S01-7-25, Steam Generator Blowdown Operations

S01-13-2, Auxiliary - Supplemental Annunciator | 2

FIGURE 1B: CONDENSATE AND FEEDWATER SYSTEM



APPENDIX A

DEVELOPMENTAL RESOURCES

Study Guide No. 57, Feedwater and Condensate

Bechtel System Description #20, Feedwater and Condensate System

FSAR
Section 3.1
Part 3.1.5, 3.1.6, 3.1.7

Plant Facility Changes

PFC 1-85-3091.0	Nitrogen Back-Up System for CV-36 and CV-37
PFC 1-85-3052.0	Main Feedwater Low Flow Ind.
PFC 1-86-004	Installation of Feedwater System Drain Valve
PFC 1-86-3400.00	Replacement of Feedwater Piping
PFC 1-86-3400.01	East Flash Evaporator Mod.
PFC 1-86-3400.05	West Flash Evaporator Mod.
PFC 1-86-3400.02	East Flash Evaporator Mod.
PFC 1-86-3400.30	Relocation of MFW Check Valves
PFC 1-86-3400.07	West Flash Evaporator Mod.

APPENDIX B

WATER CONTAMINATION OF MAIN FEEDWATER PUMP LUBE OIL

Feedwater Pump Lube Oil contamination had been experienced during startup of the Feedwater Pump.

When a complete train of Feedwater Heaters is removed from service, the inlet pressure at the affected Main Feedwater Pump is higher than the pressure of the pump seal injection water. This is sufficiently high to allow feedwater from the pump casing to overcome seal water pressure and exceed the capacity of the drain lines.

The abnormal leakage causes excessive seal water leakage through the suffing box causing contamination of the lube oil and water splashing on the pump pedestal. Depending on power level, which has a direct effect on feed pump inlet pressure, the lube oil should be sampled periodically. At a Main Feedwater Pump suction pressure of approximately 310 psig the lube oil must be sampled every other day. If, after sampling, it is found that the water concentration is greater than 2%, Maintenance should be directed to flush the oil system. R

During normal operating conditions (> 80% power) the Main Feedwater Pump Suction pressure is between 250 psi and 260 psi. Under these conditions, the seal water pressure and flow is sufficient to exclude water intrusion of the stuffing box.

During normal plant operations, high sump or motor bearing temperatures may be an indication of a contamination problem.

APPENDIX C

SAFEGUARDS AGAINST UNBORATED WATER ADDITION DURING S.I.

System design is safeguarded against the inadvertent addition of significant quantities of unborated water from the feed-water-condensate system by inherent safeguards, electrical valve interlocks, and positive administrative safeguards.

The system design also provides an inherent safeguard against accidental injection of unborated condensate. Even without considering protective interlocks and administrative procedures, it is very unlikely that an operator could produce the degree of system maloperation necessary to inject condensate due to the following:

1. Actuation of the safety injection relays will result in closing the flow path for condensate as well as tripping of the condensate and heater drain pumps. This feature alone provides two-fold assurance that significant quantities of unborated water will not be injected.

2. In order to achieve any condensate injection by individual actuation of components, it is necessary to disregard specific operating instructions, align more than one valve, and start at least one pump.

Protective interlocks between the condensate isolation valves at feedwater pump suction and safety injection header isolation valves at the pump discharge will normally be in service during cold shutdown conditions. Interlocks prevent the opening of one valve unless the other is closed, and further assure that an effective barrier to the flow of condensate is maintained.

APPENDIX D

ANNUNCIATOR LIST

WINDOW NAME (NUMBER)	INPUT	SETPOINT
Feedwater Pump G-3A Low Suction Press/Trip (1)	PS-3 162 S TD Relay	175 psig
Feedwater Pump G-3A E Recirculation Failure (2)	PS-20	400 gpm
Feedwater Pump G-3A Low Oil Pressure (3)	PS-46 63 TDC	4 psig
Feedwater Pump East Lube Oil High Temp (61)	TS-34	130°F
Feedwater Pump G-3B W Low Oil Pressure (18)	PS-47 63 TDC	4 psig
Feedwater Pump G-3B W Recirculation Failure (19)	PS-10	400 gpm
Feedwater Pump G-3B W Low Suction Press (20)	PS-4 1625 TD Relay	175 psig
Condensate Pump Seal Low Press (73)	PS-91	40 psig
Condenser Hotwell Tank Hi-Lo Level (34)	LS-17	High 2'10" above bottom Low 2'2" above bottom

APPENDIX E

FEEDLINE WATER HAMMER

To minimize the probability of water hammer occurrence in the feed lines, when re-establishing feed flow after a period of zero feed flow, it is necessary to avoid steam in the feed lines. It is also necessary to exercise close control over feed at low flow rates when re-establishing flow. 2

To avoid emptying the feed lines and feed ring of water during zero flow check valves are installed in each feed line inside containment. These check valves minimize back flow of water from feed rings, and in flow of steam into the feed lines. Drain valves, downstream of the check valves, permit drainage of these sections of piping, when required. 2 PFC-1-86-3400.03

To ensure auxiliary feedwater is directed to the steam generators, and does not leak into the main feed piping, check valves are incorporated adjacent to each feed regulator, and feed regulator bypass line. This ensures the feed lines and feed rings remain filled and auxiliary feed is properly directed to the steam generators. To facilitate leakage testing of these check valves, drain and vent connections are provided downstream and upstream of each of these check valves. Leakage tests are completed when the plant is shut down. 2 PFC-1-86-004 PFC-1-86-3400.03

During low feed flow conditions accurate indication must be available to the control room operator. A remote reading flow indicator is available for each feed regulatory bypass line to permit accurate remote manual control and indication of low flows. Low flow rates are necessary to prevent rapid condensation of any steam voids which may be present in feed rings or feed lines. 2 PFC-1-86-3051

FEEDWATER CONTROL SYSTEM

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This System Description is approved per S0123-0-44, System Descriptions Drafting, Revision and Approval. Contact CDM to verify revision information.

PREPARED BY: David J Kauppinen — Author — Date: 6-5-87

APPROVED BY: [signature] — Manager, Operations — Date: 6/5/87

0373W.cln

NOT QA PROGRAM AFFECTING

FEEDWATER CONTROL SYSTEM

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(Continued)

FEEDWATER CONTROL SYSTEM

1.0 FUNCTIONS/DESIGN BASES

1.1 The Feedwater Control System has the following main function:

1.1.1 Compares steam and feedwater flow with level deviation from level setpoint to automatically regulate the feedwater flow to the individual Steam Generators.

1.2 The Feedwater Control System has the following additional functions:

1.2.1 Provides input signals for Turbine Trip and Reactor Trip.

1.2.2 Closes feedwater valves upon Sequencer actuation.

1.2.3 Closes feedwater valves upon a Turbine Trip when accompanied by loss of Main Feedwater and actuation of Auxiliary Feedwater.

R

1.2.4 Prepositions feedwater valves upon a Turbine Trip when accompanied by low Tave.

2.0 DESCRIPTION

2.1 System Overview

2.1.1 **Main Scheme** (Figure 1)

The Feedwater Control System is a three element control system that controls the flow of feedwater to each individual Steam Generator.

The Feedwater Control System receives inputs of density compensated steam flow (steam flow modified by steam pressure), feedwater flow, and Steam Generator narrow range level for each Steam Generator. From these inputs the Feedwater Control System compares the difference between steam and feedwater flow with the level deviation from level setpoint. The resultant error signal is supplied to the individual Feedwater Control Valves to automatically regulate the flow of feedwater to each individual Steam Generator.

2.1.2 **Additional Scheme** (Figure 1)

.1 The Feedwater Control System provides Steam Generator High Water Level Trip signals to the Main Turbine Trip circuitry.

This prevents the intrusion of water into the High Pressure Turbine in the event of high water level in the Steam Generators (see SD-S01-270, Turbine Control System).

.2 The Feedwater Control System provides Steam Flow/Feedwater Flow Mismatch Trip signals to the Reactor Protection System.

This minimizes the effects of a steam line break, feedwater line break, and the loss of heat sink for the Reactor (see SD-S01-570, Reactor Protection System and Permissives).

.3 The Feedwater Control System receives inputs from the Sequencer System (SI Actuation) to close the Feedwater Block Valves, Feedwater Control Valves, and Feedwater Regulating Bypass Valves. R

This minimizes the potential of an uncontrolled cooldown of the Reactor Coolant System and the introduction of borated water into the Steam Generators (see SD-S01-590, Sequencer System).

.4 The Feedwater Control System receives inputs from the Turbine Trip circuitry, the Feedwater Pump Breakers, and the Auxiliary Feedwater System circuitry to close the Feedwater Control Valves and Feedwater Regulating Bypass Valves. R

2.0 DESCRIPTION (Continued)

2.1.2 **Additional Scheme** (Figure 1) (Continued)

.4 (Continued)

This prevents the loss of Auxiliary Feedwater flow, reverse Main Feedwater Pump rotation, and water hammer in the event of a Main Feedwater check valve failure (see SD-SO1-210, Condensate and Feedwater Systems, Appendix E). R

.5 The Feedwater Control System receives inputs from the Turbine Trip Circuitry and Tave circuitry to position the Feedwater Control Valves at 5% open. N

This prevents excessive RCS cooldown after a Reactor trip.

2.0 DESCRIPTION (Continued)

2.2 Components

2.2.1 **Steam Flow Measurement** (Figure 1)

.1 **Flow Elements** FE-460, 461, and 462 are Dall Flow Tubes and installed in the steam outlet lines of Steam Generators A, B and C respectively. The flow elements are compact flow tubes designed for use in flow measurements where a high differential pressure is developed with the lowest possible head loss.

.2 **Differential Pressure Transmitters** FT-460, 461 and 462 are Barton Differential Transmitters for Steam Generators A, B and C respectively. The transmitters measure steam flow as a function of differential pressure across their respective flow element. The flow transmitters provide an output signal of 0 to 2.5 x 10^6 lbs/hr to Steam Flow Computers FM-460, 461 and 462.

.3 **Steam Flow Computers** FM-460, 461 and 462 are located in the racks behind the West Vertical Board and extract the square root of the differential pressure signals provided by FT-460, 461 and 462 respectively. The Steam Flow Computers multiply this signal by a correction factor which is a function of steam pressure supplied by pressure transmitter PT-459 (i.e., Density Compensated Signals).

The Steam Flow Computers provide an output signal of +1 to +9 volts DC which represents true steam flow. The output signals are transmitted to Feedwater Flow Controllers FC-456A, 457A and 458A, Steam/ Feedwater Flow Comparators FM-456B, 457B and 458B, and Steam Generator Level Recorders YR-456, 457 and 458.

2.0 DESCRIPTION (Continued)

2.2.2 **Steam Pressure Measurement** (Figure 1)

.1 **PT-459** is a Foxboro Pressure Transmitter and is located on the east Main Steam Header upstream of the 24 inch block valve. PT-459 transmits a 0 - 1000 psig signal to the Density Correction Ranging Amplifier (PM-459) of the Steam Flow Computers. It also provides a signal to PI-459 located on the West Vertical Board. (PT-459 also provides an input to Steam Dump Controller PC-418A, see SD-S01-190, Main Steam System).

Since steam is compressible, the same measured mass steam flow rate will be different for various steam pressures. Therefore, to indicate a true steam flow rate, the steam flow is corrected for the different steam pressures encountered over the full operating range.

The Density Correction Ranging Amplifier provides a compensation factor in the form of an electronic signal to the Steam Flow Computers to correct steam flow for pressure variations.

2.2.3 **Feedwater Flow** (Figure 1)

.1 **Differential Pressure Transmitters** FT-456, 457 and 458 are Foxboro Differential Pressure Transmitters and are located on the Feedwater Mezzanine. The transmitters measure the feedwater flow as a function of differential pressure developed across Flow Elements FE-456, 457 and 458. The pressure transmitters provide an output signal of 0 to 2.5 x 10^6 lbs/hr to the Feedwater Flow Computers FM-456A, 457A and 458A.

.2 **Feedwater Flow Computers FM-456A, 457A and 458A** are located in the racks behind the West Vertical Board and extract the square root of the differential pressure signals provided by FT-456, 457 and 458 respectively. The Feedwater Flow Computers provide an output signal of +1 to +9 VDC which is a linear function of feedwater flow (i.e. as feedwater flow increases the output voltage signal increases correspondingly). The output signals are transmitted to Feedwater Flow Controllers FC-456A, 457A and 458A, Steam Generator Recorders YR-456, 457, 458 and Steam/Feedwater Flow Comparators FM-456B, 457B and 458B.

2.0 DESCRIPTION (Continued)

2.2.3 **Feedwater Flow** (Figure 1) (Continued)

.3 **Feedwater Flow Controllers** FC-456A, 457A and 458A receive signals from their respective Steam Flow Computers (density compensated steam flow), Feedwater Flow Computers and Steam Generator Level Controllers.

The Feedwater Flow Controllers modify the feedwater flow signal using the Steam Generator level signal and compare this modified feedwater flow signal to the steam flow signal. The controllers then transmit a proportional plus reset signal to their respective Feedwater Control Valves via the Switching Chassis and Feedwater Flow Control Station.

The Feedwater Flow Controllers are located in the racks behind the West Vertical Board.

.4 **Switching Chassis** FC-456B, 457B and 458B are located in the racks behind the West Vertical Board and receive input signals from the Feedwater Flow Controllers, Turbine Trip-Tave and LC-453B, 454B and 455B respectively.

The Switching Chassis determine which signal (Feedwater Flow Controller, Turbine Trip-Tave or Steam Generator Level) is sent to the Feedwater Flow Control Stations.

.5 **Feedwater Flow Control Stations (RMC) FIC-456, 457 and 458** (Figure 3) are Hagan Controllers which are located on the J-Console. R

With the Manual-Automatic Selector Switch in Automatic, the signal from the Feedwater Flow Controller is passed through the control station to the E/P Converter to position the Feedwater Control Valve. If it is desired to adjust the Steam Generator Level, the Auto Level Setpoint Dial is turned until the desired level (demand signal) is indicated on the Auto Level Setpoint Meter. Turning the Auto Level Setpoint Dial changes the level setpoint signal to the Steam Generator Level Controller.

With the Manual-Automatic Selector Switch in Manual, the signal from the Feedwater Flow Controller is blocked. The Manual Level Setpoint Dial is then used to position the Feedwater Control Valve.

2.0 DESCRIPTION (Continued)

2.2.3 **Feedwater Flow** (Figure 1) (Continued)

.5 (Continued)

The Null Meter indicates the difference between the Manual Level Setpoint and the Auto Level Setpoint. The Null Meter is normally maintained at 0 (Manual Signal = Auto Signal) by the adjustment of the Manual Level Setpoint Dial when the control station is in Auto or by the adjustment of the Auto Level Setpoint Dial when the control station is in Manual. By maintaining the Null Meter at 0, a "bumpless" transfer can be made between Manual and Auto, in both directions.

Also, with the control station in Manual, adjusting the Auto Level Setpoint Dial to a null condition will indirectly indicate the Manual Level Setpoint on the Auto Level Setpoint Meter.

.6 **Feedwater Regulating Bypass Valve Control Stations** RMC-142, 143 and 144 (Figure 3) are Hagan Controllers located on the J-Console and Foxboro Controllers located on the Remote Shutdown Panel.

A two position, Normal-Override, selector switch on the Remote Shutdown Panel is used to select which controller (Normal, J-Console; Override, Remote Shutdown Panel) has control of the bypass valves. R

The Manual CV Positioner Dial allows the operator to remotely position the bypass valve.

The position demand signal (0-100%) to the E/P Converter at the bypass valve is indicated on the CV Demand Meter.

NOTE: This indication is NOT the bypass valve position; it is the demand signal because the bypass valve is nonlinear.

Indication	Valve Position
0%	0%
50%	25%
100%	100%

2.0 DESCRIPTION

2.2.3 **Feedwater Flow** (Figure 1) (Continued)

.7 **Steam/Feedwater Flow Comparators FM-456B, 457B and 458B** generate control signals for the two out of three Reactor Trip relay matrix by comparing steam flow to feedwater flow. If two out of three Steam Generators produce a steam flow that exceeds feedwater flow by 25% of Full Load Steam Flow, then the comparator generates a signal to actuate the Reactor Trip circuitry.

.8 **Feedwater Flow Integrator** is mounted on the West Vertical Board and totalizes the electrical inputs from the Feedwater Flow Computers. The display is a digital readout of total feedwater flow in pounds per hour.

2.2.4 **Steam Generator Level Measurement** (Figures 1 and 2)

.1 **Narrow Range Level** is measured by LT-453, 454 and 455 for Steam Generators A, B and C respectively. The level transmitters have a signal range of +9 VDC to +1 VDC corresponding to a 0 to 100 percent level at 800 psig and 520°F (Hot Calibrated). These signals are transmitted to the Steam Generator Level Controllers LC-453A, 454A and 455A; LC-453B, 454B and 455B and LC-453C, 454C and 455C.

.2 **Steam Generator Level Controllers** LC-453A, 454A and 455A are located in the racks behind the West Vertical Board. The controllers compare the Narrow Range level signal with a level setpoint, originating from the Feedwater Flow Control Stations on the J-Console (FIC-456, 457 and 458), to generate a level error signal.

The level error signal is transmitted to the Feedwater Flow Controllers FC-456A, 457A and 458A, where the level error signal is used to modify the Feedwater Flow Signal.

The level signals are transmitted to the Steam Generator Level Recorders YR-456, 457 and 458.

.3 **Steam Generator Level Controllers** LC-453B, 454B and 455B are located in the racks behind the West Vertical Board. The controllers transmit signals to the Switching Chassis FC-456B, 457B and 458B, and the Auto Close logic circuit (see Figure 3). R

2.0 DESCRIPTION (Continued)

2.2.4 **Steam Generator Level Measurement** (Figures 1 and 2) (Continued)

.4 **Steam Generator Level Controllers** LC-453C, 454C, 455C, 450C, 451C and 452C are located in the racks behind the West Vertical Board. The controllers generate control signals for the 2 out of 2 and 1 out of 3 Turbine Trip relay matrix. If both the Wide and Narrow Range Level Instruments on any one of the three Steam Generators reaches the high level trip setpoint (85% NR and 305 in. WR-actual), then a Turbine Trip will occur. R

.5 **Wide Range Level** is measured by LT-450, 451 and 452 for Steam Generators A, B and C respectively. The level transmitters have a signal range of +1 VDC to +9 VDC corresponding to a 0" to 318" level at 80°F (Cold Calibrated). These signals are transmitted to LI-450A, 451A and 452A on the North Vertical Board; LI-450B, 451B and 452B at Feedwater Mezzanine area; LI-450C, 451C and 452C at the Remote Shutdown Panel; and at the Emergency Feed Station. In addition, the transmitters provide signals to Steam Generator Level Controllers LC-450C, 451C, and 452C. R

2.2.5 **Recorders**

.1 **Steam Generator Recorders** YR-456A, 457A and 458A are located on the J-console. Each recorder is a three pen recorder that records the following:

Red Pen - density compensated Steam flow with a range of 0 - 2.5 x 10^6 lbs/Hr.

Blue Pen - Feedwater flow with a range of 0 - 2.5 x 10^6 lbs/Hr.

Green Pen - Steam Generator narrow range level with a range of 0 - 100% (233 to 318 inches)

NOTE: All Steam Generator Narrow Range indication is Hot Calibrated, and all Steam Generator Wide Range indication is Cold Calibrated. See Figure 10 for S/G WR/NR Level Correlation. R

2.0 DESCRIPTION (Continued)

2.2.6 Feedwater Control Valves (FCV-456, 457 and 458)

FEEDWATER CONTROL VALVES (FCV's 456, 457 & 458)	
PURPOSE:	To regulate feedwater flow during power operations to maintain proper Steam Generator water level
LOCATION:	Feedwater Mezzanine, above the Main Lube Oil Reservoir
VALVE TYPE:	Double disc, ported, direct acting globe valve
VALVE SIZE:	8"
FAIL POSITION:	Open
OPERATOR TYPE:	Pneumatic diaphragm
FLOW CHARACTERISTICS:	Linear flow through full length of travel
DESIGN PRESSURE:	985 psig
DESIGN TEMPERATURE:	403°F
DESIGN MATERIAL:	Chrome molebdenum steel
POSITION INDICATION:	J-Console
CONTROLLER LOCATION:	J-Console, Local

.1 Supporting Components and Indications (See Figures 3 and 4)

Electric to Pneumatic (E/P) Converters (YM-456B, 457B and 458B) are provided for each valve to receive control signals. The converters function to convert a -1 to -9 VDC electrical input signal to a proportional pneumatic signal of 6 to 30 psig respectively. The pneumatic signal positions the diaphragm on the control valve. A signal decreasing toward 6 psig will open the valve and a signal approaching 30 psig will close the valve.

2.0 DESCRIPTION (Continued)

2.2.6 **Feedwater Control Valves (FCV-456, 457 and 458)** (Continued)

.1 (Continued)

Each E/P Converter receives an electric signal from the associated Feedwater Flow Control Station (on the J-Console), and outputs a pneumatic signal to the appropriate Bailey Positioner for Feedwater Control Valve positioning. Each Valve can also be positioned locally using the Hand-Open and Hand-Close selectors at the associated Bailey Positioner. R

When a Sequencer Actuation (SIS and SISLOP) occurs, the affected Feedwater Control Valve(s) automatically close after a 20 second time delay. The circuitry opens a solenoid valve which supplies full control air pressure (30 psig) to the Feedwater Control Valve operator. If the respective Steam Generator level is high, then the Feedwater Control Valve will close without the 20 second time delay.

In addition, the Feedwater Control Valves automatically close on an Auxiliary Trip signal. This occurs when both Feedwater Pump Breakers are open, a Turbine Trip has occurred, and either Auxiliary Feedwater System Train A or Train B has actuated.

The valve automatic closure signal (initiated by Sequencer Actuation or the Auxiliary Trip circuit) bypasses the normal Feedwater Control System. R

The valve automatic closure signal is indicated by the red backlit SIS/Aux Trip Reset pushbuttons above the respective Feedwater Regulating Bypass Valve Controller. There is no Control Room Annunciator to alert the Operator of this automatic closure signal.

To regain control of the Feedwater Control Valves after an automatic closure, the actuating condition(s) must be Reset and the appropriate red backlit SIS/Aux Trip Reset pushbuttons must be depressed. The red backlite extinguishes indicating valve control is returned to normal.

FCV-456 receives its SI signal from Sequencer 1, while FCV-457 and 458 receive their SI signal from Sequencer 2.

2.0 DESCRIPTION (Continued)

2.2.7 **Feedwater Regulating Bypass Valves (CV-142, 143 & 144)**

FEEDWATER REGULATING BYPASS VALVES (CV-142, 143 & 144)	
PURPOSE:	To control feedwater flow during startup, cooldown and emergency conditions.
LOCATION:	Feedwater Mezzanine, above the Main Lube Oil Reservoir
VALVE TYPE:	Globe
FAIL POSITION:	Closed
OPERATOR TYPE:	Pneumatic
FLOW CHARACTERISTICS:	Nonlinear
DESIGN PRESSURE:	985 psig
DESIGN TEMPERATURE:	403°F
POSITION INDICATION:	J-Console
CONTROLLER LOCATION:	J-Console, Local

.1 Supporting Components and Indications (see Figures 3 and 5)

Electric to Pneumatic (E/P) Converters are provided for each valve to receive control signals. The converters function to convert a -1 to -9 VDC electrical input signal to a proportional pneumatic signal of 3 to 15 psig respectively. The pneumatic signal positions the diaphragm on the bypass valve. A signal decreasing toward 3 psig will close the valve and a signal approaching 15 psig will open the valve.

Each E/P Converter receives an electric signal from the associated Feedwater Regulating Bypass Valve Control Station (on the J-Console or Remote Shutdown Panel), and outputs a pneumatic signal to the appropriate Bailey Positioner for Feedwater Regulating Bypass Valve positioning. Each valve can also be positioned locally using the Hand-Open and Hand-Close selectors at the associated Bailey Positioner. R

2.0 DESCRIPTION (Continued)

2.2.7 **Feedwater Regulating Bypass Valves (CV-142, 143 & 144)** (Continued)

.1 (Continued)

When a Sequencer Actuation (SIS and SISLOP) occurs, the affected Feedwater Regulating Bypass Valve(s) automatically close after a 20 second time delay. The circuitry opens a solenoid valve which vents the control air from the Feedwater Regulating Bypass Valve operator to atmosphere. If the respective Steam Generator level is High, then the Feedwater Regulating Bypass Valve will close without the 20 second time delay.

In addition, the Feedwater Regulating Bypass Valve(s) automatically close on an Auxiliary Trip signal. This occurs when both Feedwater Pump breakers are open, a Turbine Trip has occurred, and either Auxiliary Feedwater System Train A or Train B has actuated. R

The valve automatic closure signal (initiated by Sequencer Actuation or the Auxiliary Trip circuit) bypasses the normal Feedwater Control System.

The valve automatic closure signal is indicated by the red backlit SIS/Aux Trip Reset pushbutton above the respective Feedwater Regulating Bypass Valve Controller. There is no Control Room Annunciator to alert the Operator of this automatic closure signal.

To regain control of the Feedwater Regulating Bypass Valves after an automatic closure, the actuating condition(s) must be Reset and the appropriate red backlit SIS/Aux Trip Reset pushbuttons must be depressed. The red backlite extinguishes indicating valve control is returned to normal.

CV-142 receives its SI signal from Sequencer 1, while CV-143 and 144 receive their SI signal from Sequencer 2.

2.0 DESCRIPTION (Continued)

2.2.8 Feedwater Block Valves (MOV's 20, 21 & 22)

Feedwater Block Valves (MOV's 20, 21 & 22)	
PURPOSE:	To provide positive feedwater isolation.
LOCATION:	Feedwater Mezzanine, above the Main Lube Oil Reservoir
VALVE TYPE:	Gate
OPERATOR TYPE:	480 VAC Motor
DESIGN PRESSURE:	985 psig
DESIGN TEMPERATURE:	403°F
POSITION INDICATION:	J-Console
CONTROLLER LOCATION:	J-Console

.1 Supporting Components and Indication (Figure 6)

Controls for each MOV are located on the J-Console and consist of three backlit pushbuttons.

The Open (Red) pushbutton opens the valve, the Close (Green) pushbutton closes the valve, and the Stop pushbutton stops motion of the valve. To resume valve motion, after the Stop pushbutton has been depressed, the appropriate pushbutton must be depressed.

The valves will automatically close on a Sequencer Actuation. If the Stop pushbutton is depressed during a Sequencer Actuation, the valve motion will stop as long as the pushbutton is depressed. Once the Stop pushbutton is released and the Sequencer signal is still present, valve motion will automatically be resumed.

MOV-20 and 22 receive their SI signal from Sequencer 1, while MOV-21 receives its SI signal from Sequencer 2.

2.0 DESCRIPTION (Continued)

2.3 Detailed Control Scheme

2.3.1 **Automatic Feedwater Valve Control**

With the Feedwater Control Stations FIC-456, 457 and 458 in automatic, the Feedwater Control Valve position is controlled by the respective Feedwater Flow Controllers, FC-456A, 457A and 458A, which compare the steam flow signal with combined feedwater flow and Steam Generator level signals. The steam flow signal acts as the master setpoint for valve positioning.

If the Steam Generator level signal is above the setpoint, the +5 VDC Normal level signal received from LC-453A, 454A or 455A, will increase. This will raise the combined feedwater flow and level signal, and if greater than the steam flow signal, will cause the Feedwater Control to re-position the Feedwater Control Valve toward the closed position.

If the Steam Generator level signal is below the setpoint, the +5 VDC Normal level signal output from LC-453A, 454A or 455A will decrease. The effect on the Feedwater Control Valve will be the reverse of the action described above.

Any error between the steam flow signal and the combined feedwater flow and Steam Generator level signals causes the respective Feedwater Flow Controller to generate a proportional plus reset output signal (i.e., the magnitude of the input is proportional to the output) which causes the respective FCV-456, 457 or 458 to open or close.

2.3.2 **Feedwater Switching Chassis Control** (Figure 7)

Each Feedwater Switching Chassis (FC-456B, FC-457B and FC-458B) contains a Magnetic Amplifier High S/G Level Relay (LR), a Low Tave Control Relay (RY2), an Adjustable Potentiometer (R3), and a dummy Load Resistor (R1). Figure 7 shows the Switching Chassis for Steam Generator A. Steam Generators B and C are identical except for resistor numbers and relay contact numbers. R

Relay RY2 is common to all three Feedwater Control Systems and energizes when Tave is less than 545°F and a Turbine Trip has occurred.

When Relay RY2 energizes, the Switching Chassis interrupts the automatic signal between the Feedwater Flow Controller and the Feedwater Flow Control Station. Relay RY2 opens contact RY2-12 and closes contacts RY2-1 and RY2-4. The preset electrical signal from Resistor R3 closes the Feedwater Control Valve until it is only 5% open. Resistor R1 places a dummy load on the Feedwater Flow Controller to stabilize the output signal and protect circuitry. R

2.0 DESCRIPTION (Continued)

2.3.2 Feedwater Switching Chassis Control (Continued)

In the event Steam Generator narrow range level rises above 85%, the circuit established by Relay RY2 is overridden. The high Steam Generator level de-energizes Relay LR which closes contact LR(2) and opens contacts LR(3) and LR(1). Contact LR(2) re-establishes a direct path between the Feedwater Flow Controller and the Feedwater Control Station. Contact LR(3) interrupts the 5% open signal from R3, and contact LR(1) removes the dummy load (R1) from the Feedwater Flow Controller. Control reverts to Automatic and the Feedwater Control Valve closes in response to the high Steam Generator level condition. R

In the event of a high Tave (> 545°F) and a Turbine Trip, the Feedwater Control Valves will remain under Automatic Control.

In any of the above events it is possible to manually position the Feedwater Control Valve. The Manual-Automatic Selector Switch on the Feedwater Flow Control Station is selected to Manual and then the Manual Level Setpoint Dial is adjusted to achieve the desired Feedwater Control Valve position.

2.0 DESCRIPTION (Continued)

2.4 Power Supplies

COMPONENT	BREAKER	LOCATION
S/G Level Transmitter Logic Cabinet	8-1102 V	Vital Bus #1
S/G Instrumentation Rack R-10 & R-11	8-1105 V	Vital Bus #1
S/G High Level Trip (Wide Range)	8-1110 V	Vital Bus #1
S/G Instrument Rack R10 & R11	8-1205 V	Vital Bus #2
S/G High Level Trip (Narrow Range)	8-1210 V	Vital Bus #2
S/G Instrument Rack R-10 & R-11	8-1305 V	Vital Bus #3
Misc. Relay Rack R-13	8-1414 V	Vital Bus #4
S/G Instrument Rack R-10 & R-11	8-11R1	Regulated Bus #1
S/G Instrument Rack R-10 & R-11	8-12R1	Regulated Bus #2
S/G Instrument Rack R-10 & R-11	8-13R1	Regulated Bus #3
MOV-20	42-1197	MCC-1
MOV-21	42-1242	MCC-2
MOV-22	42-1387	MCC-3

2.0 DESCRIPTION (Continued)

2.4.1 **Feedwater Control System Power** (Figures 8 and 9)

The Feedwater Control System is provided with four Vital Bus 120 VAC, 60 cycle power sources and four Regulated 120 VAC, 60 cycle power supplies. The power supplies are located in the racks behind the West Vertical Board.

Three of the four Vital Bus power supplies energize the three Foxboro Deviation Bistables mounted in the Steam/Feedwater Flow Comparators. Vital Bus 1, 2 and 3 supply the Steam/Feedwater Flow Comparators for Steam Generators A, B, and C respectively.

The fourth Vital Bus power supply (Vital Bus 4) energizes convenience outlets on the racks and has no interconnections with any part of the Feedwater Control System.

The four Regulated power supplies are used in all other components of the system where 120 VAC, 60 cycle power is required.

.1 ± 15V DC Power Supplies

Primary + 15V DC power is developed by a Technipower unit associated with the Steam Flow Computer. The output of this unit is delivered to the ± 15V DC Throwover Chassis.

Primary -15V DC power is developed by Technipower unit associated with the Feedwater Flow Computer. The output of this unit is also delivered to the ± 15V DC Throwover Chassis.

Separate +15V DC and -15V DC Technipower units deliver backup supplies to the ± 15V DC Throwover Chassis.

The Steam Flow Computer also has -10V DC reference supplies which are used in both the Steam Flow and Feedwater Flow Computers.

When initially energized, the ± 15V DC Throwover Chassis operates on the backup power supply. The availability of backup ± 15V DC power is indicated by two green lights and two voltage meters on the ± 15V DC Throwover Panel, one for +15V DC and one for -15V DC. A red light on the Throwover Panel indicates that backup power is on line.

2.0 DESCRIPTION (Continued)

2.4.1 **Feedwater Control System Power** (Continued)

.1 (Continued)

The availability of the primary ± 15V DC supply is indicated by two green lights on the Throwover Panel, however, its voltage is not indicated when the supply is not on line.

To place the primary ± 15V DC Supply in operation, the Primary Reset button on the Throwover Panel is depressed. The Throwover Relay then puts the primary supply in operation in place of the backup supply. The two green lights of the primary supply remain illuminated and the voltage level is now indicated by the two meters on the Throwover Panel. The Backup On Line red light is extinguished and the Primary On Line white light is illuminated to indicate the use of the primary supply.

While operating on the primary supply, a 30 volt signal is supplied to the Throwover Relay. If the 120 VAC, 60 cycle power supply to the primary supply or the primary supply itself fails, then the 30 volt signal will decrease and the Throwover Relay will automatically switch to the backup supply.

In order to return to the primary supply, the availability of power must be indicated by the green lights on the panel and the Primary Reset button is used to make the transfer.

The transfer from backup supply to primary supply cannot be made automatically.

.2 ± 10 VDC Power Supplies

Primary +10V DC and -10V DC power is developed by QB Nobatron units that deliver their output to the ± 10V DC Throwover Chassis. Separate QB Nobatron units develop the backup +10V DC and -10V DC power supplies and also supply the ± 10V DC Throwover Chassis.

When initially energized, the ± 10V DC Throwover Chassis operates on backup power supply. The availability of backup ± 10V DC power is indicated by two red lights and two voltage meters on the ± 10V DC Throwover Panel, one for the + 10V DC and one for the -10V DC.

The availability of the primary ± 10V DC supply is indicated by two green lights on the Throwover Panel, however, its voltage is not indicated when the supply is not on line.

2.0 DESCRIPTION (Continued)

2.4.1 **Feedwater Control System Power** (Continued)

.2 (Continued)

To place the primary ± 10V DC power supplies in operation, the two Reset pushbuttons (one for each supply) must be pushed. Each supply can be switched independently. When the primary supplies are on line, a red light is illuminated for each supply and the meters indicate the voltage level.

Should there be a power failure affecting the primary supplies, the +10V DC or -10V DC supply will automatically be switched over to the backup supply. When either one or both supplies switch, the affected Primary On-line Red light will extinguish, the green light will extinguish, and the associated voltage meter will show the supplied backup voltage. Upon restoration of one or both primary supplies there will be no automatic return. The Green light(s) showing that it is permissible to shift to the primary power will be illuminated. The reset can then be made and the Red light and voltage meter will show that the primary power is on line. R

Should the backup power supplies fail in any way, the Red lights indicating that the backup supplies are operable will be extinguished.

3.0 OPERATION

3.1 Normal Operations

3.1.1 Startup Operations

Steam Generator Level is initially established at approximately 50% narrow range by the Auxiliary Feedwater System (see SD-SO1-620, Auxiliary Feedwater System). When Tave is at 535°F, Steam Generator Level is maintained at approximately 50% narrow range. All control of feedwater to the Steam Generators is accomplished manually by using the bypass CV's as necessary. During manual control the operator is cautioned to be particularly aware of S/G actual level, because blowdown or Tave changes could cause the feedring to become uncovered. When increasing power from minimum load to full power the appropriate Feedwater Flow Control Stations are manually operated to slowly open the Feedwater Control Valves while simultaneously closing the associated Feedwater Regulating Bypass Valves.

At approximately 20% load and when level is observed to be stable, the Feedwater Flow Control Stations are switched to automatic. Steam Generator level is then reduced to approximately 40% narrow range, and the Feedwater Flow Control Stations are switched to automatic and nulled. Feedwater flows and Steam Generator levels are closely monitored to ensure stability. Unit load is then increased to approximately 23% power where Steam Generator levels are reduced to the normal operating level of 30% and automatically maintained at 30% during escalation to 100% power.

3.1.2 Shutdown Operations

Prior to reducing load to 33%, the level in the Steam Generators is increased to 40%. When level stabilizes or automatic control becomes erratic due to low flow conditions, the Feedwater Flow Control Stations are placed in manual. Steam flows, feed flows, and S/G levels are closely monitored to ensure stability. Steam Generator levels are then slowly increased to 50% narrow range where they are maintained until hot standby is reached.

3.2 Other Operations

3.2.1 Automatic to Manual Transfer of the Feedwater Flow Control Stations

The Manual Level Setpoint Dial (lower knob) is adjusted until the Null Meter indicates a null (zero) reading. The Manual-Automatic Selector Switch is then placed in Manual.

3.2.2 Manual to Automatic Transfer of the Feedwater Flow Control Stations

The Auto Level Setpoint Dial (upper knob) is adjusted until the Null Meter indicates a null (zero) reading. The Manual-Automatic Selector Switch is then placed in Automatic.

4.0 REFERENCES

4.1 P&IDs

4.1.1 5178205, Feedwater System Sh. 1

4.1.2 5178206, Feedwater System Sh. 2

4.1.3 5178207, Feedwater System Sh. 3

4.1.4 5178225, Main Steam System Sh. 1

4.2 Elementaries

4.2.1 5129817-3, (N1543 02) Feedwater Control Diagram

4.2.2 0455379, (N1543 20) MOV's 20, 21 and 22 Feedwater Block Valves

4.2.3 449408, (N1543 26) Sol. Valves FCV-456, 457 and 458 Feedwater Control & Bypass

4.2.4 5147125-2, (N1543 31) Generator Level Control

4.3 Technical Manuals

4.3.1 Hagan Controls Corp. (1810-AC796-M0001)

4.4 Procedures

4.4.1 S01-1.0-30, Loss of Secondary Coolant

4.4.2 S01-1.0-40, Steam Generator Tube Rupture

4.4.3 S01-1.3-2, Response to Steam Generator High Level

4.4.4 S01-1.3-3, Response to Steam Generator Low Level

4.4.5 S01-3-1, Plant Startup From Cold Shutdown to Hot Standby

4.4.6 S01-3-2, Plant Startup From Hot Standby to Minimum Load

4.4.7 S01-3-3, Plant Operation From Minimum Load to Full Power

4.4.8 S01-3-4, Plant Shutdown From Full Power to Hot Standby

4.4.9 S01-3-5, Plant Shutdown From Hot Standby to Cold Shutdown

4.4.10 S01-7-24, Steam Generation System Alignment

4.0 REFERENCES (Continued)

4.4.11 S01-7-2, Main Feedwater System Operations

4.4.12 S01-13-3, Reactor Plant No. 2 Annunciator

4.4.13 S01-13-6, Reactor Plant First Out Annunciator

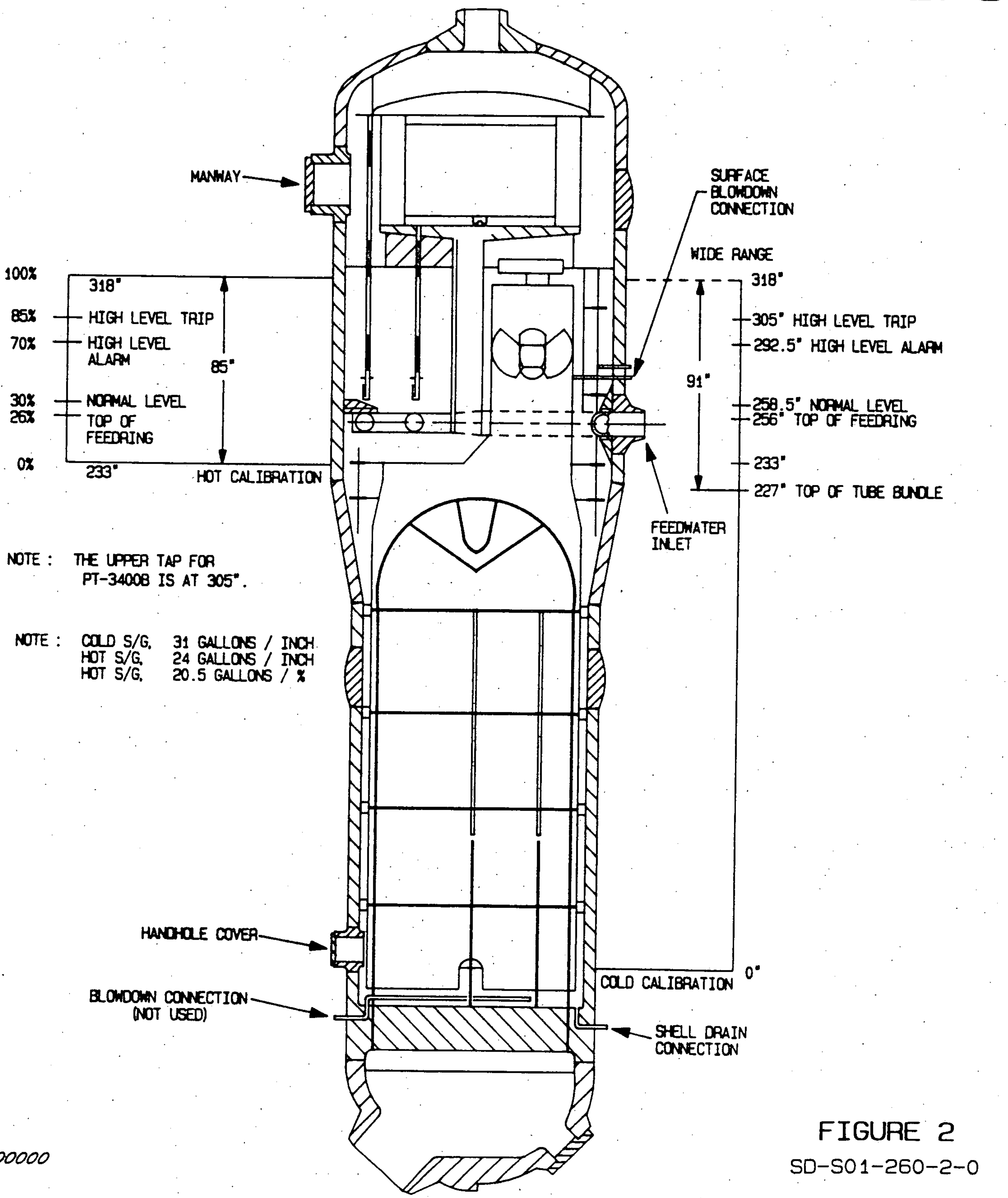
4.4.14 S01-13-7, Reactor Plant Matrix Partial Trip Annunciator

4.5 Technical Specifications

4.5.1 3.5.1, Reactor Trip System Instrumentation

4.5.2 3.5.6, Accident Monitoring Instrumentation

STEAM GENERATOR / LEVEL INSTRUMENT RELATIONSHIPS



NOTE : THE UPPER TAP FOR PT-3400B IS AT 305".

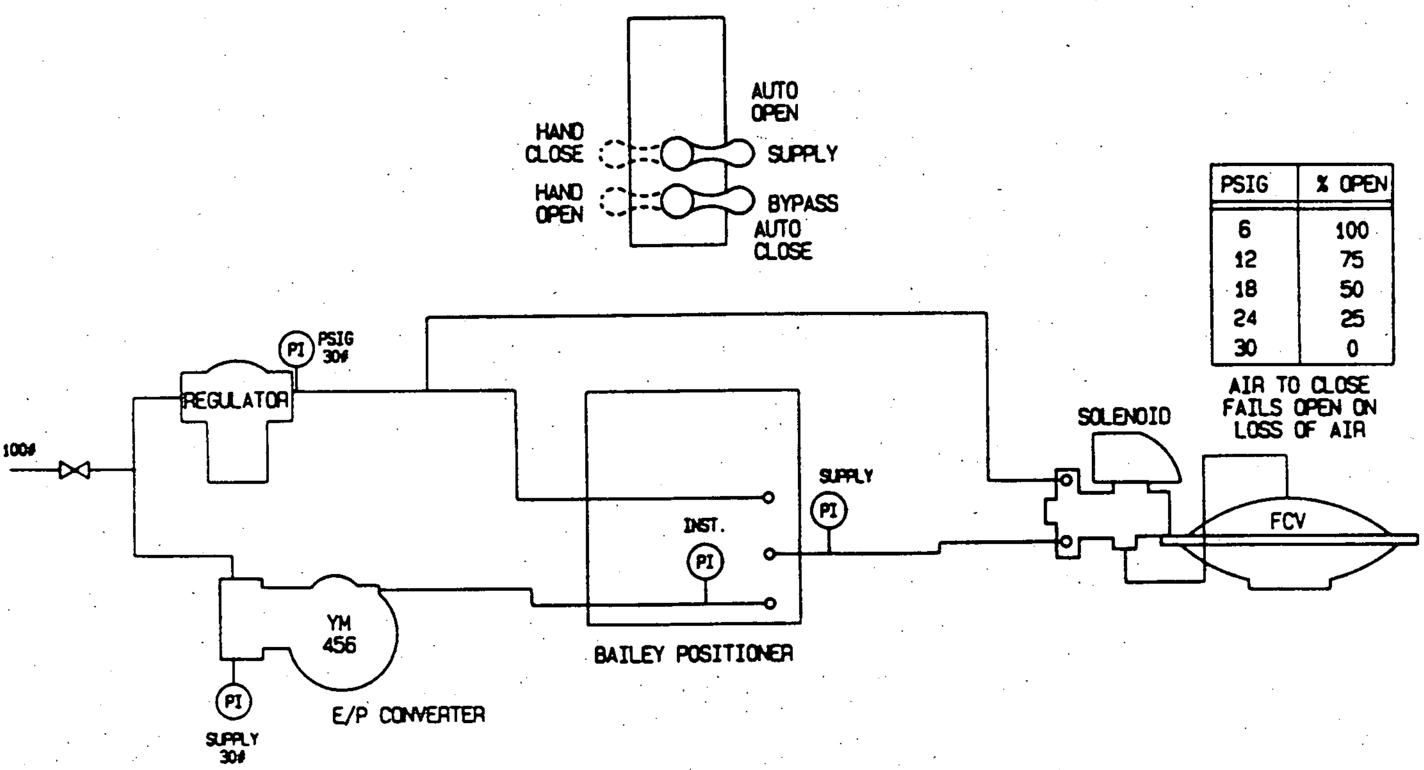
NOTE : COLD S/G, 31 GALLONS / INCH
HOT S/G, 24 GALLONS / INCH
HOT S/G, 20.5 GALLONS / %

FIGURE 2

SD-S01-260-2-0

RP0000000

FIGURE 4: FEEDWATER CONTROL VALVE AIR OPERATION



PSIG	% OPEN
6	100
12	75
18	50
24	25
30	0

AIR TO CLOSE
FAILS OPEN ON
LOSS OF AIR

FIGURE 5: FEEDWATER REGULATING BYPASS VALVE AIR OPERATION

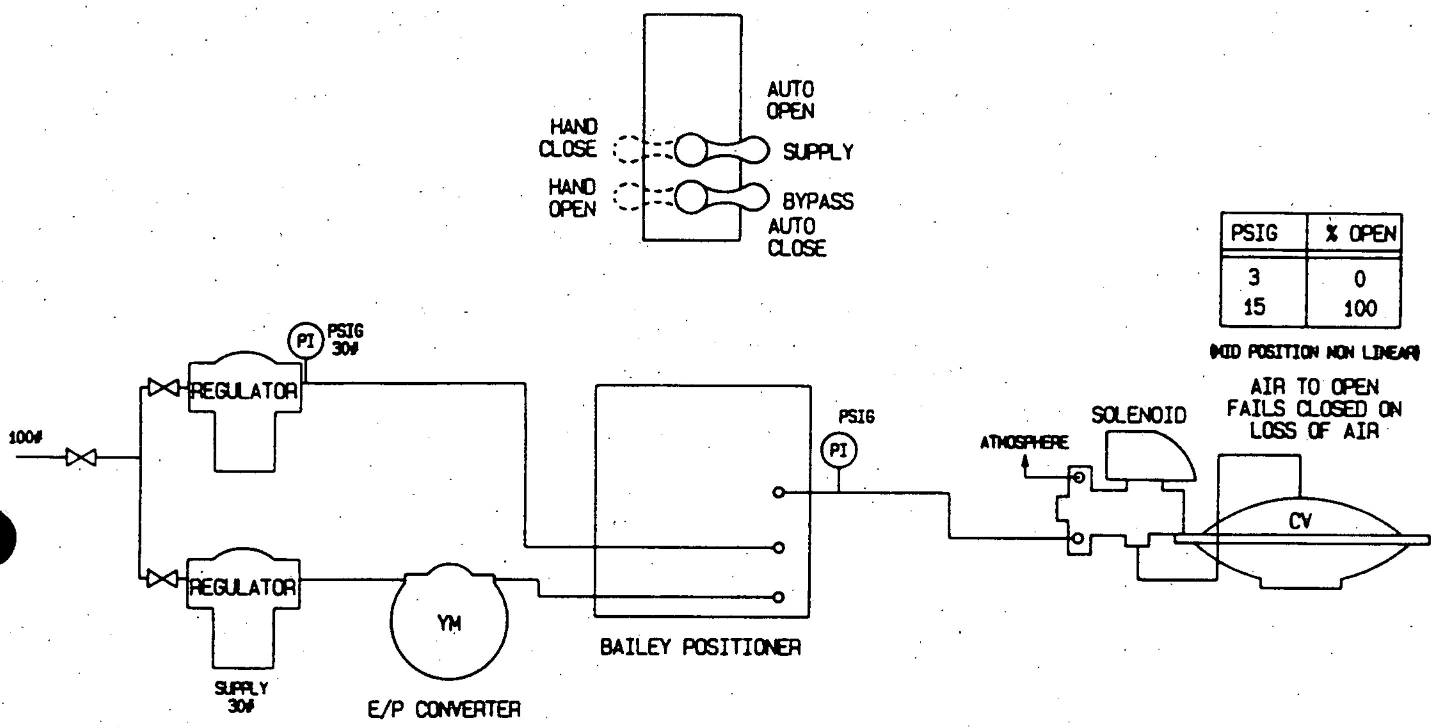
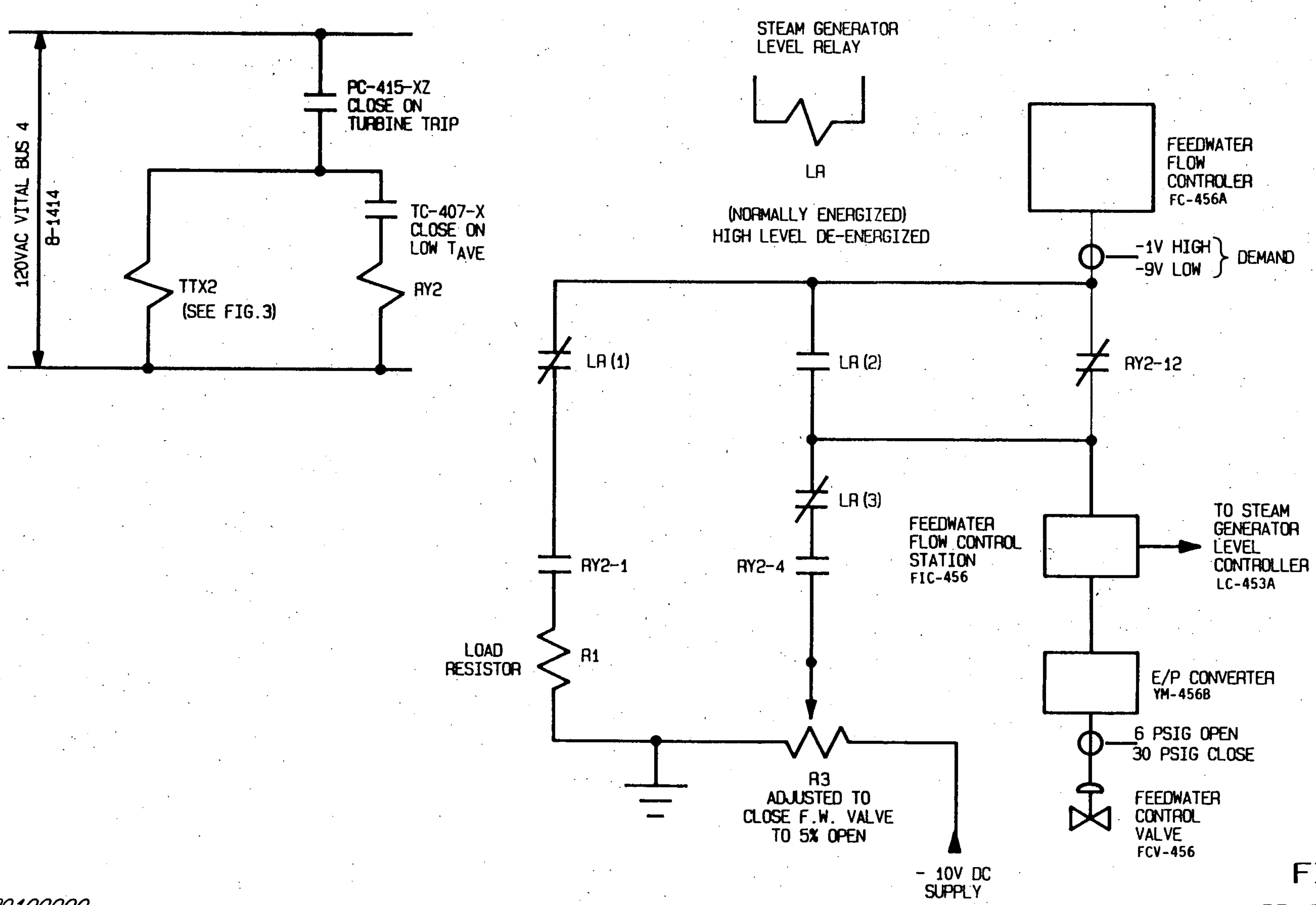


FIGURE 7: SWITCHING CHASSIS FOR ONE STEAM GENERATOR

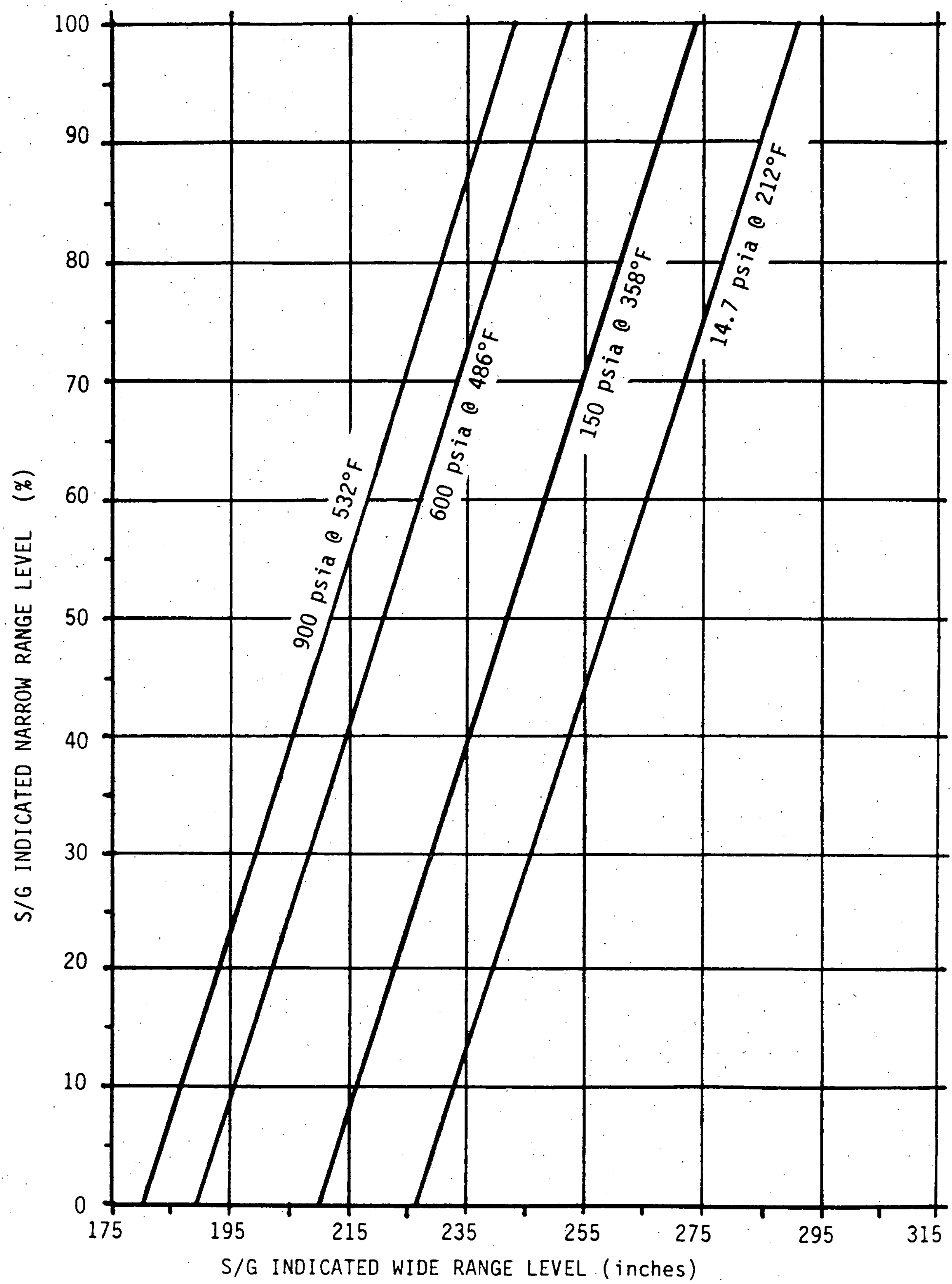


R

FIGURE 7

N

FIGURE 10: STEAM GENERATOR WR/NR LEVEL CORRELATION



APPENDIX A

DEVELOPMENTAL RESOURCES

REFERENCES

Bechtel System Descriptions

20, Feedwater and Condensate System

FSAR

3.1.5, Feedwater and Condensate System

5.5, Steam Generator Level Control System

Lesson Plans

1045, Steam Generator Water Control

1064, STA/SRO Steam Generator Water Level Control

Study Guides

62, Steam Generator Level Control System

APPENDIX B

ANNUNCIATORS

Reactor Plant No. 2

WINDOW NAME (NUMBER)	INPUT	SETPOINT
Alert SW F.W. Control to Manual (17)	QC-415B-X	15% of Full Load
Steam Generator Hi Level Loop A (18)	YR-456	70%
Steam Generator Hi Level Loop B (19)	YR-457	70%
Steam Generator Hi Level Loop C (20)	YR-458	70%
Steam Generator Lo Level Loop A (38)	YR-456	26%
Steam Generator Lo Level Loop B (39)	YR-457	26%
Steam Generator Lo Level Loop C (40)	YR-458	26%
Steam Gen. Level Cont. Power Supply Malfunction (58)	CR-1, 3, 5 through 8 RY-2, 3 and 4	Fault in Output

Reactor Plant First Out

WINDOW NAME (NUMBER)	INPUT	SETPOINT
Steam/Feedwater Flow Mismatch (23)	FM-456B-X FM-457B-X FM-458B-X	Steam Flow > Feedwater Flow by 25% of Full Load Steam Flow

APPENDIX B

ANNUNCIATORS

Reactor Plant Matrix Partial Trip

WINDOW NAME (NUMBER)	INPUT	SETPOINT
Steam/Feedwater Flow Mismatch Reactor Trip Loop A (17)	FM-456B-X	Steam Flow > Feedwater Flow by 25% of Full Load Steam Flow
Steam/Feedwater Flow Mismatch Reactor Trip Loop B (18)	FM-457B-X	Steam Flow > Feedwater Flow by 25% of Full Load Steam Flow
Steam/Feedwater Flow Mismatch Reactor Trip Loop C (19)	FM-458B-X	Steam Flow > Feedwater Flow by 25% of Full Load Steam Flow
Steam Generator A Hi Level Partial Trip (24)	LC-453C or LC-450CX	85% NR or 305 in. WR
Steam Generator B Hi Level Partial Trip (25)	LC-454C or LC-451CX	85% NR or 305 in. WR
Steam Generator C Hi Level Partial Trip (26)	LC-455C or LC-452CX	85% NR or 305 in. WR

R

REFERENCES

OVERPRESSURE MITIGATION

Drawing No.	Title
5178105	Pressurizer & Pressurizer Relief Tank System
456316	Elementary - Pressurizer Power Relief CV 545 & 546
456322	Logic Diag - Reactor Overpressure Mitigation System
456315	Elementary - Power Relief Isolation CV 530 & 531
5154617	System Logic/Signal Flow Diag - OMS
5102174	One Line Diag - 120 VAC System
5126359	Block Diag - SCE Pressurizer Control System
SD-SO1-390	System Desc - Primary Process Instrumentation

PRIMARY PROCESS INSTRUMENTATION SYSTEMS

TABLE OF CONTENTS

This System Description is approved per SO123-0-44, System Descriptions Drafting, Revision and Approval. Contact CDM to verify revision information.

PREPARED BY: David J Kauppinen — Author — 5-1-87 Date

APPROVED BY: [signature] — Manager, Operations — 5/11/87 Date

0335W

NOT QA PROGRAM AFFECTING

PRIMARY PROCESS INSTRUMENTATION SYSTEMS

1.0 FUNCTIONS/DESIGN BASES

1.1 The Primary Process Instrumentation Systems have the following main functions:

1.1.1 The Reactor Coolant System Temperature Instrumentation monitors, indicates, records and annunciates the temperature of the Reactor Coolant System.

1.1.2 The Reactor Coolant System Flow Instrumentation monitors, indicates, records and annunciates the flow of the Reactor Coolant System.

1.1.3 The Pressurizer Instrumentation monitors, indicates, records and annunciates the pressure, level and temperature of the Pressurizer.

1.1.4 Provides temperature, flow, pressure, and level inputs to the Rod Control System (SD-S01-400), the Reactor Protection System (SD-S01-570), and various other control systems to ensure safe operation of the Plant.

2.0 DESCRIPTION

2.1 System Overview

2.1.1 Main Scheme

.1 Reactor Coolant System Temperature Instrumentation (Figure 1A)

The Reactor Coolant System Temperature Instrumentation uses Resistance Temperature Detectors (RTDs) in the Hot Legs, Intermediate Legs, and Cold Legs of each Reactor Coolant Loop to indicate, record, and annunciate the individual Loop Temperatures, Loop Average Temperatures, and Loop Differential Temperatures.

Each Reactor Coolant System loop supplies a Hot Leg (Th) and a Cold Leg (Tc) signal to a Loop Tave Computer for individual Loop Tave computation.

The individual Loop Tave Computers supply signals to the Tave Recorder, the individual Loop Variable Low Pressure Trip (VLPT) Bistables in the Reactor Protection System (Reactor Protection System and Permissives, SD-SO1-570), the individual loop High-Low Tave Annunciators, and an Ave Tave Summing Computer through a Tave Defeat Switch.

The Ave Tave Summing Computer supplies signals to the Ave Tave Minus Tref Computer for the Steam Dump System (see SD-SO1-570), Ave Tave Deviation Recorder and Annunciator, Pressurizer Program Level Setpoint, Feedwater Control (see SD-SO1-260, Feedwater Control System), Control Rod Drive Summing Computer (see SD-SO1-400, Rod Control System), Shutdown Margin Computers, and Reactivity Computer.

Each Reactor Coolant System loop also supplies a Hot Leg (Th) and Cold Leg (Tc) signal to a loop ΔT Computer for individual Loop ΔT computation.

The individual Loop ΔT Computers supply signals to the ΔT Recorder, the individual loop Variable Low Pressure Bistables in the Reactor Protection System, the individual Loop ΔT Indications, the High ΔT Annunciators, the Reverse ΔT Interlock, and the ΔT Summing Computer through a ΔT Defeat Switch.

The ΔT Summing Computer supplies signals to the Shutdown Margin Computer and Reactivity Computer.

2.1.2 Reactor Coolant System Flow Instrumentation (Figure 1B)

The Reactor Coolant System Flow Instrumentation uses Differential Pressure Transmitters (located in each Hot Leg elbow just upstream of the Steam Generators) to indicate and annunciate the individual loop flows.

2.0 DESCRIPTION (Continued)

2.1.2 **Reactor Coolant System Flow Instrumentation** (Figure 1B) (Continued)

Each Reactor Coolant System Flow Instrument supplies an individual Flow Controller.

The individual Flow Controllers supply signals to the Loss of Flow circuitry in the Reactor Protection System, the individual flow indicators, and the Loss of Flow Annunciators.

2.1.3 **Pressurizer Instrumentation** (Figure 1C)

The Pressurizer Pressure Instrumentation uses Pressure Transmitters to indicate, record and annunciate Pressurizer Pressure, and control pressure in the Pressurizer.

The Pressurizer Pressure Transmitters supply signals to the Reactor Protection System (SD-S01-570), the Sequencer System (SD-S01-590), the Sub-Cooling Monitor, the Residual Heat Removal System (SD-S01-320), the Power Operated Relief Valves, the Pressurizer Spray Valves, the Pressurizer Heaters (Pressurizer Components are in SD-S01-280, Reactor Coolant System), the Overpressure Mitigation System (SD-S01-280), and the Rod Control System (SD-S01-400).

The Pressurizer Level Instrumentation uses Differential Pressure Transmitters to indicate, record and annunciate Pressurizer Level, and control level in the Pressurizer.

The Pressurizer Level Differential Pressure Transmitters supply signals to the Reactor Protection System, the Chemical and Volume Control System (SD-S01-310), the Pressurizer Heaters, and the Rod Control System (SD-S01-400).

The Pressurizer Temperature Instrumentation uses Resistance Temperature Detectors (RTDs) to indicate, record and annunciate temperature in the Pressurizer steam and water spaces.

2.0 DESCRIPTION (Continued)

2.2 Components

2.2.1 **Reactor Coolant System Loop A Temperature Instrumentation** (Figure 2)

.1 Hot Leg TE-402A

- Output to TI-5402A on Remote Shutdown Panel | R
- Indicated Range is 100-700°F

.2 Hot Leg TE-3402A

- Output to Sub-cooling Monitor System Train A
- Output to TI-3401 on AFW Panel
- Indicated Range is 100-700°F

.3 Hot Leg TE-2401A

- Output to Sub-cooling Monitor System Train B
- Output to TI-3402 on AFW Panel
- Indicated Range is 100-700°F

.4 Hot Leg TE-401A

- Output to TQ-401A for Loop Tave development | R

.5 Hot Leg TE-400A

- Output to TT-400 for Loop ΔT development

.6 Intermediate Leg TE-402B

- Output to TI-402B on Remote Shutdown Panel | R
- Indicated Range is 100-700°F

.7 Cold Leg TE-400C

- Output to TT-400 for Loop ΔT development

.8 Cold Leg TE-401C

- Output to TQ-401A for Loop Tave development | R

.9 Cold Leg TE-402C

- Output to TR-402 on J-Console
- Indicated Range is 100-600°F

2.0 DESCRIPTION (Continued)

2.2.2 **Reactor Coolant System Loop B Temperature Instrumentation** (Figure 2)

.1 Hot Leg TE-412A

- Output to TI-5412A on Remote Shutdown Panel R
- Indicated Range is 100-700°F

.2 Hot Leg TE-2412A

- Output to Sub-cooling Monitor System Train A
- Output to TI-2412A on AFW Panel
- Indicated Range is 100-700°F

.3 Hot Leg TE-3411A

- Output to Sub-cooling Monitor System Train B
- Output to TI-3411A on AFW Panel
- Indicated Range is 100-700°F

.4 Hot Leg TE-411A

- Output to TQ-411A for Loop Tave development R

.5 Hot Leg TE-410A

- Output to TT-410 for Loop ΔT development

.6 Intermediate Leg TE-411B

- Output to TR-402 on J-Console
- Indicated Range is 100-600°F

.7 Intermediate Leg TE-412B

- Output to TI-412B on Remote Shutdown Panel
- Indicated Range is 100-700°F R

.8 Cold Leg TE-411C

- Output to TQ-411A for Loop Tave development R

.9 Cold Leg TE-412C

- Output to TT-410 for Loop ΔT development

2.0 DESCRIPTION (Continued)

2.2.3 **Reactor Coolant System Loop C Temperature Instrumentation** (Figure 2)

.1 Hot Leg TE-422A

- Output to TI-5422A on Remote Shutdown Panel R
- Indicated Range is 100-700°F

.2 Hot Leg TE-2422A

- Output to Sub-cooling Monitor System Train A
- Output to TI-2422A on AFW Panel
- Output to TI-2009 on AFW Panel
- Indicated Range is 100-700°F

.3 Hot Leg TE-3421A

- Output to Sub-cooling Monitor System Train B
- Output to TI-3412 on AFW Panel
- Output to TI-3009 on AFW Panel
- Indicated Range is 100-700°F

.4 Hot Leg TE-421A

- Output to TQ-421A for Loop Tave development R

.5 Hot Leg TE-420A

- Output to TT-420 for Loop ΔT development

.6 Intermediate Leg TE-422B

- Output to TI-422B on Remote Shutdown Panel R
- Indicated Range is 100-700°F

.7 Cold Leg TE-422C

- Output to TR-402 on J-Console
- Indicated Range is 100-600°F

.8 Cold Leg TE-421C

- Output to TQ-421A for Loop Tave development R

2.0 DESCRIPTION (Continued)

2.2.3 **Reactor Coolant System Loop C Temperature Instrumentation** (Figure 2) (Continued)

.9 Cold Leg TE-420C

- Output to TT-420 for Loop ΔT development

2.2.4 **Reactor Coolant System Flow Instrumentation** (Figure 2)

.1 Loop A FT-400

- Output to FC-400 which outputs to the Reactor Protection System, Low Flow Annunciator, and FI-400
- Indicated Range is 0-100%

.2 Loop B FT-410

- Output to FC-410 which outputs to the Reactor Protection System, Low Flow Annunciator, and FI-410
- Indicated Range is 0-100%

.3 Loop C FT-420

- Output to FC-420 which outputs to the Reactor Protection System, Low Flow Annunciator, and FI-420
- Indicated Range is 0-100%

2.2.5 **Tave Defeat Switch** (Figure 3)

The Tave Defeat Switch, located in Instrument Rack R-1, is a four position switch that allows one of the Loop Tave signals to be defeated during testing or RTD failure.

Depending upon the position of the Tave Defeat Switch, the Loop Tave signals are supplied to the Ave Tave Summing Computer. The Ave Tave Summing Computer calculates the Average Tave using the following formulas:

1. Operate - Output = (A + B + C)/3
2. Loop A - Output = (2B + C)/3
3. Loop B - Output = (A + 2C)/3
4. Loop C - Output = (2A + B)/3

2.0 DESCRIPTION (Continued)

2.2.6 **ΔT Defeat Switch** (Figure 4)

The ΔT Defeat Switch, located in Instrument Rack R-2, is a four position switch that allows one of the Loop ΔT signals to be defeated during testing or RTD failure.

Depending upon the position of the ΔT Defeat Switch, the Loop ΔT signals are supplied to the ΔT Summing Computer. The ΔT Summing Computer calculates the Average ΔT using the following formulas:

1. Operate - Output = (A + B + C)3
2. Loop A - Output = (2B + C)/3
3. Loop B - Output = (A + 2C)/3
4. Loop C - Output = (2A + B)/3

2.2.7 **Reactor Coolant System Temperature Recorders**

.1 Loop ΔT Recorder, TR-400

- Located in Rack R-2 behind the West Vertical Board
- 3 Pen Recorder; Red Pen - Loop A, Green Pen - Loop B, Blue Pen - Loop C
- Range in -15 to +60°F

.2 Loop Tave Recorder, TR-401

- Located on J-Console
- 3 Pen Recorder; Red Pen - Loop A, Green Pen - Loop B, Blue Pen - Loop C
- Range is 525 to 600°F

.3 Loop Tc Recorder, TR-402

- Located on J-Console
- 3 Pen Recorder; Red Pen - Loop A, Green Pen - Loop B, Blue Pen - Loop C
- Range is 100 to 600°F

.4 Tave - Tref Recorder, TR-405

- Located on J-Console
- 2 Pen Recorder; Red Pen - Tave, Green Pen - Tref
- Range is 525 - 600°F

2.0 DESCRIPTION (Continued)

2.2.8 **Pressurizer Pressure Instrumentation** (Figure 5)

.1 PT-430

- Output to PI-430 on North Vertical Board
- Output to Variable Low Pressure Trip Bistable (SD-S01-570, Reactor Protection System and Permissives)
- Output to PI-400B on North Vertical Board (VLPT Setpoint)
- Output to Fixed High Pressure Trip Bistable (SD-S01-570, Reactor Protection System and Permissives)
- Output to Unblock Safety Injection Bistable (SD-S01-590, Sequencer System)
- Output to Safety Injection Signal Bistable (SD-S01-590, Sequencer System)
- Output to PR-430 on J-Console
- Normally outputs, through Switch P/432, to PORV CV-545 Bistable; PC-430J to control the High Pressure Alarm, Spray Valve PC-430C Controller, Spray Valve PC-430H Controller, Pressurizer SCR Control Group Heater Bistables, and Pressurizer Backup Group Heater Bistables (SD-S01-280, Reactor Coolant System) R
- Indicated Range is 1600 - 2400 psig

.2 PT-431

- Output to PI-431 on North Vertical Board
- Output to Variable Low Pressure Trip Bistable (SD-S01-570, Reactor Protection System and Permissives)
- Output to PI-410B on North Vertical Board (VLPT Setpoint)
- Output to Fixed High Pressure Trip Bistable (SD-S01-570, Reactor Protection System and Permissives)
- Output to Unblock Safety Injection Bistable (SD-S01-590, Sequencer System)

2.0 DESCRIPTION (Continued)

2.2.8 **Pressurizer Pressure Instrumentation** (Figure 5) (Continued)

.2 (Continued)

- Output to Safety Injection Signal Bistable (SD-S01-590, Sequencer System)
- Output to PR-430 on J-Console
- Normally outputs, through Switch P/432, to PORV CV-546 Bistable, Low Pressure Alarm Bistable, and Alert Block Safety Injection Bistable (SD-S01-280, Reactor Coolant System)
- Indicated Range is 1600 - 2400 psig

.3 PT-432

- Output to PI-432 on North Vertical Board
- Output to Variable Low Pressure Trip Bistable (SD-S01-570, Reactor Protection System and Permissives)
- Output to PI-420B on North Vertical Board (VLPT Setpoint)
- Output to Fixed High Pressure Trip Bistable (SD-S01-570, Reactor Protection System and Permissives)
- Output to Unblock Safety Injection Bistable (SD-S01-590, Sequencer System)
- Output to Safety Injection Signal Bistable (SD-S01-590, Sequencer System)
- Output to PR-430 on J-Console
- Can also output, through Switch P/432, to PORV CV-545 Bistable; PC-430J to control the High Pressure Alarm, Spray Valve PC-430C Controller, Spray Valve PC-430H Controller, Pressurizer SCR Control Group Heater Bistables, and Pressurizer Backup Group Heater Bistables (SD-S01-280, Reactor Coolant System) R

  OR, through Switch P/432,

- to PORV CV-546 Bistable, Low Pressure Alarm Bistable, and Alert Block Safety Injection Bistable (SD-S01-280, Reactor Coolant System)
- Indicated Range is 1600 - 2400 psig

2.0 DESCRIPTION (Continued)

2.2.8 **Pressurizer Pressure Instrumentation** (Figure 5) (Continued)

.4 PT-425

- Output to PR-425 on J-Console
- Output to interlock for MOV-813 and MOV-814 (SD-SO1-320, Residual Heat Removal System)
- Output to Sub-cooling Monitor System Train A for Tsat computation
- Indicated Range is 0-3000 psig

.5 PT-425-X1

- Output to Overpressure Mitigation System for ARM PORV, Pressure Transient in Progress, and OMS High Pressure annunciators
- Output to Sub-cooling Monitor System Train B for Tsat computation

.6 PT-425-X2

- Output to Overpressure Mitigation System for ARM PORV, Pressure Transient in Progress, and OMS High Pressure annunciators
- Output to Sub-Cooling Monitor System Train A for Tsat computation

.7 PT-434 and 434A

- Output to PI-434 on North Vertical Board
- Output to PI-434A on Remote Shutdown Panel |R
- Indicated Range is 0-2500 psig

.8 DPT-434

- One side is connected to the Pressurizer, the other side to a Dead Weight Tester.
- Used to check calibration of other Pressurizer Pressure Transmitters

.9 PT-3000A, B, C

- Outputs (one per transmitter) to the Sequencer System Train B (SD-SO1-590, Sequencer System)

2.0 DESCRIPTION (Continued)

2.2.9 **Pressurizer Pressure Transmitter Selector Switch, P/432** (Figure 5)

The Pressurizer Pressure Transmitter Selector Switch, P/432, is a three position switch located on the North Vertical Board. P/432 is used (during channel testing or transmitter failure) to transfer the controlling functions of PT-430 or PT-431 to PT-432.

Normal Position -

Each pressure transmitter supplies its normal functions as described in 2.2.8.1, 2.2.8,2 and 2.2.8.3

PT-430 Position -

PT-432 supplies its normal functions and PORV CV-545 Bistable; PC-430J to control the High Pressure Alarm, Spray Valve PC-430C Controller, Spray Valve PC-430H Controller, Pressurizer SCR Control Group Heater Bistables, and Pressurizer Backup Group Heater Bistables | R

PT-431 Position -

PT-432 supplies its normal functions, and PORV CV-546 Bistable, Low Pressure Alarm Bistable, and Alert Block Safety Injection Bistable

2.2.10 **Pressurizer Pressure Transmitter Test Switches**

The three Pressurizer Pressure Transmitter Test Switches (one for each pressure transmitter) are two position switches located in the racks behind the North Vertical Board.

When a pressure transmitter fails, the appropriate Test Switch is placed in the Test position. This installs a trip signal in the Safety Injection and Reactor Trip circuitry.

2.2.11 **Pressurizer Pressure Controllers**

.1 Main Pressure Controller, PC-430J (Figure 1C and 6)

Main Pressure Controller, PC-430J, is a Proportional plus Rate plus Setpoint Controller.

PC-430J is the pressure controller that normally controls the Pressurizer Pressure, by controlling the operation of the Pressurizer Spray Valves and Heaters when their controllers are in automatic.

2.0 DESCRIPTION (Continued)

2.2.11 **Pressurizer Pressure Controllers** (Continued)

.1 (Continued)

PC-430J normally receives its input from PT-430, however, it can receive its input from PT-432, if selected by Switch P/432.

PC-430J is located on the J-Console and is equipped with a Manual-Auto Switch, a Manual Adjust Dial and an Auto Adjust Dial.

In Auto, PC-430J compares the actual Pressurizer Pressure signal to the setpoint signal. The setpoint signal is established using the Auto Adjust Dial on PC-430J. PC-430J will then transmit a signal that is proportional to the Pressurizer Pressure Signal, the rate at which the pressure is changing, and the length of time the pressure has been off its setpoint.

In Manual, the Manual Adjust Dial is used to establish the output of PC-430J.

PC-430J outputs to the Rod Control System (P minus Pref), the High Pressure Annunciator, the Spray Valves via their controllers, the SCR Control Group Heaters, and the Backup Heaters.

.2 Spray Valve Controller, PC-430C (PCV-430C)

Spray Valve Controller, PC-430C, is located on the J-Console and is equipped with a Manual-Auto Switch, a Manual Adjust Dial and an Auto Adjust Dial.

In Manual, the Spray Valve is operated using the Manual Adjust Dial.

In Auto, PC-430C receives its signal from PC-430J to operate the Spray Valve.

The relationship between PC-430C and PC-430J is a 1 to 4 ratio. That is 0-100% on PC-430C correlates to a PC-430J output band of 25%. For example, if PC-430C is set at 30% the Spray Valve would start to open when PC-430J output reaches 30%, and the Spray Valve would be full open when PC-430J output reaches 55%.

In Auto the Auto Adjust Dial is used to adjust the output of PC-430C so that the Spray Valve operates at the desired setpoint. This enables the operator to change the operating setpoint of the Spray Valve without changing the setpoint of PC-430J (which would also change the setpoint of the other functions supplied by PC-430J).

2.0 DESCRIPTION (Continued)

2.2.11 **Pressurizer Pressure Controllers** (Continued)

.3 Spray Valve Controller, PC-430H (PCV-430H)

Spray Valve Controller, PC-430H is identical to PC-430C (2.2.11.2).

2.2.12 **Pressurizer Pressure Recorders**

.1 Wide Range Pressurizer Pressure Recorder, PR-425

- Located on J-Console
- 2 Pen Recorder, Red Pen - Full Range Pressure, Green Pen - Low Range Pressure
- Range is: 0-3000 psig (Red)
  0-600 psig (Green)

.2 Pressurizer Pressure Recorder, PR-430

- Located on J-Console
- 3 Pen Recorder; Red Pen - Pressurizer Pressure, Green Pen - VLPT Setpoint, Blue Pen - Not Used
- 3 position selector switch on J-Console, selects which Pressurizer Pressure Transmitter output is to be recorded
- Range is 1600 to 2400 psig

2.2.13 **Pressurizer Level Instrumentation** (Figure 7)

.1 LT-430

- Output to LI-430 on North Vertical Board
- Output to High Level Trip Bistable (SD-SO1-570, Reactor Protection System and Permissives)
- Output to a spare bistable
- Output to LR-430 on J-Console
- Normally outputs through Switch L/432, to: Pressurizer SCR Control Group and Backup Group Heater Bistables to turn on all heaters on a High Level and to turn off all heaters on a Low Level, LC-430F for FCV-1112 (SD-SO1-310, Chemical and Volume Control System), Low Level Annunciator Bistable, and Letdown Isolation (SD-SO1-310, Chemical and Volume Control System)

2.0 DESCRIPTION (Continued)

2.2.13 **Pressurizer Level Instrumentation** (Figure 7) (Continued)

.1 (Continued)

- Indicated range is 0-100% (4.7 to 37.2 ft)

.2 LT-431

- Output to LI-431 on North Vertical Board
- Output to High Level Trip Bistable (SD-SO1-570, Reactor Protection System and Permissives)
- Output to a spare bistable
- Output to LR-430 on J-Console
- Normally outputs through Switch L/432, to: Pressurizer SCR Control Group and Backup Group Heater Bistables to turn off all heaters on a Low Level, and Letdown Isolation (SD-SO1-310 Chemical and Volume Control System)
- Indicated range is 0-100% (4.7 to 37.2 ft)

.3 LT-432

- Output to LI-432 on North Vertical Board
- Output to High Level Trip Bistable (SD-SO1-570, Reactor Protection System and Permissives)
- Output to a spare bistable
- Output to LR-430 on J-Console
- Can also output through Switch L/432, to: Pressurizer SCR Control Group and Backup Group Heater Bistables to turn on all heaters on a High Level and to turn off all heaters on a Low Level, LC-430F for FCV-1112 (SD-SO1-310, Chemical and Volume Control System), Low Level Annunciator Bistable, and Letdown Isolation (SD-SO1-310, Chemical and Volume Control System)

  OR, through Switch L/432,

  to Pressurizer SCR Control Group and Backup Group Heater Bistables to turn off all heaters on a Low Level, and Letdown Isolation (SD-SO1-310, Chemical and Volume Control System)
- Indicated range is 0-100% (4.7 to 37.2 ft)

2.0 DESCRIPTION (Continued)

2.2.13 **Pressurizer Level Instrumentation (Figure 7) (Continued)**

.4 LT-430A

- Output to LI-430A on the Remote Shutdown Panel R
- Indicated range is 0-100% (4.7 to 37.2 ft)

.5 LT-435

- Output to LI-435 on the North Vertical Board
- Cold calibrated (80°F), used when RCS is cooled down due to the density difference between Hot and Cold conditions
- Indicated range is 0-100% (4.7 - 37.2 ft)

2.2.14 **Pressurizer level Transmitter Selector Switch, L/432 (Figure 7)**

The Pressurizer Level Transmitter Selector Switch, L/432, is a three position switch located on the North Vertical Board. L/432 is used during channel testing or transmitter failure to transfer the controlling functions of LT-430 or LT-431 to LT-432.

Normal Position -

Each level transmitter supplies its normal functions as described in 2.2.13.1, 2.2.13.2, and 2.2.13.3

LT-430 Position -

LT-432 supplies its normal functions and Pressurizer SCR Control Group and Backup Group Heater Bistables to turn on all heaters on a High Level and to turn off all heaters on a Low Level, LC-430F for FCV-1112 Low Level Annunciator Bistable, and Letdown Isolation (SD-SO1-310, Chemical and Volume Control System).

LT-431 Position -

LT-431 supplies its normal functions and Pressurizer SCR Control Group and Backup Group Heater Bistables to turn off all heaters on a Low Level and Letdown Isolation (SD-SO1-310, Chemical and Volume Control System).

2.0 DESCRIPTION (Continued)

2.2.15 Pressurizer Level Transmitter Test Switches

The three Pressurizer Level Transmitter Test Switches, (one for each level transmitter) are two postion switches located in the racks behind the North Vertical Board.

When a level transmitter fails, the appropriate Test Switch is placed in the Test position. This installs a trip signal in the Reactor Trip circuitry.

2.2.16 Pressurizer Level Controller, LC-430F

The Pressurizer Level Controller, LC-430F, is located on the J-Console and is equipped with a Manual-Auto selector, a Manual Adjust Dial, an Auto Adjust Dial, and a Cascade/Man-Set selector.

LC-430F compares the Program Level Setpoint to the actual Pressurizer Level. LC-430F then supplies an output (cascade) signal to FC-1112 (SD-SO1-310, Chemical and Volume Control System) to adjust charging flow as necessary to match actual Pressurizer Level to the Program Level Setpoint.

The Program Level Setpoint is varied depending on the selector positions on LC-430F.

Auto/Cascade: Program Level Setpoint is controlled by the input signal from Reactor Coolant System Ave Tave.

Auto/Man-Set: Program Level Setpoint is controlled by Auto Adjust Dial on LC-430F. In this mode, Pressurizer level is automatically maintained at a level determined by the Operator. R

Manual: LC-430F output signal is controlled by the Manual Adjust Dial. All LC-430F automatic functions are blocked. PZR level must be closely monitored in this mode.

The Pressurizer Level Program is further described in SD-SO1-280, Reactor Coolant System.

2.2.17 Pressurizer Level Recorder, LR-430

- Located on J-Console
- 2 Pen Recorder; Red pen - Actual level, Green pen - Program Level Setpoint

2.0 DESCRIPTION (Continued)

2.2.17 Pressurizer Level Recorder, LR-430 (Continued)

- 3 position selector switch on J-Console, selects which Pressurizer Level Transmitter output is recorded
- Range is 0 to 100% (4.7 to 37.2 ft)

2.2.18 Pressurizer Temperature Instrumentation (Figure 1C)

.1 TE-430A

- Output to High Liquid Temperature Annunciator
- Output to TI-430A on the North Vertical Board
- Output to TR-430 on West Vertical Board
- Indicated range is 0 - 700°F

.2 TE-430B

- Output to High Vapor Temperature Annunciator
- Output to TI-430B on North Vertical Board
- Output to TR-430 on West Vertical Board
- Indicated range is 0 - 700°F

2.2.19 Pressurizer Temperature Recorder, TR-430 | R

- Located on West Vertical Board
- 2 Pen Recorder, Red pen - Liquid Temperature, Green pen - Vapor Temperature
- Range is 0-700°F

2.2.20 Sub-Cooling Monitoring System (Figure 8) | D

PFC-86-3383

The Sub-cooling Monitoring System calculates, indicates, and annunciates the Reactor Coolant System Margin to Saturation.

The Sub-cooling Monitoring System consists of two trains identified as Train A and Train B.

Each train of the Sub-cooling Monitoring System receives signals from four Incore Thermocouples via individual toggle switches (one per Core quadrant), three RCS Hot Leg (Th) RTDs, and three Pressurizer Pressure Transmitters to calculate the Margin to Saturation.

2.0 DESCRIPTION (Continued)

2.2.20 **Sub-Cooling Monitoring System** (Figure 8) (Continued)

The two trains are identical with the exception of the Pressurizer Pressure inputs. Train A receives two pressure inputs of which the lowest is selected. Train B receives one pressure input. A Function Generator, for each train, generates the saturation temperature for the input pressure.

The Incore Thermocouple and RCS Hot Leg RTD signals for each train are auctioneered high. The highest signal is subtracted from the generated saturation temperature to indicate Margin to Saturation for each train.

The Sub-cooling Monitoring System provides indication and annunciation on the Auxiliary Feedwater Panel. More specifically, indication of the individual RCS Hot Leg RTDs, the highest of the Incore Thermocouples or RCS Hot Leg RTDs, the generated saturation temperature for the Pressurizer Pressure, the Margin to Saturation, and annunciation of approach to saturation.

2.2.21 **Shutdown Margin Computer** (Figure 9)

The Shutdown Margin Computer calculates, records, and annunciates the Control Rod Insertion Limits.

The Shutdown Margin Computer receives signals from Average Tave and ΔT to calculate the proper Control Rod Insertion Limits for Control Banks 1 and 2.

The calculated Control Rod Insertion Limits are compared to the actual Control Bank positions. If the actual position is outside the calculated position, then the Shutdown Margin Computer will cause the appropriate annunciator in the Main Control Room to illuminate.

The Shutdown Margin Computer calculated Control Rod Insertion Limits are recorded on the Control Rod Position Recorder on the J-Console.

The Control Rod Insertion Limits ensure the following:

1. An acceptable core power distribution during power operation.

2. Core subcriticality after a Reactor Trip.

3. A limit of potential reactivity addition on a hypothetical Rod Ejection Accident.

2.0 DESCRIPTION (Continued)

2.2.22 **Overpressure Mitigation System** (Figure 10)

The Overpressure Mitigation System protects the Reactor Coolant System against overpressurization during solid water operations and low pressure conditions.

The Overpressure Mitigation System uses the Pressurizer Power Operated Relief Valves (CV-545 and CV-546) and two Disable/Enable Control Switches (HS-320 and HS-321 respectively) to reduce the PORV opening setpoint pressure. R

The Overpressure Mitigation System supplies signals to four annunciators to indicate the status of the Overpressure Mitigation System, the Power Operated Relief Valves, and the Power Operated Relief Valve Isolation Valves (CV-530 and CV-531).

The Disable/Enable Control Switches, HS-320 and HS-321 (PORVs CV-545 and CV-546 respectively) are two position switches located on the North Vertical Board. R

In the Disable Position, the PORVs operate at their normal setpoints.

In the Pull for Enable position, the PORVs operate at the reduced pressure, provided the PORV Control Switches are in Pull for Auto.

2.0 DESCRIPTION (Continued)

2.3 Detailed Control Scheme

2.3.1 Tave and Ave Tave Development (Figure 3)

Each Reactor Coolant System Loop supplies a Hot Leg (Th) and a Cold Leg (Tc) signal to a Loop Tave Computer.

Each Loop Tave Computer adds the Loop Th and Tc signals together and then divides by 2, to provide the Loop Average Temperature.

The output of each Loop Tave Computer is supplied to the Variable Low Pressure Trip Bistables, High and Low Tave Annunciators, Tave Recorder and Ave Tave Summing Computer via the Tave Defeat Switch.

The output of the Ave Tave Summing Computer is supplied to the Steam Dump Control System, Pressurizer Level Program, Tave-Tref Annunciator, Tave-Tref Recorder, Feedwater Control System, Rod Control System for the Tave Program (Figure 11), Shutdown Margin Computer, and Reactivity Computer. The Tave Program is further described in SD-SO1-280, Reactor Coolant System, Appendix E. N

2.3.2 ΔT and Average ΔT Development (Figure 4)

Each Reactor Coolant System Loop supplies a Hot Leg (Th) and a Cold Leg (Tc) signal to a Loop ΔT Computer.

Each Loop ΔT Computer subtracts the Loop Tc from the Loop Th to provide the loop differential temperature.

The output of each Loop ΔT Computer is supplied to an individual loop temperature indicator, ΔT Recorder, High ΔT Annunciator, Reverse ΔT Interlock, Variable Low Pressure Trip Bistables, and ΔT Summing Computer via the ΔT Defeat Switch.

The output of the ΔT Summing Computer is supplied to the Reactivity Computer and the Shutdown Margin Computer.

2.3.3 Tref Controller, TC-415 and Tref Development (Figure 3)

Tref Controller, TC-415 is located on the J-Console and is equipped with a Manual-Auto Switch and a Manual Adjust Dial.

In Auto, the Tref signal is derived by TM-415 from PT-415, Turbine First Stage Pressure which correlates to Turbine Load.

In Manual, the Tref signal is controlled by the Manual Adjust Dial.

The Tref signal is supplied to the Steam Dump Control System (SD-SO1-190, Main Steam Systems), Tave - Tref Annunciator, Tave - Tref Recorder on the J-console, and the Rod Control System (SD-SO1-400, Rod Control System).

2.0 DESCRIPTION (Continued)

2.4 Power Supplies

2.4.1 **North Vertical Board Instrumentation**

COMPONENT	BREAKER	LOCATION
Loop A ΔT, TI-400A	8-1103V	120VAC Vital Bus #1
Loop B ΔT, TI-400B	8-1203V	120VAC Vital Bus #2
Loop C ΔT, TI-400C	8-1303V	120VAC Vital Bus #3
Pressurizer Liquid Temperature, TI-430A	8-1101V	120VAC Vital Bus #1
Pressurizer Vapor Temperature, TI-430B	8-1201V	120VAC Vital Bus #2
High Pressure Trip, PI-400A Low Pressure Trip, PI-400B Pressurizer Pressure, PI-430	8-1101V	120VAC Vital Bus #1
High Pressure Trip, PI-411A Low Pressure Trip, PI-410B Pressurizer Pressure, PI-431	8-1201V	120VAC Vital Bus #2
High Pressure Trip, PI-421A Low Pressure Trip, PI-420B Pressurizer Pressure, PI-432	8-1301V	120VAC Vital Bus #3
Pressurizer Pressure, PI-434	8-1401V	120VAC Vital Bus #4
Pressurizer Level, LI-435	8-1401V	120VAC Vital Bus #4
Pressurizer Level, LI-430	8-1101V	120VAC Vital Bus #1
Pressurizer Level, LI-431	8-1201V	120VAC Vital Bus #2
Pressurizer Level, LI-432	8-1301V	120VAC Vital Bus #3
Pressurizer Program Level Setpoint, LI-419	8-1401V	120VAC Vital Bus #4
Loop A Flow, FI-400	8-1103V	120VAC Vital Bus #1

2.0 DESCRIPTION (Continued)

2.4.1 North Vertical Board Instrumentation (Continued)

COMPONENT	BREAKER	LOCATION
Loop B Flow, FI-410	8-1203V	120VAC Vital Bus #2
Loop C Flow, FI-420	8-1303V	120VAC Vital Bus #3
Indicating Lights for P/432 & L/432	8-1508	120VAC Utility Bus

2.4.2 J-Console Recorders

COMPONENT	BREAKER	LOCATION
Pressurizer Pressure & VLPT Setpoint, PR-430 Wide Range Pressurizer Pressure, PR-425 Pressurizer Pressure & Program Level Setpoint, LR-430 RCS Loop A, B & C RCS Loop A, B & C Cold Leg, TR-402 RCS Average Temperature & Reference Temperature, TR-405 RCS Loop A, B & C Average Temperature, TR-401	8-1404V	120VAC Vital Bus #4

2.4.3 J-Console Controllers

COMPONENT	BREAKER	LOCATION
Pressure Controller, PC-430J Spray Valve PCV-430C Controller, PC-430C Spray Valve PCV-430H Controller, PC-430H Pressurizer Level Controller, LC-430F	8-11R7	120VAC Reg. Bus #1
Reference Temperature Controller, TC-415	8-14R5	120VAC Reg. Bus #4

PFC 86-3383
D

2.0 DESCRIPTION (Continued)

2.4.4 West Vertical Board Recorder

COMPONENT	BREAKER	LOCATION
Pressurizer Liquid & Vapor Temperature, TR-430	120 AC Plug Outlet	Rear of West Vertical Board

R

2.4.5 Rack R2 Recorder

COMPONENT	BREAKER	LOCATION
Loop ΔT, TR-400	8-1403V	120VAC Vital Bus #4

2.4.6 Subcooling Monitor System

COMPONENT	BREAKER	LOCATION
Subcooling Monitor System, Train A	8-3309V	120VAC Vital Bus #3A
Subcooling Monitor System, Train B	8-2904V	120VAC Vital Bus #5

2.4.7 Overpressure Mitigation System

COMPONENT	BREAKER	LOCATION
PORV CV-545 Logic	8-1215V	120VAC Vital Bus #2
PORV CV-546 Logic	8-1112V	120VAC Vital Bus #1

3.0 OPERATION

3.1 Normal Operations

3.1.1 Enabling the Overpressure Mitigation System

The Overpressure Mitigation System is Enabled prior to going above 50% Pressurizer Level during a fill of the Reactor Coolant System after a drain down, or between 475 and 425 psig during cooldown.

The Overpressure Mitigation System is Enabled by: closing the PORV's, placing the PORV control switches in Pull for Auto, opening the PORV Block Valves, and placing the Disable/Enable control switches in Pull for Enable.

3.1.2 Disabling the Overpressure Mitigation System

The Overpressure Mitigation System is Disabled prior to going above 400 psig and after Pressurizer Level has been reduced to less than 50%.

The Overpressure Mitigation System is disabled by placing Disable/Enable control switches in the Disable position.

3.2 Other Operations

3.2.1 Removing a Loop Tave Circuit from Service

Should a Loop Tave Circuit fail, or if it is desired to test a Loop Tave circuit, then the affected Loop Tave is removed from service.

The affected Loop Tave is removed from service by: placing Reactor control in Manual, placing the Tave Defeat Switch in the affected Loop position, and opening the appropriate VLPT Bistable Knife Switch.

Reactor control can be returned to Auto, if desired, after Tave has stabilized and Tave and Tref are within $\pm 2°F$.

3.2.2 Returning a Loop Tave Circuit to Service

The affected Loop Tave circuit is returned to service by: placing the Reactor control in Manual, closing the appropriate VLPT Bistable Knife Switch, verifying normal output, and placing the Tave Defeat Switch in the Operate position.

Reactor control can be returned to Auto, if desired, after Tave has stabilized, and Tave and Tref are within $\pm 2°F$.

3.0 OPERATION (Continued)

3.2.3 Removing a Loop ΔT Circuit from Service

Should a Loop ΔT circuit fail or if it is desired to test a Loop ΔT circuit, the affected Loop ΔT is removed from service.

The affected Loop ΔT is removed from service by: placing the ΔT Defeat Switch in the affected Loop position, and opening the appropriate VLPT Bistable Knife Switch.

3.2.4 Returning a Loop ΔT Circuit to Service

The affected Loop ΔT circuit is returned to service by: closing the appropriate VLPT Bistable knife switch, verifying normal output, and placing the ΔT Defeat Switch in the Operate position.

3.2.5 Removing a Pressurizer Pressure Channel from Service

Should a Pressurizer Pressure Channel fail, or if it is desired to test a Pressurizer Pressure Channel, then the affected Pressurizer Pressure Channel is removed from service.

The affected Pressurizer Pressure Channel is removed from service by: placing the PORV's in a non-automatic condition, placing PC-430J in Manual, placing the Pressurizer Pressure Transmitter Selector Switch in a non-affected position, and placing the appropriate Pressurizer Pressure Transmitter Test Switch in the Test position.

The PORV's and PC-430J can now be returned to Auto, if desired.

3.2.6 Returning a Pressurizer Pressure Channel to Service

The affected Pressurizer Pressure Channel is returned to service by: placing the appropriate Pressurizer Pressure Transmitter Test Switch in the Operate position, verifying normal output, placing the PORV's in a non-automatic condition, placing PC-430J in Manual, and placing the Pressurizer Pressure Transmitter Selector Switch in Normal.

The PORV's and PC-430J can now be returned to Auto, if desired.

3.0 OPERATION (Continued)

3.2.7 Removing a Pressurizer Level Channel from Service

Should a Pressurizer Level Channel fail, or if it is desired to test a Pressurizer Level, then the affected Pressurizer Level Channel is removed from service.

The affected Pressurizer Level Channel is removed from service by: placing LC-430F in Manual, placing the Pressurizer Heaters in Manual, placing FC-1112 in Manual, placing the Pressurizer Level Transmitter Selector switch in a non-affected position, and placing the appropriate Pressurizer Level Transmitter Test Switch in the Test position.

LC-430F, the Pressurizer Heaters and FC-1112 can now be returned to Auto, if desired.

3.2.8 Returning a Pressurizer Level Channel to Service

The affected Pressurizer Level Channel is returned to service by: placing the appropriate Pressurizer Level Transmitter Test Switch in the Operate position, verifying normal output, placing LC-430F in Manual, placing the Pressurizer Heaters in Manual, placing FC-1112 in Manual, and placing the Pressurizer Level Transmitter Selector Switch in Normal.

LC-430F, the Pressurizer Heaters and FC-1112 can now be returned to Auto, if desired.

4.0 REFERENCES

4.1 P&IDs

4.1.1	5178100,	Reactor Coolant System
4.1.2	5178105,	Pressurizer and Pressurizer Relief Tank

4.2 Elementaries

4.2.1	5102174,	(N1540 18) 120 Volt AC System
4.2.2	5150338,	(N1542 16) Press. Htrs Group A&B ACB's (Control Group)
4.2.3	5150339,	(N1542 17) Press. Htrs Group C&D ACB's (Backup Group)
4.2.4	0456316,	(N1542 20A) Press. Power Relief CV-545 & 546
4.2.5	5154617,	(N1542 20M) Reactor Overpressure Mitigation System
4.2.6	N15420052,	(N1542 52) Reactor Auxiliaries
4.2.7	5130359,	(N1542 53) Vertical Board Instr. Pwr. Supply-Vital Bus
4.2.8	N15420054,	(N1542 54) Reactor Auxiliaries
4.2.9	5151907,	(N1542 55) Vertical Board Instrument Pwr. Supply
4.2.10	Y-20929,	(N1542 102C) Reactor Control & Protection System
4.2.11	0063714,	(N1542 132) Reactor Coolant System
4.2.12	0063716,	(N1542 133) Pressurizer Pressure System
4.2.13	5126359,	(N1542 133A) Pressurizer Cont. Sys. Block Diagram
4.2.14	0063717,	(N1542 134) Pressurizer Level System
4.2.15	0063720,	Reactor Control and Protection System (Loop Diagram) N

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4.0 REFERENCES (Continued)

4.3 Technical Manuals

4.3.1 Westinghouse, Reactor Control & Protection System

4.4 Procedures

4.4.1 SO1-2.1-11, Overpressurization Mitigation System Actuation

4.4.2 SO1-2.3-3, Abnormal Pressurizer Pressure

4.4.3 SO1-2.3-4, Abnormal Pressurizer Level

4.4.4 SO1-3-1, Plant Startup from Cold Shutdown to Hot Standby

4.4.5 SO1-3-3, Plant Operation from Minimum Load to Full Power

4.4.6 SO1-3-4, Plant Shutdown from Full Power to Hot Standby

4.4.7 SO1-3-5, Plant Shutdown from Hot Standby to Cold Shutdown

4.4.8 SO1-4-1, Filling and Venting the Reactor Coolant System

4.4.9 SO1-4-21, Core Monitoring Systems Operations

4.4.10 SO1-13-3, Reactor Plant No. 2 Annunciator

4.4.11 SO1-13-4, Reactor Plant No. 1 Annunciator

4.4.12 SO1-13-5, Permissive Information Display Annunciator

4.4.13 SO1-13-6, Reactor Plant First-Out Annunciator

4.4.14 SO1-13-7, Reactor Plant Matrix Partial Trip Annunciator

4.4.15 SO1-13-19, Auxiliary Feedwater Annunciator

4.5 Technical Specifications

4.5.1 Section 3.5.1, Reactor Trip System Instrumentation

4.5.2 Section 3.5.6, Accident Monitoring Instrumentation

LOOP A TAVE & AVE TAVE DEVELOPMENT

UNIT 1

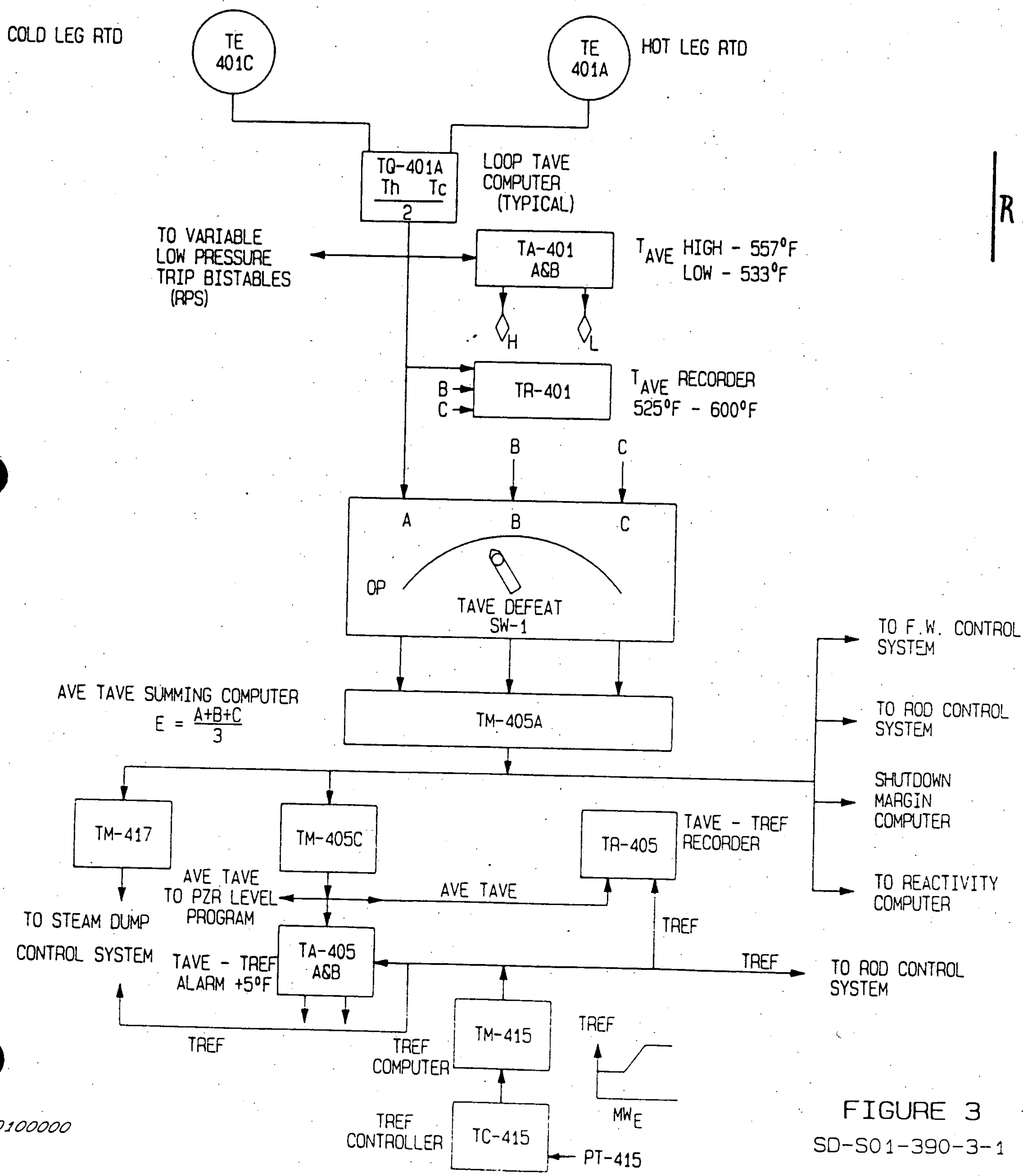


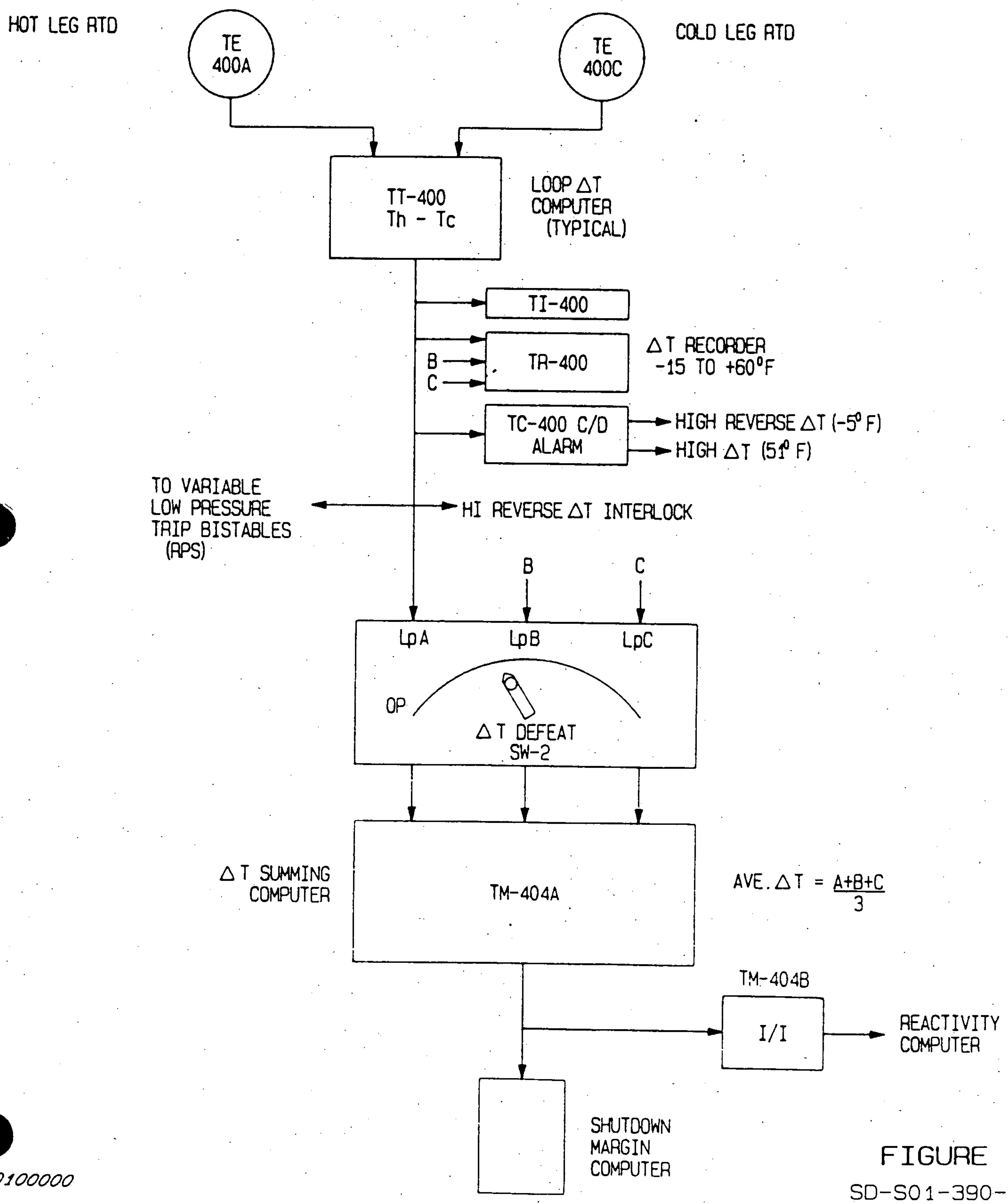
FIGURE 3
SD-S01-390-3-1

RP0100000

LOOP A ΔT & AVERAGE ΔT DEVELOPEMENT

UNIT 1

R

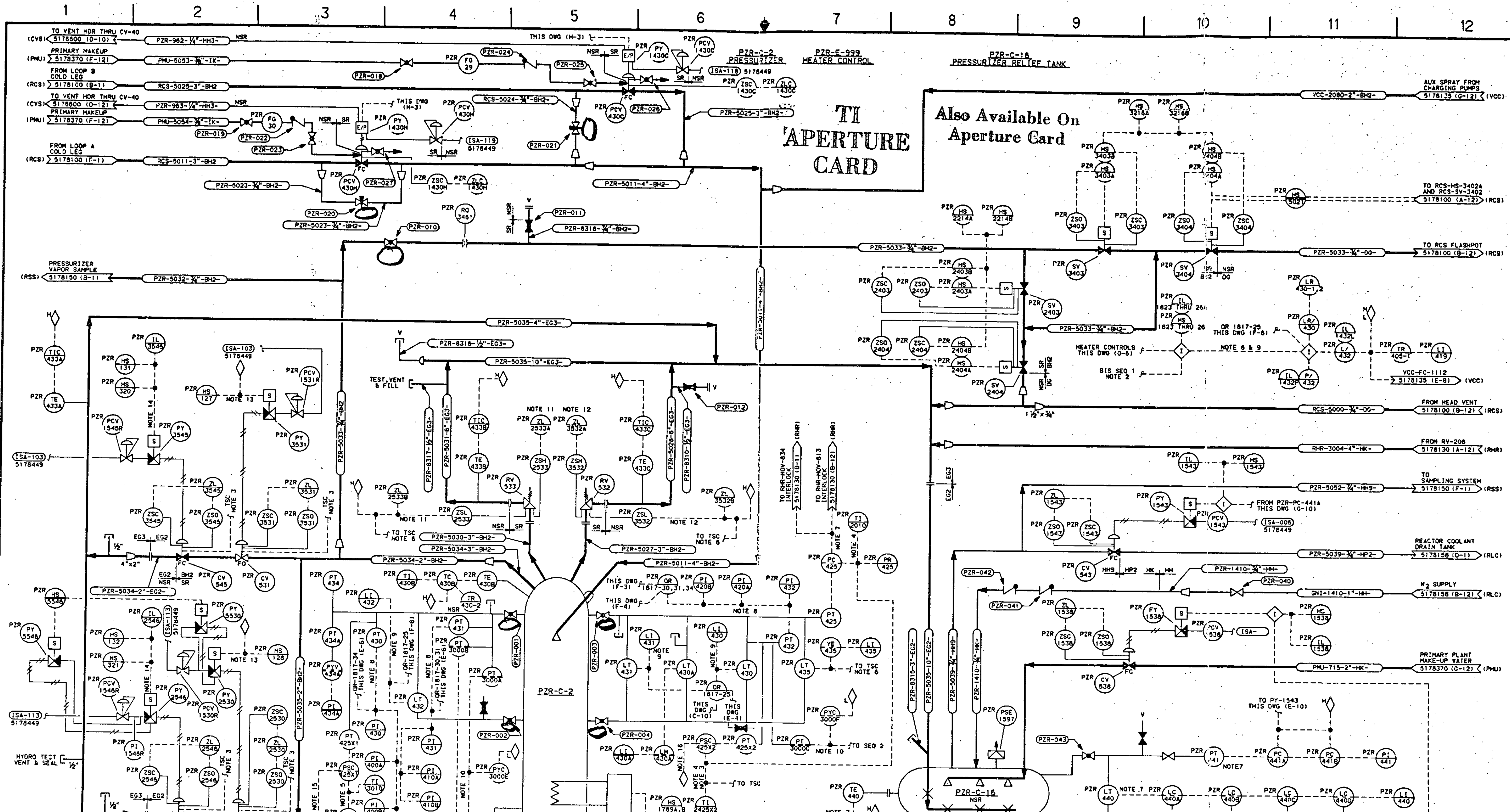


R

RP0100000

FIGURE 4

SD-S01-390-4-0



NOTES:
1. ALL ANNUNCIATORS AND ALARMS ARE NSR
2. SEE DWG 5149974 FOR CONTROL DETAILS
3. SEE DWG 5181374 FOR CONTROL DETAILS
4. SEE DWG 5181376 FOR CONTROL DETAILS
5. SEE DWG 5181377 FOR CONTROL DETAILS
6. SEE DWG 5181378 FOR CONTROL DETAILS
7. SEE DWG 63714 FOR CONTROL DETAILS
8. SEE DWG 63715 & 63716 FOR CONTROL DETAILS
9. SEE DWG 63717 FOR CONTROL DETAILS
10. SEE DWG 451356 FOR CONTROL DETAILS
11. SEE DWG 451780 FOR CONTROL DETAILS
12. SEE DWG 451790 FOR CONTROL DETAILS
13. SEE DWG 456315 FOR CONTROL DETAILS
14. SEE DWG 456318 FOR CONTROL DETAILS
15. SEE DWG 456322 FOR CONTROL DETAILS
16. SEE DWG 456323 FOR CONTROL DETAILS
17. THIS DRAWING SUPERSEDES DRAWINGS 568766 & 5130353 AND ALL CCN'S WHICH PERTAIN TO THEM
18. VALVE STEM LEAKOFFS ARE NSR

DWG. LIST M- SH.
● REVISE ON CADD SYSTEM ONLY ●

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1	5154618	SCHEMATIC-RCS OVERPRESS SYSTEM
5178001	P & I DIAGRAM LEGEND SH 2	5159539	ELEM DIAGRAM-RV-532 & RV-533 POSITION
5178002	P & I DIAGRAM LEGEND SH 3	5180711	ELEM DIAGRAM-PT-3000A,PT-3000B,PT-3000C
63720	REACTOR CONTROL & PROTECTION SYSTEM		TRAIN B
5150338	ELEM DIAGRAM-PRESS HTR CTRL GRP A & B		
5150339	ELEM DIAGRAM-PRESS HTR CTRL GRP C & D		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
10	AS BUILT-INCORP DCN #11		6/15/87					WLO	AAR	GAC	3831
9	AS BUILT-INCORP DCN #10			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
8	AS BUILT-INCORP DCN #9			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
7	AS BUILT-INCORP DCN #8			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
6	AS BUILT-INCORP DCN #7			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
5	AS BUILT-INCORP DCN #6			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
4	AS BUILT-INCORP DCN #5			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP CC #2			SEE	CDM	FILES	FOR SIGNATURES			BLS	8881
2	AS BUILT-INCORP DCN#4			SEE	CDM	FILES	FOR SIGNATURES			GJK	8744
1	AS BUILT-INCORP DCN#3 CC#1 CANCELED			SEE	CDM	FILES	FOR SIGNATURES			GJK	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			JV	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM PRESSURIZER & PRESSURIZER RELIEF TANK

Southern California Edison

PZR

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

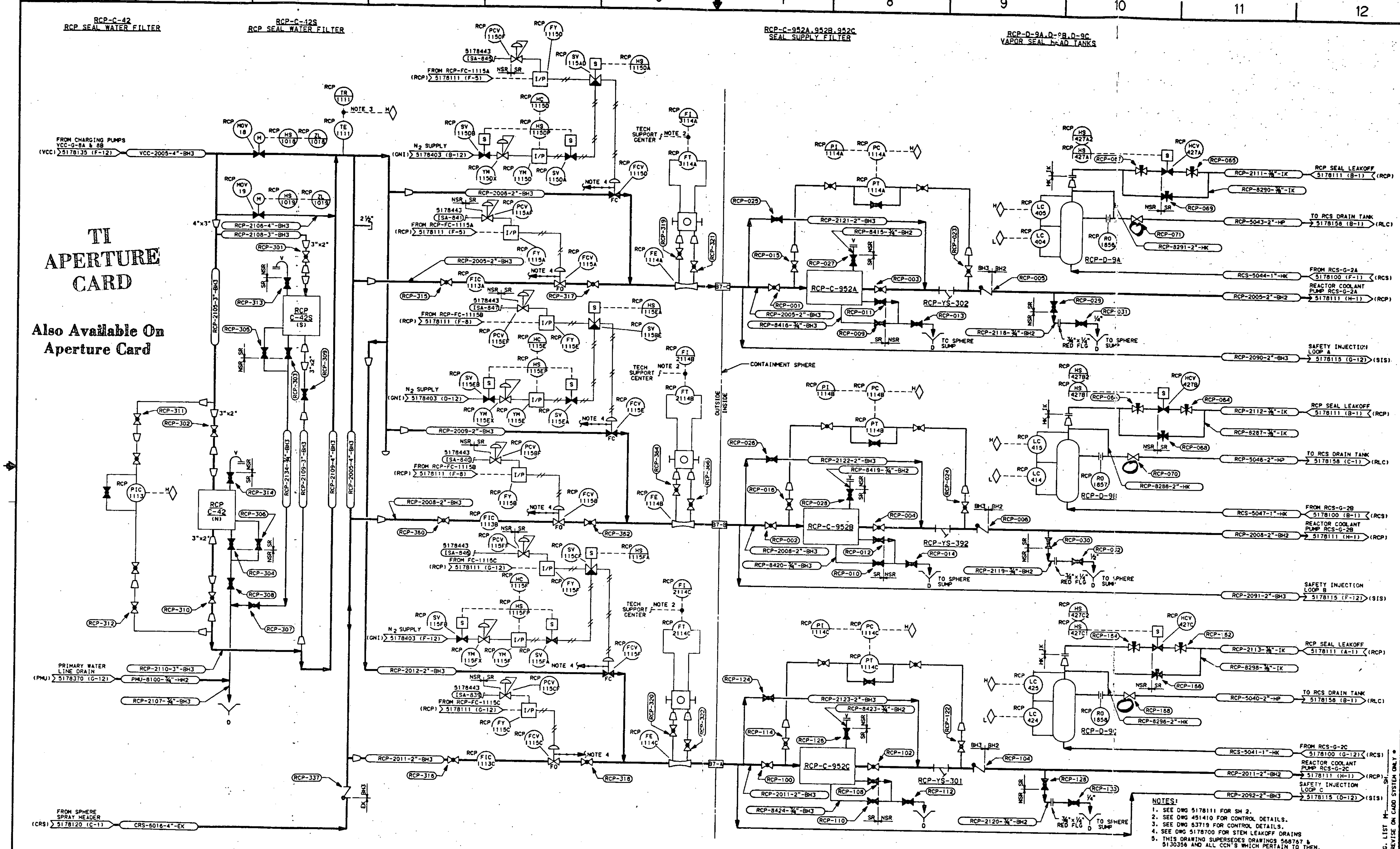
06-11-87 CASTRO

E4-632-CADD 03-85

568776

8711100274-01

5178105-10



NOTES:
1. SEE DWG 5178111 FOR SH 2.
2. SEE DWG 451410 FOR CONTROL DETAILS.
3. SEE DWG 63719 FOR CONTROL DETAILS.
4. SEE DWG 5178700 FOR STEM LEAKOFF DRAINS
5. THIS DRAWING SUPERSEDES DRAWINGS 568767 & 5130356 AND ALL CCN'S WHICH PERTAIN TO THEM.

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

5178000	P & I DIAGRAM LEGEND SH 1	456246	ELEM DIAGRAM - SEAL WATER SUPPLY CONTROL BYPASS VALVE
5178001	P & I DIAGRAM LEGEND SH 2		
5178002	P & I DIAGRAM LEGEND SH 3	5153166	CONTAINMENT SPRAY & SIS RECIRCULATION SYSTEM FLOW DIAGRAM
63719	ELEM DIAG-CHEM & VOLUME CONTROL SYSTEM		
451410	LOOP DIAG-RECIRC SI FLOW TSC SYSTEM		
455371	ELEM DIAGRAM - MOV'S 18 & 19		
	REFERENCE DRAWINGS		REFERENCE DRAWINGS

NO.	REVISIONS				APPROVED		
2	AS BUILT-INCORP DCN #2	7/15/87				GAC	3831
1	AS BUILT-INCORP DCN #1	SEE COM FILES FOR SIGNATURES				BLS	8744
0	ISSUED AS BUILT	SEE COM FILES FOR SIGNATURES				BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
REACTOR COOLANT PUMP
SEAL WATER SYSTEM SH 1

Southern California Edison

RCP

SHEET NO. M

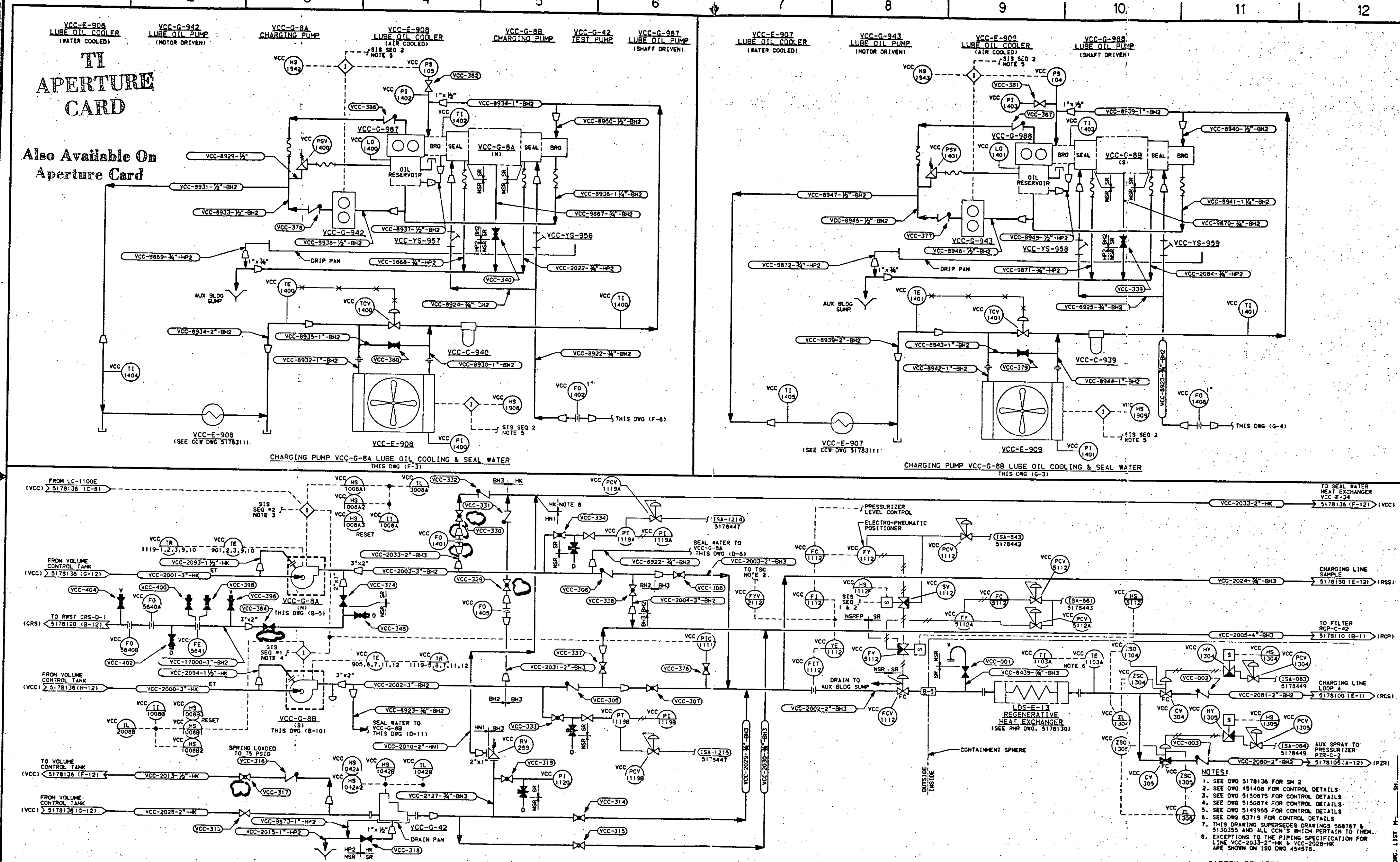
SCALE: NONE

___ OF ___ SHTS.

DWG. LIST M— SH
• REVISE ON CADD SYSTEM ONLY •

8711100274-02

5178110-2



NOTES:
1. SEE DWG 5178136 FOR SH 2
2. SEE DWG 451408 FOR CONTROL DETAILS
3. SEE DWG 5150875 FOR CONTROL DETAILS
4. SEE DWG 5150874 FOR CONTROL DETAILS
5. SEE DWG 5149955 FOR CONTROL DETAILS
6. SEE DWG 83719 FOR CONTROL DETAILS
7. THIS DRAWING SUPERSEDES DRAWINGS 568767 & 5130355 AND ALL CCN'S WHICH PERTAIN TO THEM.
8. EXCEPTIONS TO THE PIPING SPECIFICATION FOR LINE VCC-2033-2"-HK & VCC-2028-HK ARE SHOWN ON ISO DWG 454578.

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1	236711	LOGIC DIAGRAM-CV-305
5178001	P & I DIAGRAM LEGEND SH 2	451408	LOOP DIAGRAM-CHARGING LINE FLOW
5178002	P & I DIAGRAM LEGEND SH 3	5150626	ELEM DIAGRAM-CHARGING PUMPS & LUBE OIL PUMPS
5150337	ELEM DIAGRAM-TEST PUMP G-42		
5149181	LOAD SEQUENCE SCHEDULE	455510	ELEM DIAGRAM-LUBE OIL COOLERS
455446	ELEM DIAGRAM-CV-305	5153166	CONT SPRAY & SIS RECIRC SYS FLOW DIAGRAM
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
9	AS BUILT-INCORP DCN #19,20 & MINOR CHNG.		12-11-86						AR	GAC	3831
8	AS BUILT-INCORP DCN #18			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
7	AS BUILT-INCORP DCN #15,16 & 17			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
6	AS BUILT-INCORP DCN #12,13 & 14			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
5	AS BUILT-INCORP DCN #7,8,9,10 & 11			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
4	AS BUILT-INCORP DCN #6			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
3	AS BUILT-INCORP CC #2 & DCN #5			SEE	CDM	FILES	FOR SIGNATURES			BLS	8881
2	AS BUILT-INCORP DCN #4			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
1	AS BUILT-INCORP DCN #3-CC #1 CANCELED			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	8252

SCE E4-482-CADD 03-86

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM VOLUME CONTROL AND CHARGING SYSTEM SH 1

Southern California Edison

VCC

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

DWG. LIST M- ___ SH. ___

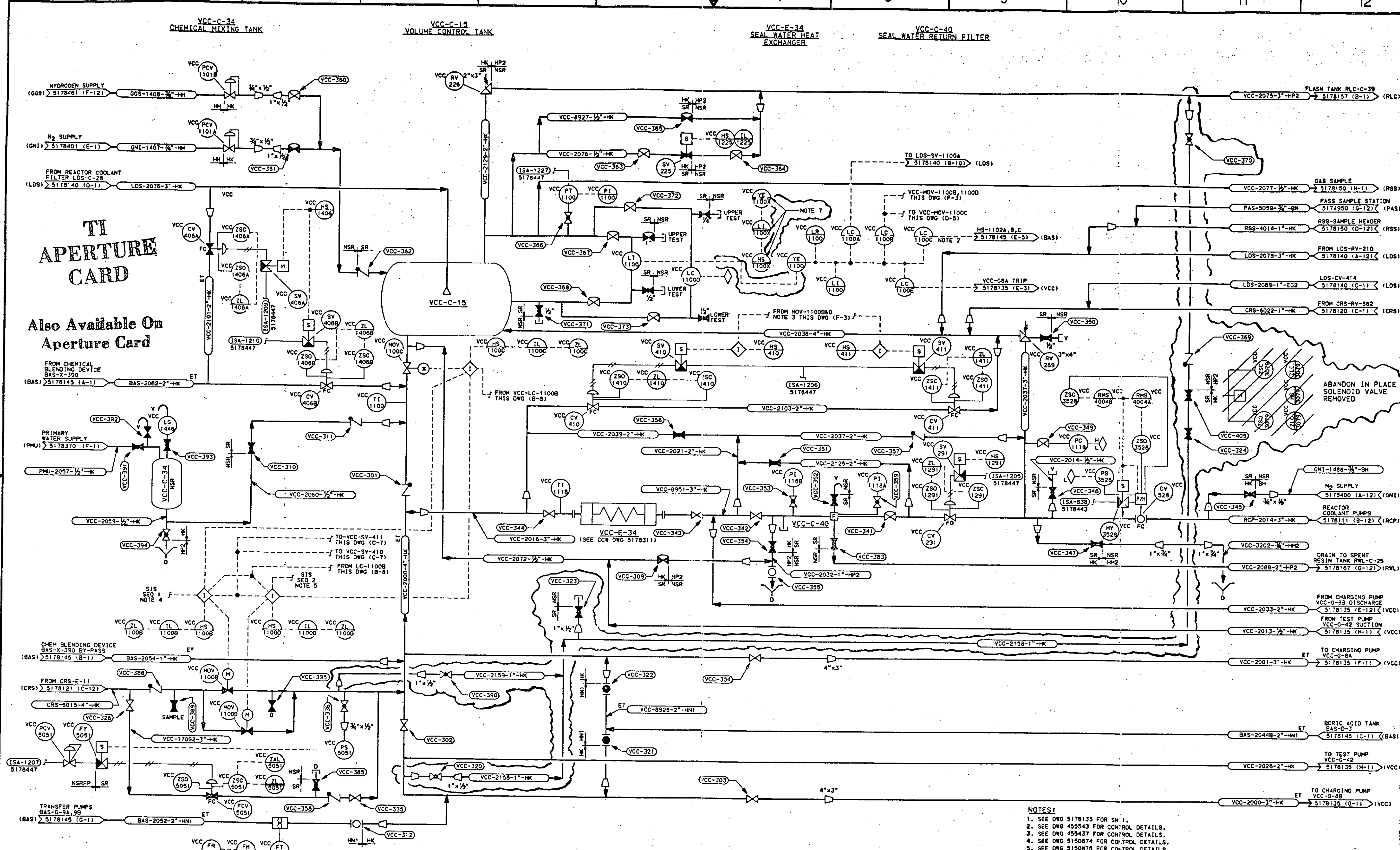
• REVISE ON CADD SYSTEM ONLY •

12-01-86

568767

8711100274-03

5178135-9



NOTES:
1. SEE DWG 5178135 FOR SH 1.
2. SEE DWG 455543 FOR CONTROL DETAILS.
3. SEE DWG 455437 FOR CONTROL DETAILS.
4. SEE DWG 5150874 FOR CONTROL DETAILS.
5. SEE DWG 5150875 FOR CONTROL DETAILS.
6. THIS DRAWING SUPERSEDES DRAWINGS 568767 & 5130355 AND ALL CCN'S WHICH PERTAIN TO THEM.
7. TEMP MOD NO LONGER REQUIRED ABANDON IN PLACE.

SAFETY RELATED EXCEPT AS NOTED (SREAN) WP 82-297

VCC

DWG. LIST M- SH.
* REVISE ON CADD SYSTEM ONLY *

5178000	P & I DIAGRAM LEGEND SH 1	5151028	ELEM DIAGRAM MOV-1100C
5178001	P & I DIAGRAM LEGEND SH 2		
5178002	P & I DIAGRAM LEGEND SH 3		
238710	CONTROL LOGIC DIAGRAM		
457257	LOGIC DIAGRAM VOLUME CONTROL TANK		
455369	ELEM DIAGRAM MOV-1100B & 1100D		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
9	AS BUILT-INCORP DCN #13, 14 & 15		7/15/87						AR	GAC	3831
8	AS BUILT-INCORP DCN #12 & MINOR CHANGE			SEE	CDM FILES	FOR SIGNATURES				GAC	3831
7	AS BUILT-INCORP DCN #11 & MINOR CHANGES			SEE	CDM FILES	FOR SIGNATURES				GAC	3024
6	AS BUILT-INCORP DCN #10			SEE	CDM FILES	FOR SIGNATURES				DVY	3083

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
5	AS BUILT-INCORP DCN #7-#9 & MINOR CHNGS			SEE	CDM FILES	FOR SIGNATURES				CVY	3083
4	AS BUILT-INCORP DCN #5,#6 & MINOR CHNGS			SEE	CDM FILES	FOR SIGNATURES				CVY	3083
3	AS BUILT-INCORP DCN #4			SEE	CDM FILES	FOR SIGNATURES				BLS	3083
2	AS BUILT-INCORP DCN #3 (DCN #2 NOT USED)			SEE	CDM FILES	FOR SIGNATURES				BLS	8881
1	AS BUILT-INCORP DCN #1			SEE	CDM FILES	FOR SIGNATURES				DVY	8744
0	ISSUED AS BUILT			SEE	CDM FILES	FOR SIGNATURES				BLS	8252

LOCATION:

P & I DIAGRAM
VOLUME CONTROL AND CHARGING SYSTEM SH 2

Southern California Edison

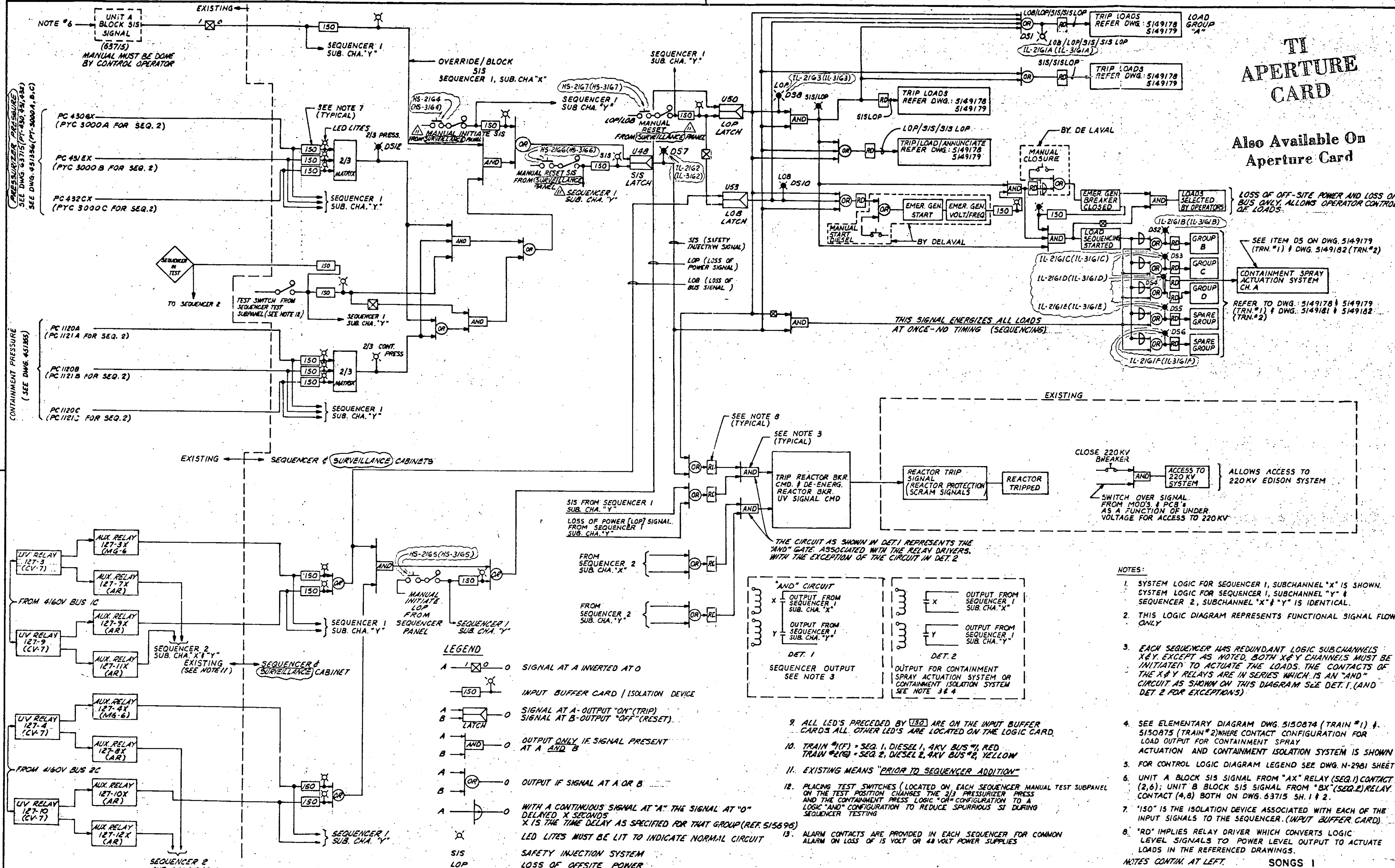
SHEET NO. M
SCALE: NONE
OF SHTS.

07-07-87 CASTRO

E4-632-CADD 03-85

8711100274-04 568767

5178136-9



LEGEND

A —[inverter]— O	SIGNAL AT A INVERTED AT O
ISO / LED	INPUT BUFFER CARD / ISOLATION DEVICE
A, B — LATCH	SIGNAL AT A - OUTPUT "ON" (TRIP) SIGNAL AT B - OUTPUT "OFF" (RESET)
A, B — AND — O	OUTPUT ONLY IF SIGNAL PRESENT AT A AND B
A, B — OR — O	OUTPUT IF SIGNAL AT A OR B
A —[delay]— O	WITH A CONTINUOUS SIGNAL AT "A" THE SIGNAL AT "O" DELAYED X SECONDS X IS THE TIME DELAY AS SPECIFIED FOR THAT GROUP (REF. 515696)
[LED]	LED LITES MUST BE LIT TO INDICATE NORMAL CIRCUIT
SIS	SAFETY INJECTION SYSTEM
LOP	LOSS OF OFFSITE POWER
LOB	LOSS OF 4KV BUS

NOTES:

1. SYSTEM LOGIC FOR SEQUENCER 1, SUBCHANNEL "X" IS SHOWN. SYSTEM LOGIC FOR SEQUENCER 1, SUBCHANNEL "Y" & SEQUENCER 2, SUBCHANNEL "X" & "Y" IS IDENTICAL.
2. THIS LOGIC DIAGRAM REPRESENTS FUNCTIONAL SIGNAL FLOW. ONLY
3. EACH SEQUENCER HAS REDUNDANT LOGIC SUBCHANNELS X & Y. EXCEPT AS NOTED, BOTH X & Y CHANNELS MUST BE INITIATED TO ACTUATE THE LOADS. THE CONTACTS OF THE X & Y RELAYS ARE IN SERIES WHICH IS AN "AND" CIRCUIT AS SHOWN ON THIS DIAGRAM SEE DET. 1. (AND DET. 2 FOR EXCEPTIONS)
4. SEE ELEMENTARY DIAGRAM DWG. 5150874 (TRAIN #1) & 5150875 (TRAIN #2) WHERE CONTACT CONFIGURATION FOR LOAD OUTPUT FOR CONTAINMENT SPRAY ACTUATION AND CONTAINMENT ISOLATION SYSTEM IS SHOWN.
5. FOR CONTROL LOGIC DIAGRAM LEGEND SEE DWG. N-2981 SHEET 1.
6. UNIT A BLOCK SIS SIGNAL FROM "AX" RELAY (SEQ.1) CONTACT (2,6); UNIT B BLOCK SIS SIGNAL FROM "BX" (SEQ.2) RELAY CONTACT (4,8) BOTH ON DWG. 63715 SH. 1 & 2.
7. "ISO" IS THE ISOLATION DEVICE ASSOCIATED WITH EACH OF THE INPUT SIGNALS TO THE SEQUENCER. (INPUT BUFFER CARD)
8. "RD" IMPLIES RELAY DRIVER WHICH CONVERTS LOGIC LEVEL SIGNALS TO POWER LEVEL OUTPUT TO ACTUATE LOADS IN THE REFERENCED DRAWINGS.

NOTES CONTIN. AT LEFT.

9. ALL LED'S PRECEDED BY $\boxed{ISO}$ ARE ON THE INPUT BUFFER CARDS ALL OTHER LED'S ARE LOCATED ON THE LOGIC CARD.
10. TRAIN #1(F) = SEQ. 1, DIESEL 1, 4KV BUS #1, RED; TRAIN #2(G) = SEQ. 2, DIESEL 2, 4KV BUS #2, YELLOW
11. EXISTING MEANS "PRIOR TO SEQUENCER ADDITION"
12. PLACING TEST SWITCHES (LOCATED ON EACH SEQUENCER MANUAL TEST SUBPANEL ON THE TEST POSITION CHANGES THE 2/3 PRESSURIZER PRESS AND THE CONTAINMENT PRESS LOGIC "OR" CONFIGURATION TO A LOGIC "AND" CONFIGURATION TO REDUCE SPURRIOUS SI DURING SEQUENCER TESTING
13. ALARM CONTACTS ARE PROVIDED IN EACH SEQUENCER FOR COMMON ALARM ON LOSS OF 15 VOLT OR 48 VOLT POWER SUPPLIES

STATION FILE 1542 SH. 137M

SONGS 1
SAFETY RELATED
W.P. # 2.1.4 (82-297)

Reference Drawings

5150875	SEQUENCER ELEMENTARY DIAGRAM	5156597	SEQ. MOD. RELAY DRIVER/INPUT BUFFER	5156591	SEQ. MODULE DATA INPUT DRIVER	5149957	LOP-SIS-SISLOP-TRAIN #1
451336	LOOP DIAG. PRESSURIZER PRESS.	5156596	LOGIC DIAGRAM. LOGIC CIRCUITS	5156590	SEQ. I OUTPUT FUNCTION-RELAYS	5149955	SIS/LOP LOCKOUT RELAYS-TRAIN 2
451 355	LOGIC DIAGRAM CIS	5156595	LOGIC DIAGRAM INPUT GATING	5156589	SEQUENCE I BLOCK DIAGRAM	5149182	LOAD SEQUENCE SCHEDULE TR #2
63715	ELEM. DIAGRAM S.I.S	5156594	W.D SEQ. MANUAL TEST PANEL	5149975	SIS/LOP LOCKOUT RELAYS TRAIN 2	5149181	LOAD SEQUENCE SCHEDULE TR #2
5156599	SEQUENCER 2 BLOCK DIAGRAM	5156593	SEQ MOD. DATA RELAY DRIVER OUTPUTS	5149974	SIS/LOP LOCKOUT RELAYS TRAIN 1	5149179	LOAD SEQUENCE SCHEDULE TR #1
5150874	SEQUENCER ELEMENTARY DIAGRAM	5156592	SEQ. MOD. DATA RELAY DRIVER OUTPUTS	5149958	LOP-SIS-SISLOP TRAIN #2	5149178	LOAD SEQUENCE SCHEDULE TR #1

Revisions

No.	Revisions	Date	Approved	O.K.	O.K.	Ch'd.	Made	J.O. No.
11	[illegible] INCORP. SCN 15, 16 NOT INCORP, ADDED EDITORIAL CHANGES	7-16-87				SH	EAC	3033
10	ISSUED FOR "AS CONSTRUCTED" INC. CC #13, CC #12 CANCELLED	9-17-81				D.S	GJ	7764
9	ISSUED FOR CONSTRUCTION — "AS CONSTRUCTED"	1/14/80				CAG		7701
8	INCORP. CCN 10 & 11, EFF. DATE: IMMED.	11/8/79				AS	GJ	6839
7	INCORP. CCN 8 + 9 EFF DATE IMMED.	5-3-78						7345

No.	Revisions	Date	Approved	O.K.	O.K.	Ch'd.	Made	J.O. No.
6	REC. REV. ADDED STATION FILE NO.	6-10-77					RO.	6500
5	INCORP CCN 6 EFF DATE IMMED	5-11-77				STD		0736
4	INCORP CCN 5 EFF DATE: IMMEDIATELY	4-14-77				STD		0736
3	INCORP CCN 4 EFF DATE 2-15-77 (REDRAWN)	2-17-76						0736

Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

SEQUENCER LOGIC DIAGRAM

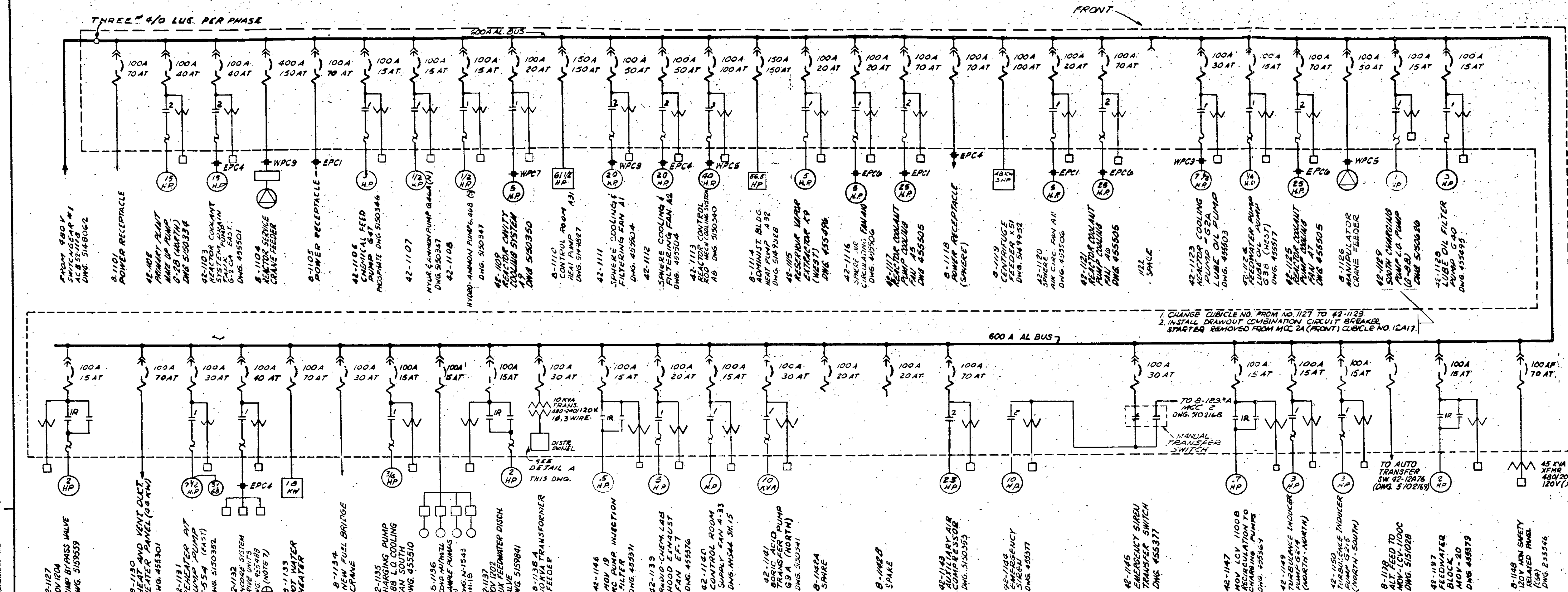
Southern California Edison Company

TI APERTURE CARD

Also Available On Aperture Card

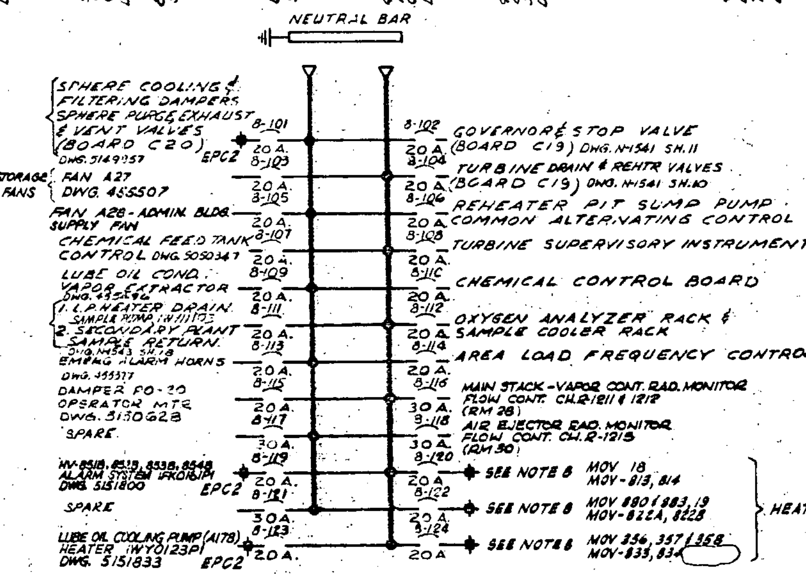
8711100274-05

5149180-11



36-MI-1 (NOTE 6)								86-MI-2 (NOTE 6)	86-MI-3 (NOTE 6)			
WIRE WAY												
RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.
8-1142A SPARE / 8-1142B SPARE	8-1101	42-1106	8-1110	8-1114	8-1118	8-1122 SPACE	8-1126	8-1130	8-1134	8-1138A	42-1109	42-1149
42-1143	42-1102		42-1111	42-1115	8-1119	42-1123	42-1129	42-1131	42-1135	DISTRIBUTION PANEL 240-120V 1Ø-3WIRE	42-1140	42-1150
42-1144	42-1103	42-1107	42-1112	42-1116	42-1120	42-1124	42-1128	42-1132	8-1136			8-1198
8-1145	8-1104	42-1108	42-1113	42-1117	42-1148	42-1147	42-1127	8-1133	42-1137	8-1148	42-1141	42-1197
		8-1105		42-1121				42-1125		10 KVA TRANSFORMER 480-240/120V	42-1139	

FRONT



DETAIL A
DISTRIBUTION PANEL
120-240 V, 1Ø, 3 WIRE

NOTES:
1. ALL DISCONNECT SWITCHES ARE RATED 30 AMPS. UNLESS OTHERWISE NOTED.
2. CONTROL TRANFORMERS WILL BE 100 VA UNLESS OTHERWISE NOTED.
3. STARTER SIZE IS SHOWN BESIDE CONTACT SYMBOL.
4. FUSES WILL BE FUSETRON TYPE FRS DUAL ELEMENT.
5. FOR MCC "1A" ONE LINE DIAGRAM & FRONT VIEW SEE DWG. 5118200.
6. FOR DETAILS SEE DWG. 455872.
7. SOURCE IS "SAFETY RELATED," LOAD IS "NON-SAFETY RELATED."
8.

MOV	SCHEME CABLE NO.	PEN LOC NO.
18	1WY12001	NO PEN LOC
813	1WY11901A	EPC2
814	1WY11902A	WPC3
880	1WY12202	NO PEN LOC
883	1WY12203	NO PEN LOC
19	1WY12201	NO PEN LOC
822A	1WY12101A	EPC3
822B	1WY12102A	W.PC3
356	1WY12403A	WPC3
357	1GB243C2A	WPC3
358	1WY12401A	EPC3
833	1WY12302A	EPC3
834	1WY12303A	WPC3

TI APERTURE CARD

Also Available On Aperture Card

87111100274-06

SONGS I
SAFETY RELATED
(EXCEPT AS NOTED ⊕)
SUPERSEDES DWG. N1540 SH.7

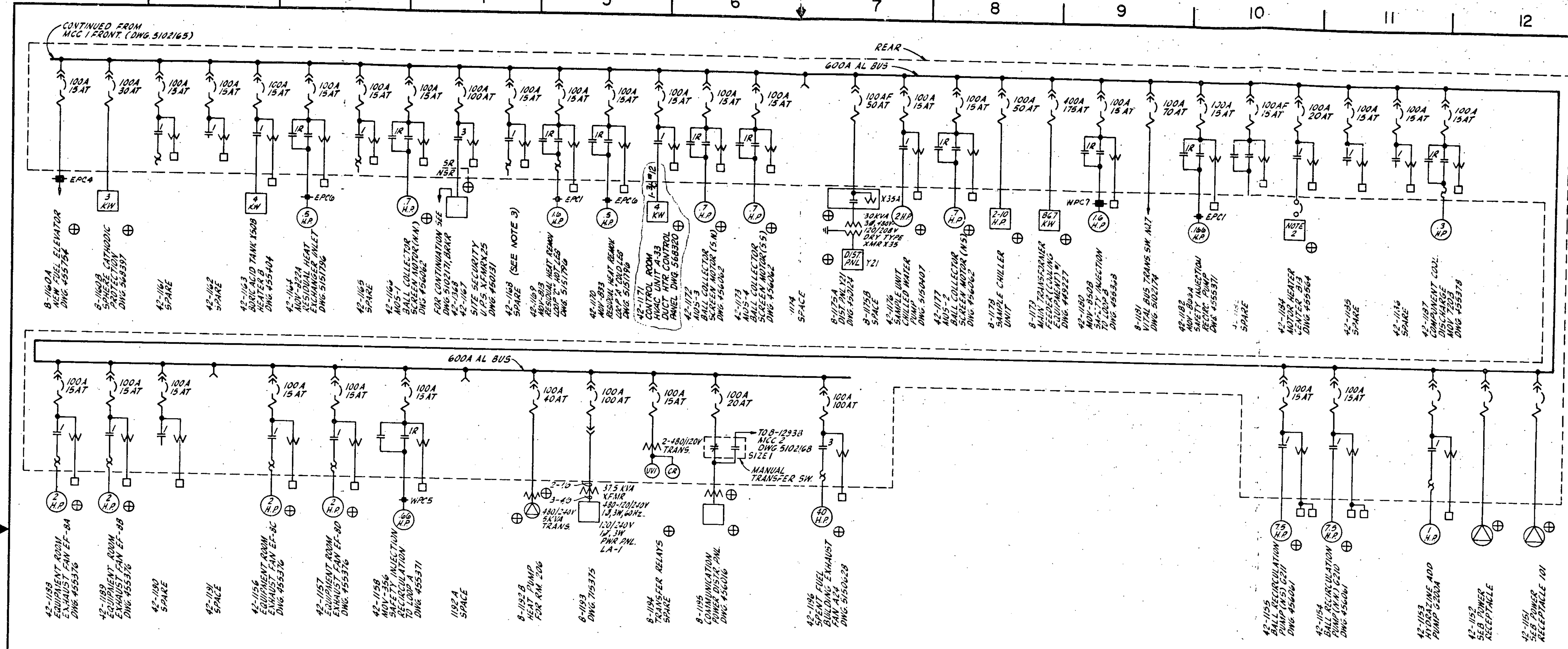
BECHTEL CORPORATION
ENGINEERS & CONSTRUCTORS
LOS ANGELES, CALIF.
JOB NO. 3246 DATE 2-2-65

CROSS REFERENCES
5150046 RELAY DATA MCC 1 & 2
5102149 ONE LINE DIAGRAM MCC 2A
5149062 ONE LINE DIAGRAM SH.1
5146888 MAIN ONE LINE DIAGRAM
5102166 ONE LINE DIAG. 480V MCC-1 REAR
449957 LOP-515-515/LOP TRAIN 1

REVISIONS
38 AS BUILT - INCORP. DCN 46
37 AS BUILT - INCORP DCN 41, 42, 43, 44, 45
36 AS BUILT - INCORP DCN 39, 40
35 AS BUILT - INCORP DCN 37, 38
34 AS BUILT - INC. DCN 36
33 AS BUILT - INCORP DCN 33, 34
32 AS BUILT INCORP DCN 30, 31, 32 FCR 52029
31 ISSUED FOR CONSTRUCTION

LOCATION SAN ONOFRE NUCLEAR GENERATING STATION
ONE LINE DIAGRAM
480 V. MCC - 1 FRONT
SOUTHERN CALIFORNIA EDISON COMPANY
SCALE NONE

5102165-38



						WIRE WAY						
RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.
42-1151	42-1156	8-1160A / 8-1160B	42-1161 SPARE	42-1165 SPARE	42-1168 SPARE	42-1171	-1174	8-1178	8-1181	42-1184	42-1188	8-1194 TRANSFER RELAYS & TRANS
42-1152	42-1157	42-1196	42-1162 SPARE	42-1166	42-1169	42-1172	8-1175A XMRX35 / 8-1175B SPACE	8-1179	42-1182 SPARE	42-1185 SPARE	42-1189	42-1193
42-1153	42-1167		42-1163				42-1176			42-1186 SPARE	42-1190 SPARE	1192A SPACE / 8-1192B
42-1154		1159 SPACE	42-1164	42-1158	42-1170	42-1173	42-1177	42-1180	42-1183 SPARE	42-1187	1191 SPACE	8-1195
42-1155		10 KVA TRANS. SEE FRONT										

FRONT

NOTES:
1. FOR GENERAL NOTES SEE DWG. 5102165.
2. SEE DWG. 5151734 FOR MOTOR HEATER CENTER 1.
3. REMOVE EXISTING COMPT. (W/DOOR) AND INSTALL AT COMPT. #12A17 OF MCC-2A (PRESENTLY SPACE) REPLACE BY NEW BUCKET PURCHASED UNDER IPOR #F-3151.

TI APERTURE CARD

Also Available On Aperture Card

SONGS 1
SAFETY RELATED
(EXCEPT AS NOTED ⊕)

SUPERSEDES DWG. N1540, SH 3

REFERENCE DRAWINGS	
5148062	ONE LINE DIAGRAM SWGR 1
5146828	MAIN ONE LINE DIAGRAM
5118200	ONE LINE DIAGRAM MCC 1A
5149957	LOP-515-515/LOP TRAN 1

NO.	REVISIONS	DATE	APPROVED	ENGR.	CK'D.	MADE
30	AS BUILT - INCORP DCN 33	7/14/87			COPE	3083
29	AS BUILT-INCORP DCN 31, 32	8/15/86	GG		ARR	3082
28	AS BUILT- INCORP DCN 30		GG		EAC	3066
27	REDRAWN DUE TO POOR LEGIBILITY & AS BUILT-INCORP CC 22, 24 DCN 23, 26, 28, 29 CANC CC17 THRU 21, DCN 25 (#27 NOT USED)	7/17/85			EAC	3083

LOCATION SAN ONOFRE NUCLEAR GEN. STATION

ONE LINE DIAGRAM
480V MCC-1 REAR

Southern California Edison

SHEET NO. E

___OF___SHTS.

8711100274-07

5102166-30

INTERIM DCN NO. ABQ-1371

PAGE 1 OF 2

Southern California Edison Company

~~INTERIM DESIGN CHANGE NOTICE (IDCN)~~ / DESIGN CHANGE NOTICE (DCN)
(For SONGS 1, 2 & 3)

CDM/DDC USE ONLY	
DOCUMENT 5102169	REV. NO. 3 ~~36~~
SHEET	DCN CONVERSION NO. 41 AUG 18 1987

1. ORIGINATOR Augusto Alvarez — PAX 28390 — DATE 6-30-87
DOCUMENT TITLE O/L DIAG 480V MCC-2A Front & Rear — DRADM E-07 — SC SRCAN

DESCRIPTION OF CHANGE

Remove "Abandon in Place" for Bkr 8-2A19
& Add "Spare".

2. **Other Affected Documents**

The associated document/source initiating change on Form SO(123) 183 is (check one):

- [x] This IDCN SO(123) 183 (attached)
- [ ] The following document(s):

Specific affected documents are listed on the SO(123) 184 associated with the above checked source document(s).

3. **Affected Systems**

4. **SCE Design Approvals**

NUCLEAR GENERATION SITE DEPARTMENT	DATE	ENGINEERING AND CONSTRUCTION DEPARTMENT/NES & L	DATE
OTHER		OTHER	
OTHER		CHECKER Arlland C. Kaci	7-10-87
CHECKER		X INDEPENDENT REVIEW ENGR. [signature]	8-3-87
INDEPENDENT REVIEW ENGR.		X RESPONSIBLE ENGINEER [signature]	8/5/87
RESPONSIBLE ENGINEER		DISCIPLINE GROUP LEADER [signature]	8/5/87
GROUP SUPERVISING ENGINEER		X DISCIPLINE SUPERVISOR A Kanelko	8/7/87
SUPERVISING ENGINEER I		X PROJECT ENGINEER [signature]	8/11/87
MANAGER, STATION TECHNICAL		DISCIPLINE CHIEF	
QUALITY ASSURANCE		X QUALITY ASSURANCE [signature]	8-19-87

Conversion to DCN Date ______ Debra Martinez AUG 18 1987
SCE PROJECT ADMINISTRATOR

SCE 26-179-1 REV 11/85

Southern California Edison Company
Songs 1, 2 & 3

~~INTERIM DESIGN CHANGE NOTICE (IDCN)~~/DESIGN CHANGE NOTICE (DCN)
SUPPLEMENTAL PAGE

INTERIM DCN NO. ABG-1371

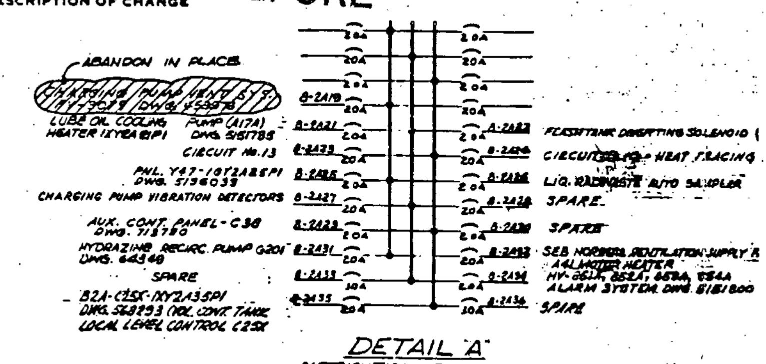
IDCN NUMBER					
DRAWING NO.	SHEET NO.	REV. NO.	DCN CONV. DATE AUG 18 1987 DRG. REV.	DCN NO.	QUALITY CLASS
5102169		~~36~~	37	41	SRCAN

Date 6-30-87 Page 2 of 2

By Augusto Alvarez

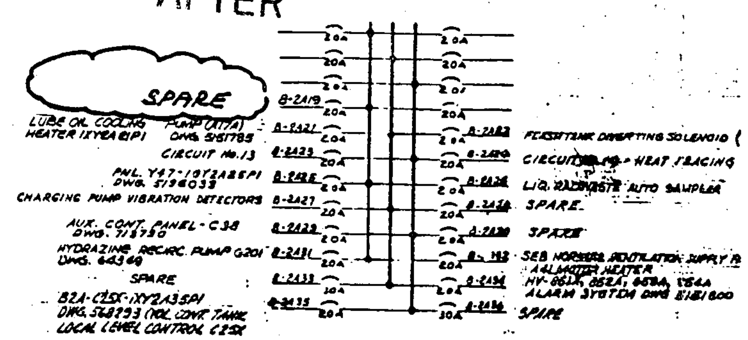
DESCRIPTION OF CHANGE

BEFORE



DETAIL "A"
DISTRIBUTION PANEL
120-208V. 3φ 4 WIRES

AFTER



DETAIL "A"
DISTRIBUTION PANEL
120-208V. 3φ 4 WIRES

SCE 26-179-2 REV 11/85

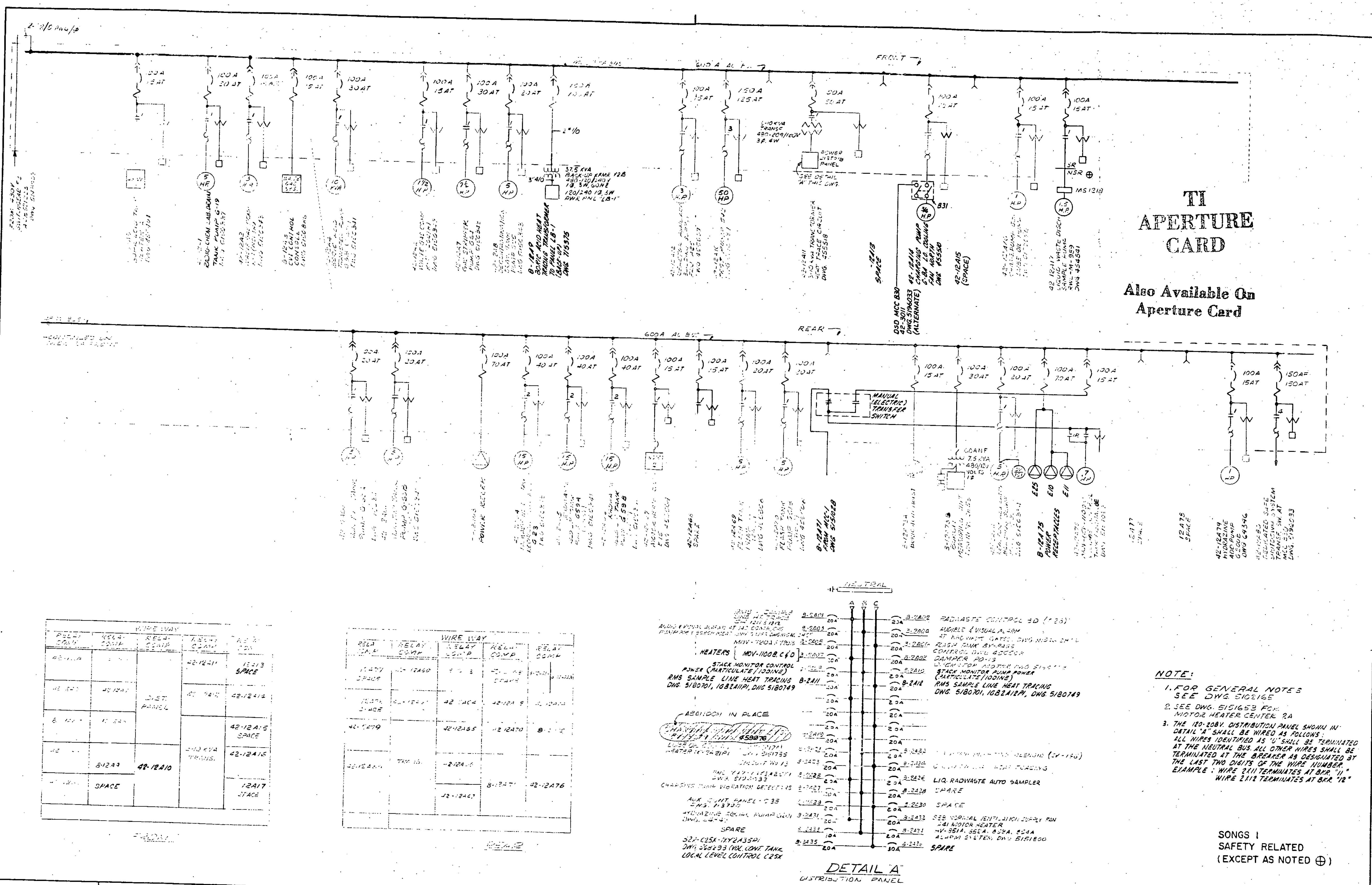
16X

MICROFILMED FROM BEST AVAILABLE COPY

TI APERTURE CARD

Also Available On Aperture Card

8711100274-09



NOTE:

1. FOR GENERAL NOTES SEE DWG. 5102165
2. SEE DWG. 5151653 FOR MOTOR HEATER CENTER 2A
3. THE 120-208V. DISTRIBUTION PANEL SHOWN IN DETAIL "A" SHALL BE WIRED AS FOLLOWS: ALL WIRES IDENTIFIED AS "U" SHALL BE TERMINATED AT THE NEUTRAL BUS. ALL OTHER WIRES SHALL BE TERMINATED AT THE BREAKER AS DESIGNATED BY THE LAST TWO DIGITS OF THE WIRE NUMBER. EXAMPLE: WIRE 2X11 TERMINATES AT BKR. "11" WIRE 2X12 TERMINATES AT BKR. "12"

SONGS 1
SAFETY RELATED
(EXCEPT AS NOTED ⊕)

SUPERSEDES DWG N-1540 SH. II

REV. NO.	REVISIONS
37	AS BUILT - INCORP. DCN #40
36	AS BUILT - INCORP. DCN 14
35	AS BUILT - INCORP. DCN 33
34	AS BUILT - INCORP. DCN 33 THRU 37
0	ISSUED FOR CONSTRUCTION
33	[illegible]
32	[illegible] AS BUILT
31	[illegible]
30	[illegible]
29	INCORP. DCN #11, EFF. DATE IMMED.
28	[illegible] EFF. DATE IMMED.

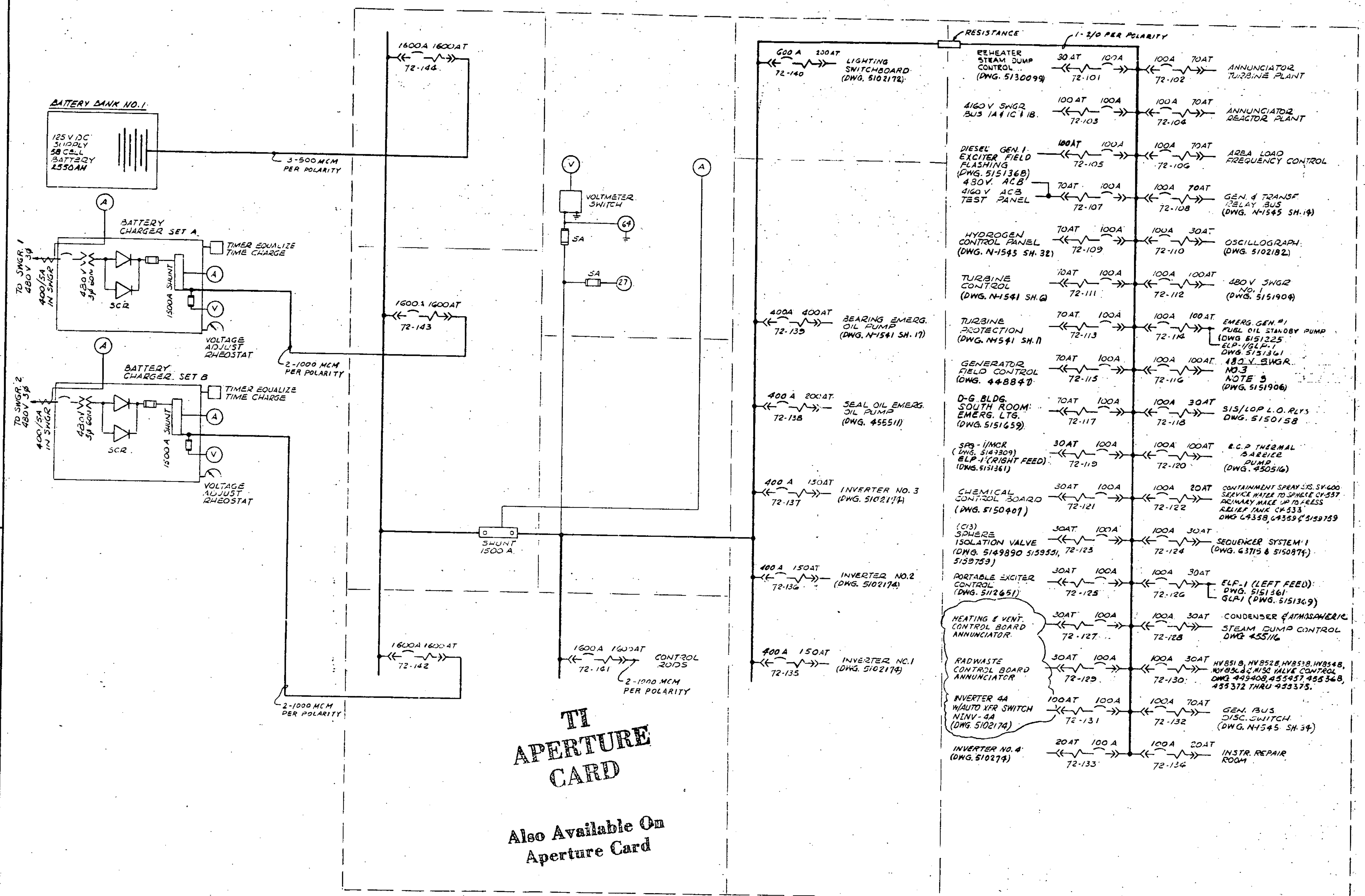
CROSS REFERENCES

BECHTEL CORPORATION
ENGINEERS & CONSTRUCTORS
LOS ANGELES, CALIF.
JOB NO. 3246 DATE 2-3-66

LOCATION SAN ONOFRE NUCLEAR GENERATING STATION
ONE LINE DIAGRAM
480 V. MCC - 2A
FRONT & REAR
SOUTHERN CALIFORNIA EDISON COMPANY
SCALE NONE LOS ANGELES, CALIF.

8711100274-09

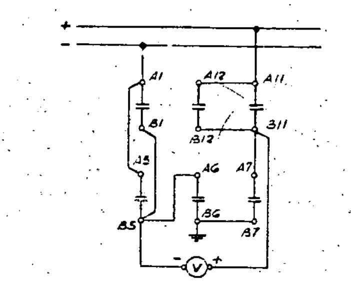
5102169-37



VOLTMETER
POS. TO GND.
BATT VOLT / NEG TO GND
OFF
WESTINGHOUSE

CONTACT	POSITION			
	OFF	1	2	3
A11-B11		X		
A12-B12			X	
A1-B1				X
A5-B5		X		
A6-B6			X	
A7-B7				X

TYPE W-2
ROUND FIXED HANDLE SWITCH S# 505A702G05



VOLTMETER SCHEMATIC

LEGEND

- AIR CIRCUIT BREAKER WITH THERMAL - MAGNETIC TRIP
- DC INSTRUMENT SHUNT
- (A) AMMETER
- (V) VOLTMETER
- RELAY (SEE DEVICE NO. INSIDE CIRCLE FOR RELAY FUNCTION)
- AT ACB AMP TRIP
- FUSE

DEVICE TABLE

DEVICE NO	DESCRIPTION	MFG. & TYPE	FUNCTION
64	DC GROUND RELAY	GUARDIAN ELECT F/M 3407-2D	ALARM
72	D.C. LINE CIRCUIT BREAKERS		
27	D.C. UNDERVOLTAGE RELAY	STRUTHER-DUNN	ALARM
27F	D.C. FEEDER UNDERVOLTAGE RELAY	STRUTHER-DUNN 219X8XP	ALARM

NOTES:

1. D.C. FEEDER UNDERVOLTAGE RELAY (27F) PROVIDES AN ALARM FOR ITS PROTECTIVE BREAKER ON TRIP POSITION. BREAKERS MARKED WITH AN ASTERISK DO NOT HAVE UNDERVOLTAGE RELAY.
2. CIRCUIT BREAKERS CARRYING INPUT POWER FROM BATTERY AND CHARGER DO NOT HAVE UNDERVOLTAGE RELAYS.
3. 480V SWGR 3 D.C. CONTROL POWER IS SERVED FROM EITHER 125V. D.C. SYSTEM 1 OR 2 THROUGH AN INTERLOCKING DEVICE TO AVOID BOTH D.C. SYSTEMS BEING PARALLELED.

8711100274-10

SONGS 1
SAFETY RELATED

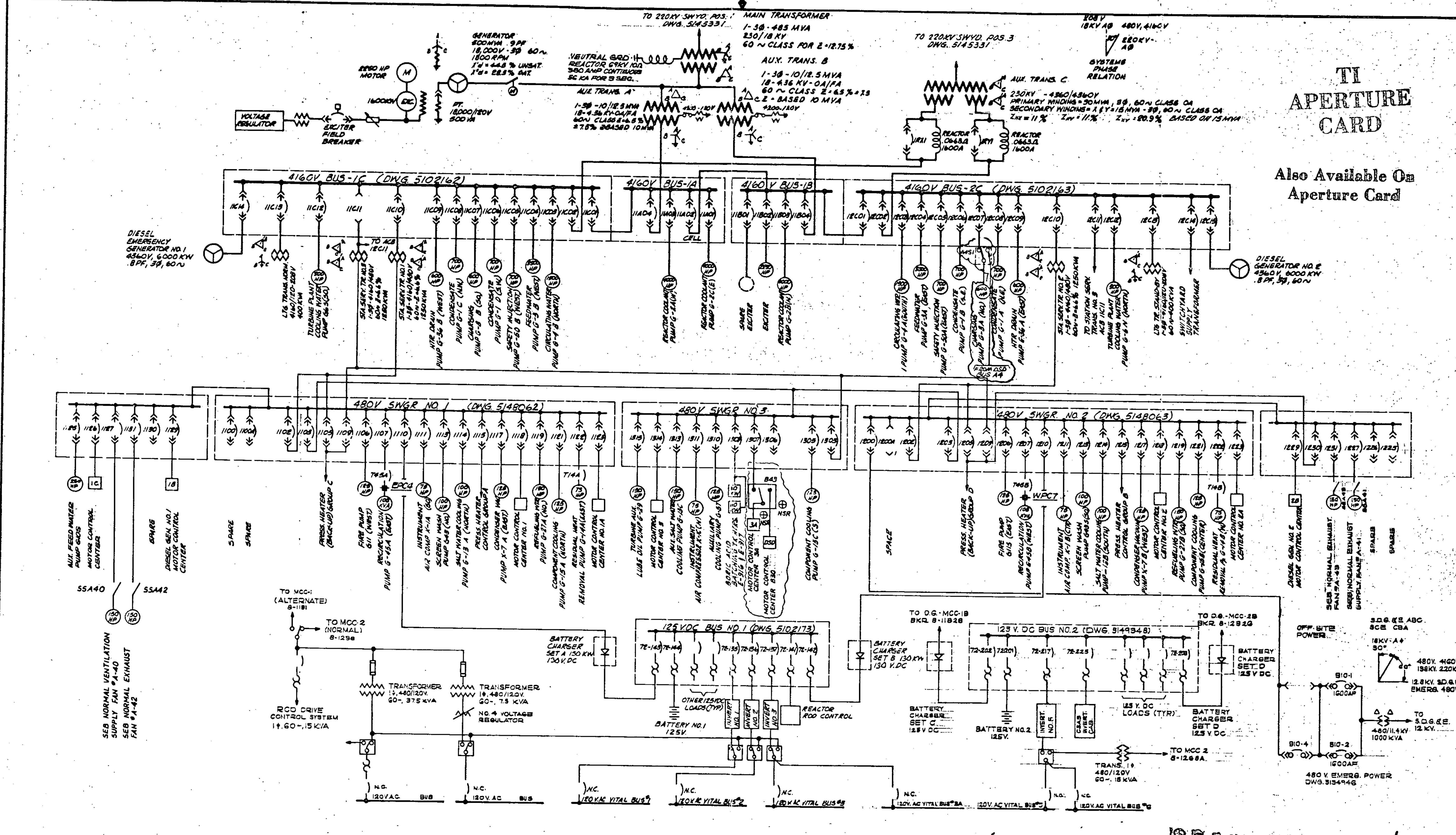
BECHTEL CORPORATION
ENGINEERS & CONSTRUCTORS
LOS ANGELES, CALIF.
JOB NO. 3246 DATE 6-18-65

CROSS REFERENCES
W.D. 2 WIRE 125 V. D.C.
568264 W.D. 125V D.C. CONT. & DIST. SWBD

REVISIONS
21 AS BUILT - INCORP DCN 19 & 20
20 AS BUILT - INCORP DCN 15, 16, 18, 30 (41 NOT USED)
19 AS BUILT - INCORP. CC 13
17 INCORP CCN 11, EFFECT DATE: IMMED.
16 INCORP CCN 7.3 (10) EFF DATE IMMED
15 INCORP CCN 6 EFF. DATE IMMED.
14 INCORP DCN 4 EFFECT DATE 11-1-76
13 INCORP CCN 1, 3 (DCN 2 - EFF DATE 11-1-76

LOCATION SAN ONOFRE NUCLEAR GENERATING STATION
ONE LINE DIAGRAM
125 VOLT D.C. SYSTEM 1
SOUTHERN CALIFORNIA EDISON COMPANY
SCALE: NONE LOS ANGELES, CALIF.

E17 N-1540 SH.17 5102173-21



TI
APERTURE
CARD

Also Available On
Aperture Card

8711100274-11

SONGS 1
SAFETY RELATED
EXCEPT AS NOTED

SUPERSEDES DWG.# 5146828-13

No.	Revisions
24	AS BUILT - INCORP. DCN 32,33
23	AS BUILT - INCORP. DCN 30,31
22	AS BUILT - INCORP. DCN 29
21	[illegible]
20	INCORP. CCN 12, REVISED & REDRAWN

SAN ONOFRE NUCLEAR GEN. STA.

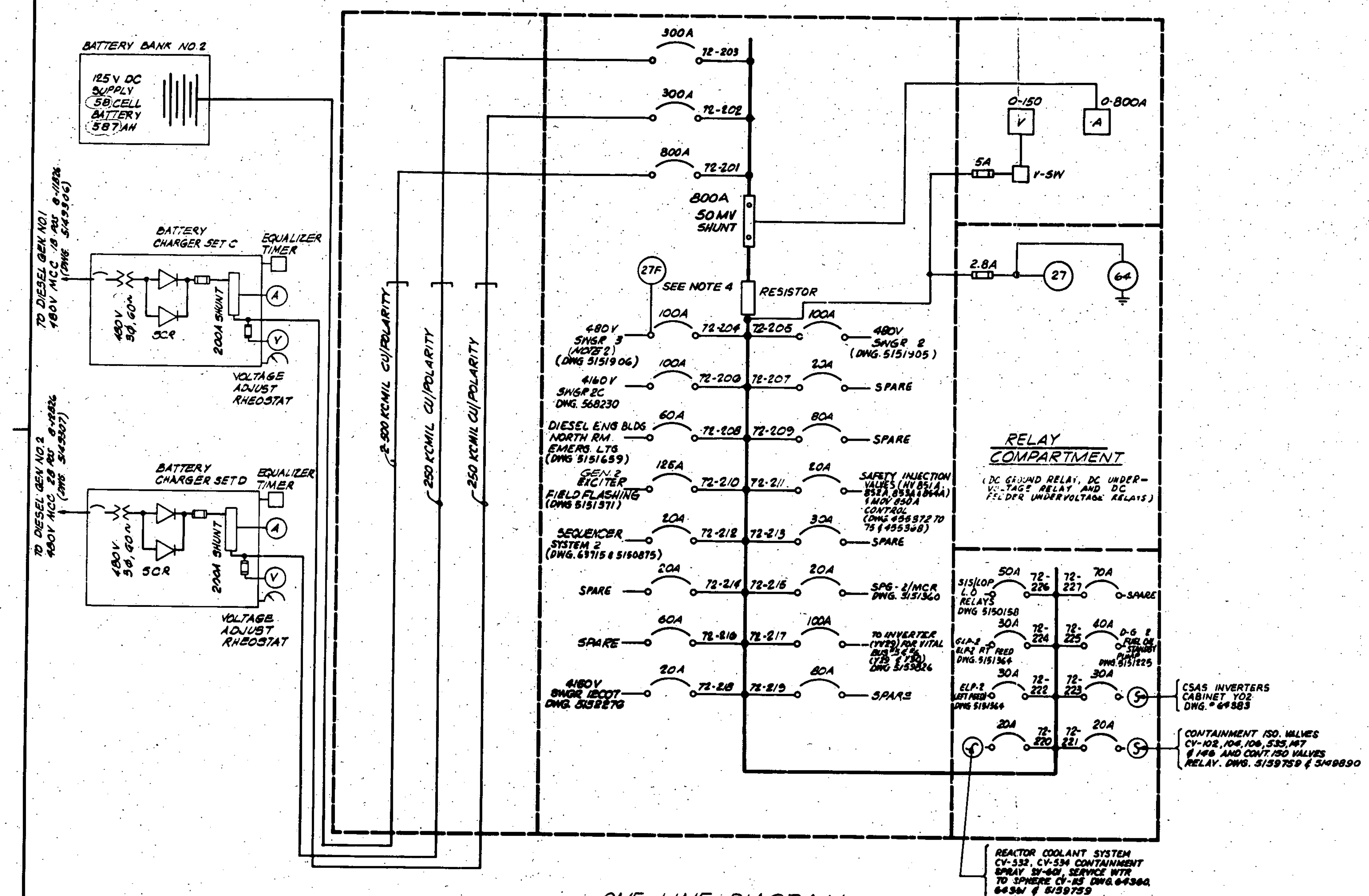
MAIN
ONE LINE DIAGRAM

Southern California Edison Company

5146828-24

TI
APERTURE
CARD

Also Available On
Aperture Card



ONE LINE DIAGRAM
125 V DC BUS 2 SWITCHBOARD

DEVICE TABLE			
DEVICE NO.	DESCRIPTION	MFG & TYPE	FUNCTION
64	DC GROUND RELAY	GUARDIAN 7152-0915-9006	ALARM
72	DC CIRCUIT BREAKER		OVERLOAD & FAULT PROT.
27	DC UNDERVOLTAGE RELAY	PWR CONV. PROD MODEL DSLV120T2-01	ALARM
27F	DC FEEDER UNDERVOLTAGE RELAY	STRUTHER-DUNN 219XBXP	ALARM

LEGEND

- MOLDED CASE CIRCUIT BREAKER WITH THERMAL-MAGNETIC TRIP
- DC INSTRUMENT SHUNT
- AMMETER
- VOLTMETER
- RELAY (SEE DEVICE NO. INSIDE CIRCLE FOR RELAY FUNCTION.)
- FUSE
- V-SW VOLTMETER SWITCH, FOUR POSITIONS: 1. BATTERY VOLTAGE 2. POSITIVE TO GROUND 3. NEGATIVE TO GROUND 4. OFF

NOTES:

1. PROVIDE SELECTIVE COORDINATION WHEREIN ONLY THE CIRCUIT BREAKER NEAREST THE FAULT OPENS TO REMOVE A SHORT CIRCUIT AND THE MAIN 800A CIRCUIT BREAKER REMAINS CLOSED.
2. 480V SWGR. 3 D.C. CONTROL POWER IS SERVED FROM EITHER 125V. D.C. SYSTEM 1 OR 2 THROUGH AN INTERLOCKING DEVICE TO AVOID BOTH D.C. SYSTEMS BEING PARALLELED.
3. THE SYSTEM IS UNGROUNDED.
4. TYPICAL FOR BREAKERS 72-204 THRU 72-227
5. CHECK CALCULATION DC-1399 "SIZING 125 V. D.C. BATTERY #2" BEFORE ADDING ANY LOADS TO 125 V. D.C. BATTERY #2.

SONGS 1
SAFETY RELATED
1540 SH. 17B

10	AS BUILT-INCORP. DCN 23, 24, 25	
9	AS BUILT-INCORP DCN 22 (21 NOV USED)	
6	REC. REV.-ADDED STA. FILE NO.	
5	INCORP CCN 11 EFF DATE WAIVED	
4	INCORP. CCN 6, 7, 8, 9 & 10 EFF DATE WAIVED	5341
3	INCORP CCN 8 EFFECT DATE WAIVED	8088
11	AS BUILT-INCORP DCN 26	7444
0	ISSUE FOR CONSTRUCTION	6500

Reference Drawings: 5149634 / 5149631 ... D.C. SWBD

Location SAN ONOFRE NUCLEAR GEN. STA.

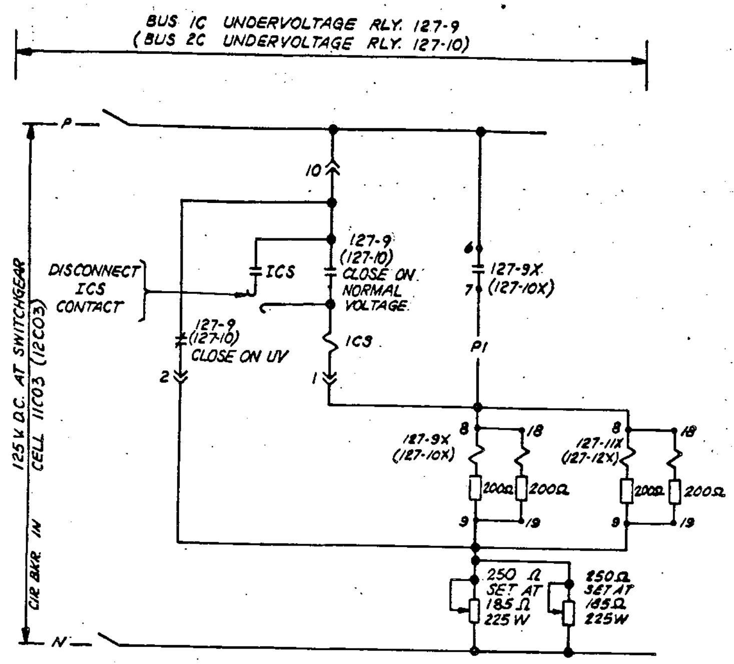
ONE LINE DIAGRAM
125V DC SYSTEM NO. 2

Southern California Edison Company

5149348-11

8711100274-12

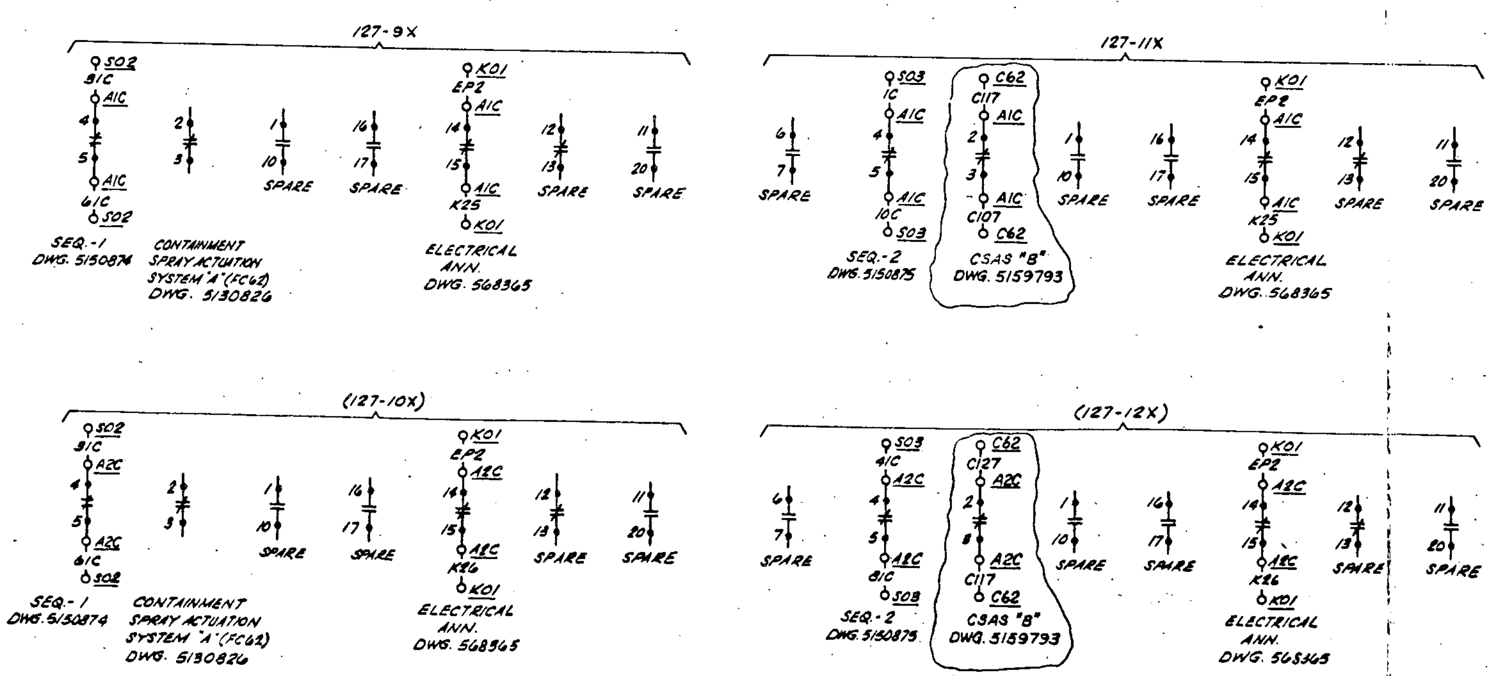
MICROFILMED



DEVICE TABLE		
DEVICE	TYPE	DESCRIPTION
127-9,10	CV-7 (WEST)	UNDERVOLTAGE RELAY
127-9X, 10X,11X,12X	AR (WEST)	AUXILIARY RELAY 48V DC COILS WITH 4N.C. & 4 N.O. CONTACTS

TI APERTURE CARD

Also Available On Aperture Card



NOTES:
1. BUS 1C RELAYS SHOWN, BUS 2C IDENTICAL EXCEPT AS SHOWN IN PARENTHESIS.
2. TARGET WILL NOT DROP WHEN RELAY 127-9 (127-10) IS ENERGIZED.

SONGS 1
SAFETY RELATED
ELECTRICAL AUXILIARIES

Drawing	Reference Drawings
5149269	DEVICE FUNCT. NOS. & SYMBOLS
5150875	E.D. SAFETY INJECTION SEQ. 2
5150874	E.D. SAFETY INJECTION SEQ. 1
5102163	1-LINE DIAG. 4160V BUSSES 1B & 2C
5102162	1-LINE DIAG. 4160V BUSSES 1A & C
M-	Drawing List Sheet
5149180	SEQUENCER LOGIC DIAGRAM

No.	Revisions	Date	I.O. No.
5	AS BUILT - INCORP DCN 9	9-23-86	3083
4	AS BUILT - INCORP DCN 8	8-6-90	3083
3	AS BUILT INCORP DCN# 7	7/9/75	3083
2	AS-BUILT-INCORP CC'S 3 & 4. T.O. #1420	5-28-68	3842
1	INCORP CCN'S #1 & 2 EFFECT. DATE IMMED.	7/5/66	7345
0	ISSUED FOR CONSTRUCTION	6-9-11	7345

Scale NONE

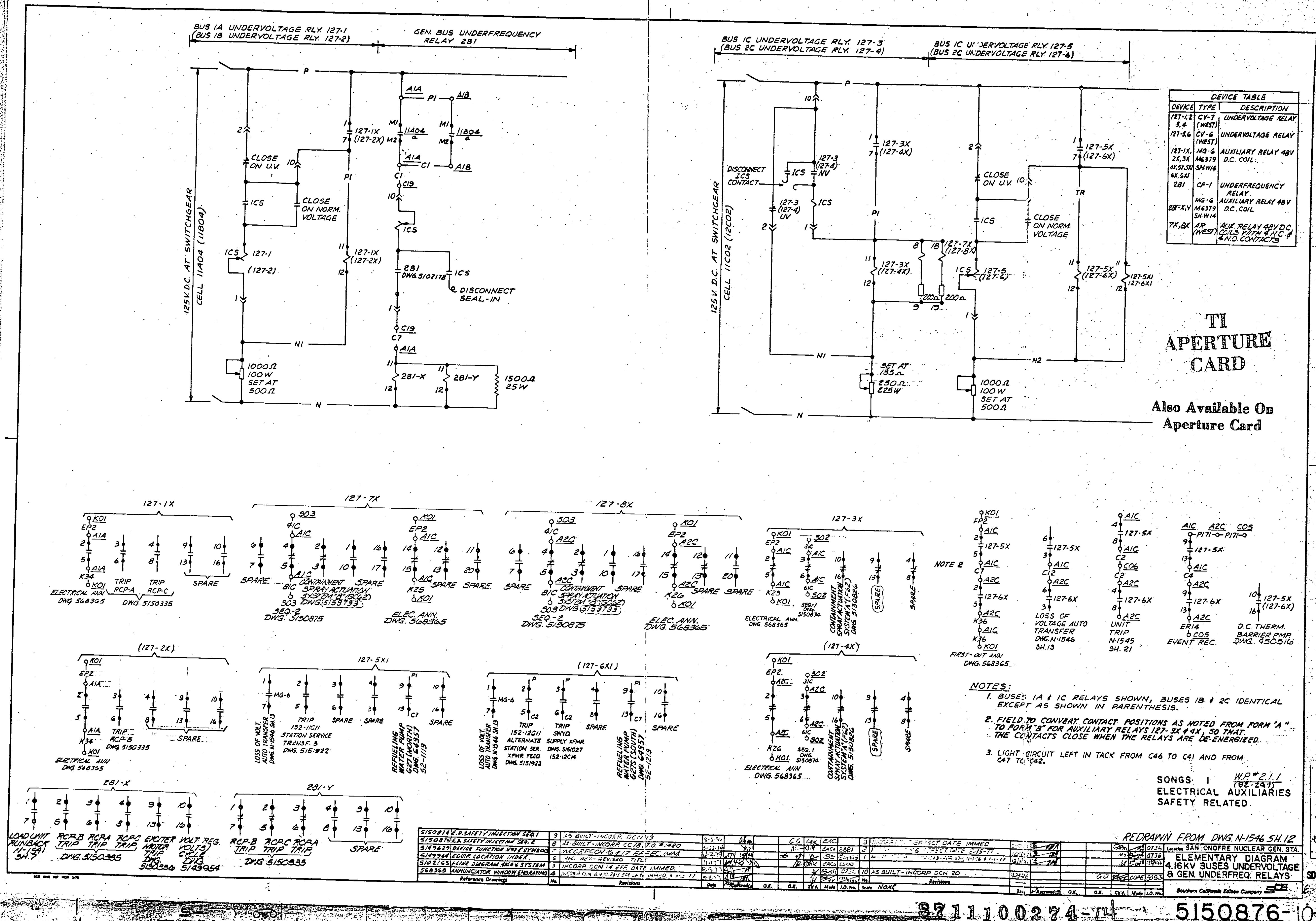
Location SAN ONOFRE NUCLEAR GEN. STA.

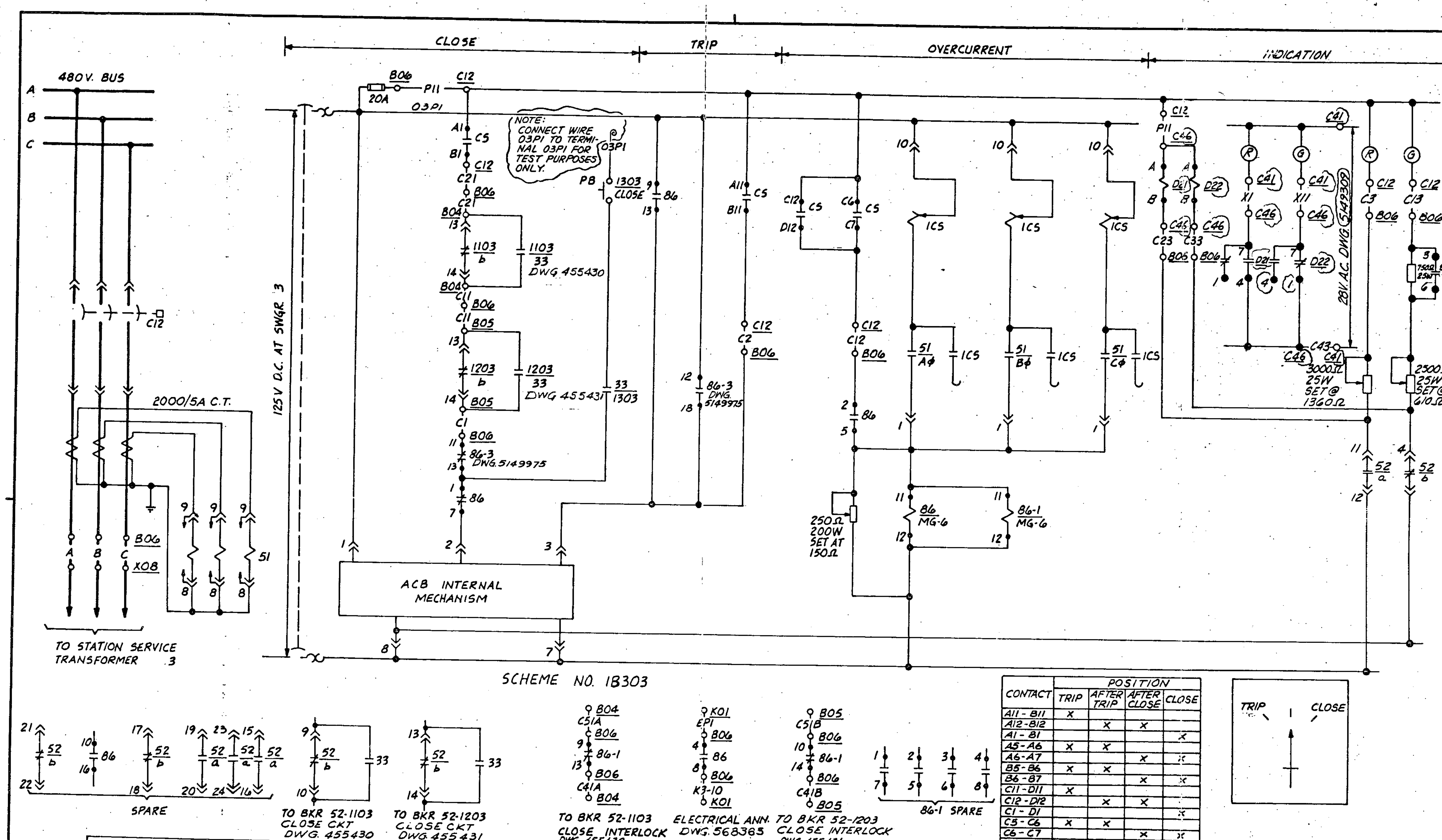
ELEMENTARY DIAGRAM
4.16 KV BUSES
UNDERVOLTAGE RELAYS

Southern California Edison Company

8711100274-13

5130351-5


BUS 1A UNDERVOLTAGE RLY. 127-1
(BUS 1B UNDERVOLTAGE RLY. 127-2)
GEN. BUS UNDERFREQUENCY RELAY 281
BUS 1C UNDERVOLTAGE RLY. 127-3
(BUS 2C UNDERVOLTAGE RLY. 127-4)
BUS 1C UNDERVOLTAGE RLY. 127-5
(BUS 2C UNDERVOLTAGE RLY. 127-6)
125 V. D.C. AT SWITCHGEAR CELL 11A04 (11B04)
125 V. D.C. AT SWITCHGEAR CELL 11C02 (12C02)
CLOSE ON U.V.
CLOSE ON NORM. VOLTAGE
DISCONNECT SEAL-IN
DISCONNECT ICS CONTACT
1000Ω 100W SET AT 500Ω
1500Ω 25W
SET AT 135Ω 250Ω 225W
DEVICE TABLE
DEVICE | TYPE | DESCRIPTION
127-1,2,3,4 | CV-7 (WEST) | UNDERVOLTAGE RELAY
127-5,6 | CV-6 (WEST) | UNDERVOLTAGE RELAY
127-1X, 2X, 3X, 4X, 5X, 5X1, 6X, 6X1 | MG-6 M6379 SH.W14 | AUXILIARY RELAY 48V D.C. COIL
281 | CF-1 | UNDERFREQUENCY RELAY
281-X,Y | MG-6 M6379 SH.W14 | AUXILIARY RELAY 48V D.C. COIL
7X, 8X | AR (WEST) | AUX. RELAY 48V DC COILS WITH 4 N.C. & 4 N.O. CONTACTS
TI APERTURE CARD
Also Available On Aperture Card
127-1X
ELECTRICAL ANN. DWG. 568365
TRIP RCP-A
TRIP RCP-C
DWG. 5150335
SPARE
127-7X
CONTAINMENT SPRAY ACTUATION SYSTEM "A" (SC62) DWG. 5159793
SEQ-2 DWG. 5150875
ELEC. ANN. DWG. 568365
127-8X
CONTAINMENT SPRAY ACTUATION SYSTEM "B" (SC62) DWG. 5159793
127-3X
ELECTRICAL ANN. DWG. 568365
SEQ-1 DWG. 5150874
CONTAINMENT SPRAY ACTUATION SYSTEM "A" (SC62) DWG. 5150826
NOTE 2
FIRST-OUT ANN. DWG. 568365
LOSS OF VOLTAGE AUTO TRANSFER DWG. N-1546 SH.13
UNIT TRIP N-1545 SH. 21
EVENT REC.
D.C. THERM. BARRIER PMP. DWG. 4505116
(127-2X)
TRIP RCP-B DWG 5150335
127-5X1
LOSS OF VOLT. AUTO TRANSFER DWG. N-1546 SH.13
TRIP 152-11C11 STATION SERVICE TRANSF. 3 DWG. 5151922
REFUELING WATER PUMP G27 (NORTH) DWG. 64957 52-1119
(127-6X1)
TRIP 152-12C11 ALTERNATE STATION SER. XFMR. FEED DWG. 5151922
TRIP SNYD. SUPPLY XFMR. DWG. 5151027 152-12C14
REFUELING WATER PUMP G27S (SOUTH) DWG. 64957 52-1219
(127-4X)
ELECTRICAL ANN. DWG. 568365
281-X
LOAD UNIT RUNBACK N-1541 SH.7
RCP-B TRIP
RCP-A TRIP
RCP-C TRIP
DWG. 5150335
EXCITER MOTOR TRIP DWG. 5150356
VOLT. REG. VOLTS/CYCLE DWG. 5143954
281-Y
SPARE
NOTES:
1. BUSES 1A & 1C RELAYS SHOWN, BUSES 1B & 2C IDENTICAL EXCEPT AS SHOWN IN PARENTHESIS.
2. FIELD TO CONVERT CONTACT POSITIONS AS NOTED FROM FORM "A" TO FORM "B" FOR AUXILIARY RELAYS 127-3X & 4X, SO THAT THE CONTACTS CLOSE WHEN THE RELAYS ARE DE-ENERGIZED.
3. LIGHT CIRCUIT LEFT IN TACK FROM C46 TO C41 AND FROM C47 TO C42.
SONGS 1 ELECTRICAL AUXILIARIES SAFETY RELATED
W.R.# 2.1.1 (82-297)
REDRAWN FROM DWG. N-1546 SH.12
5150874 S.I. SAFETY INJECTION SEQ. 1
5150875 S.I. SAFETY INJECTION SEQ. 2
5149629 DEVICE FUNCTION NOS. & SYMBOLS
5149366 EQUIP. LOCATION INDEX
5102163 1-LINE DIAGRAM 4160 & 480V SYSTEM
568365 ANNUNCIATOR WINDOW ENGRAVING
Reference Drawings
9 AS BUILT-INCORP. DCN 19
8 AS BUILT-INCORP. CC 18, T.C. # 1420
7 INCORP. CCN 16 & 17 EFFEC. IMM.
6 REC. REV.-REVISED TITLE
5 ADDED EFF. DATE IMMED.
4 INCORP. CCN 14 EFF. DATE IMMED.
10 AS BUILT-INCORP DCN 20
Revisions
Scale NONE
SAN ONOFRE NUCLEAR GEN. STA.
ELEMENTARY DIAGRAM 4.16KV BUSES UNDERVOLTAGE & GEN. UNDERFREQ. RELAYS
Southern California Edison Company
8711100274-14
5150876-10



CONTACT	POSITION			
	TRIP	AFTER TRIP	AFTER CLOSE	CLOSE
A11 - B11	X			
A12 - B12		X	X	
A1 - B1				X
A5 - A6	X	X		
A6 - A7			X	X
B5 - B6	X	X		
B6 - B7			X	X
C11 - D11	X			
C12 - D12		X	X	
C1 - D1				X
C5 - C6	X	X		
C6 - C7			X	X
D5 - D6	X	X		
D6 - D7			X	X

CONTROL SWITCH CS

WEST. TYPE "W-2" SPRING RETURN
BLACK OVAL FIXED HANDLE

SONGS I
SAFETY RELATED

EQUIPMENT	SCHEME NO.	BREAKER NO.	INTERLOCKS				
STATION SERVICE TRANS. NO. 3	1B303	52-1303	52-1103/b	52-1103/33	52-1203/b	52-1203/33	86-3, 71-13

REDRAWN FROM N-1546 SH.18

Reference Drawings	
5149629	DEVICE FUNC. NO'S & SYMBOLS
5149964	EQUIP. LOCATION INDEX
5146828	MAIN ONE-LINE DIAGRAM
5108063	ONE-LINE SWGR. 2 & 3
5151906	E.D. 480V SWGR. 3, 125V. DC. CONTROL

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	J.O. No.
4	AS BUILT - INCORP DCN #9	10-3-86			GG			3083
3	AS BUILT INC DCN 6, 8 CANC CC 5 (#7 NOT USED)						EA	3083
2	REC. REV. - REVISED TITLE	11-10-77					CE	6500
1	INCORP. CCN 1 EFF DATE 4-15-76, CCN 2 & 3 EFF DATE	1-7-77						0736
0	REVISED LOCKOUT CKTS ISSUED FOR CONSTRUCTION							0736

Scale NONE

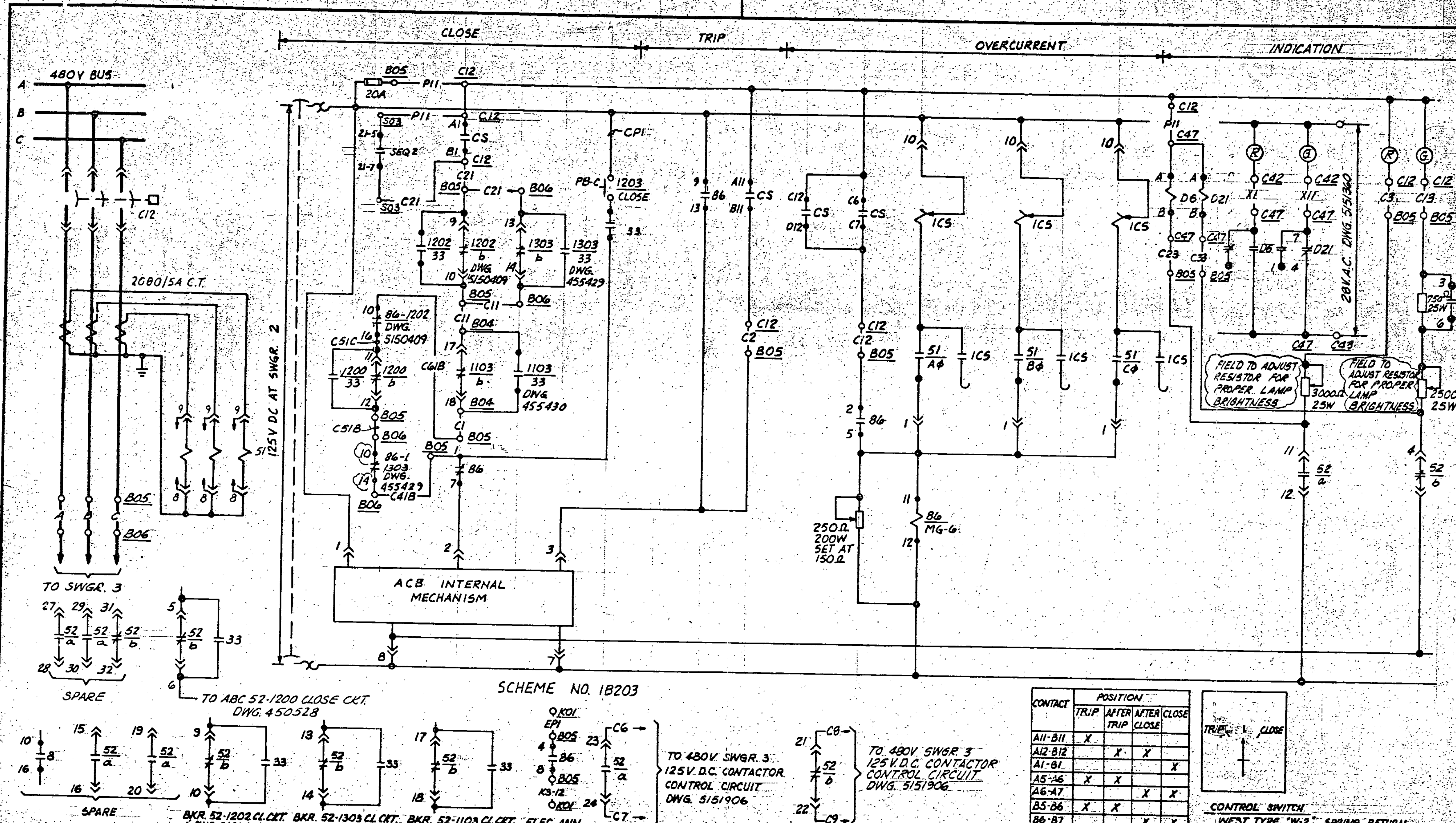
Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
STA. SERVICE TRANS. NO. 3
480V ACB

Southern California Edison Company SCE

455429-4

8711100274-15



CONTACT	POSITION: TRIP	AFTER TRIP	AFTER CLOSE	CLOSE
A11-B11	X			
A12-B12		X	X	
A1-B1				X
A5-A6	X	X		
A6-A7			X	X
B5-B6	X	X		
B6-B7			X	X
C11-D11	X			
C12-D12		X	X	
C1-D1				X
C5-C6	X	X		
C6-C7			X	X
D5-D6	X	X		
D6-D7			X	X

EQUIPMENT	SCHEME NO.	BREAKER NO.	INTERLOCKS						SEQUENCER NO.	T.B.	STUD	TIME	DWG. NO
TIE BREAKER BUS NO. 2 - BUS NO. 3	1B203	52-1203	52-1202/b	52-1202/33	52-1303/b	52-1303/33	52-1103/b	52-1103/33	2	21	5;7	0 SEC.	5150875

SONGS 1
SAFETY RELATED
REDRAWN FROM N-1546 SH 20

Reference Drawings	
5151905	E.D. 480V SWGR. 2, 125V D.C. CONTROL
5150874	E.D. SAFETY INJECTION SEQ. I
63715	SAFETY INJECTION SYSTEM
5146828	MAIN-1-LINE DIAGRAM
5149629	DEVICE FUNC. NOS. & SYMBOLS
5149964	EQUIP. LOCTION INDEX

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	I.O. No.
4	AS BUILT INCORP DCN 8, 9 (#7 NOT USED)	4/2/85					EAQ	3083
3	INCORP CCN #6: EFFECT. IMMED.	5-1-79						1827
2	REC. REV. - REVISED TITLE	11-10-77						6300
1	INCORP CCN 1, 2, 3 & 4 EFF DATE 6-14, 10-1-76 & IMMED.	1-21-77						0736
0	ISSUED FOR CONSTRUCTION, ADDED SEQUENCE CONTACT, REMOVED 86-3 CONTACT	3-17-76						0736

Scale NONE

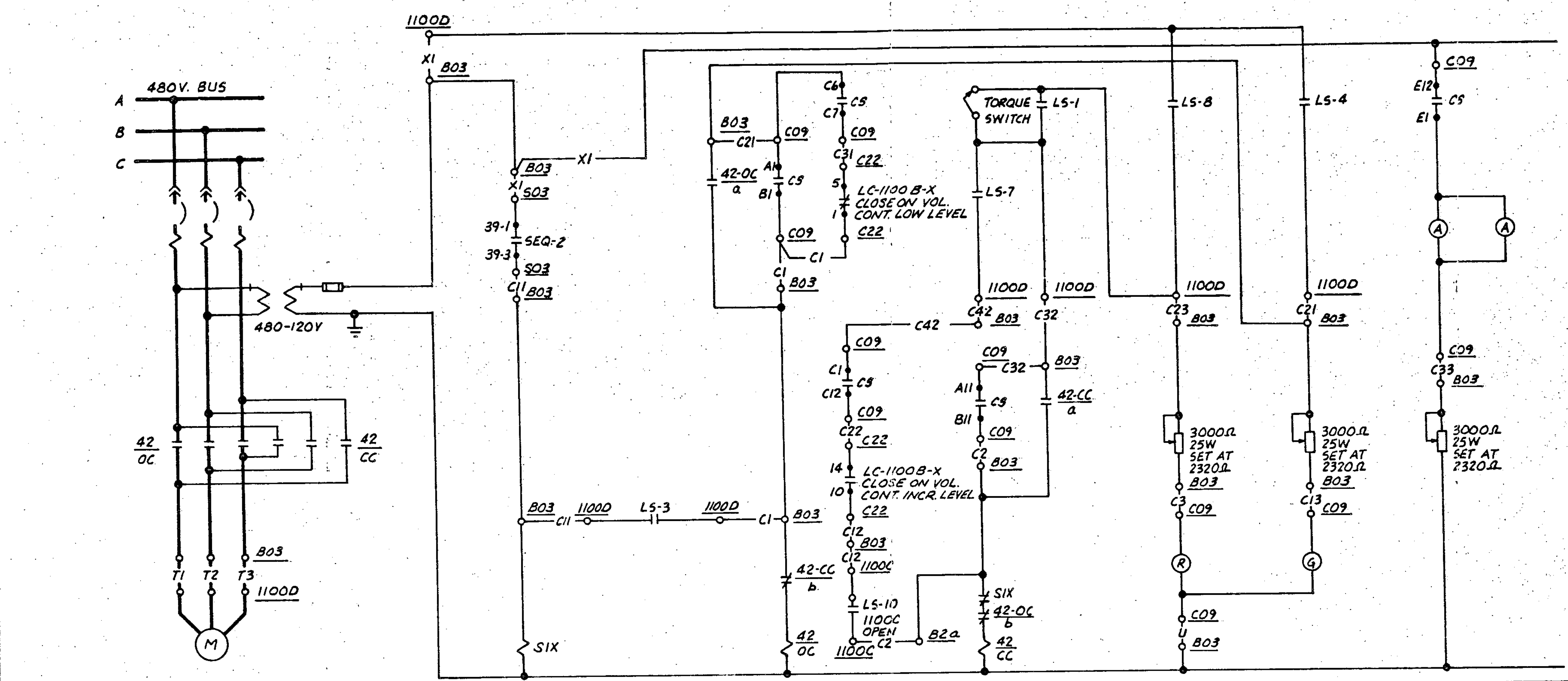
Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
BUSTIE 2-3 480V ACB

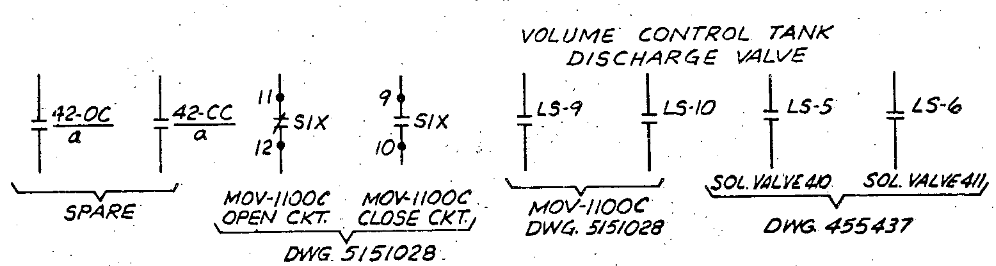
Southern California Edison Company

8711100274-16

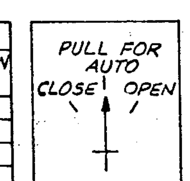
455431-4



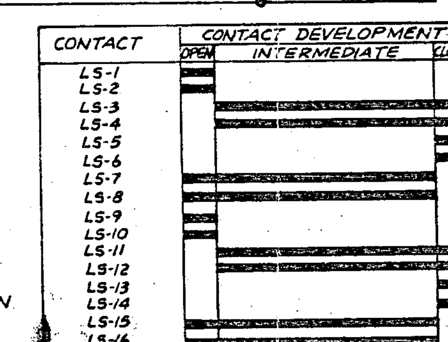
SCHEME NO. 18378 SHOWN



CONTACT	POSITION			
	CLOSE	OFF	AUTO	OPEN
A11-B11	X			
A12-B12		X	X	
A1-B1				X
A5-B5	X			
A6-B6		X	X	
A7-B7				X
C12-C1			X	
D12-D1	X	X		X
C6-C7			X	
D6-D7	X	X		X
E12-E1			X	
F12-F1	X	X		X
E6-E7			X	
F6-F7	X	X		X



CONTROL SWITCH CS
WEST TYPE "W-2" SPRING RETURN
GREEN OVAL FIXED HANDLE



LIMIT SWITCH

EQUIPMENT	SCHEME NO.	STARTER NO.	INTERLOCKS	LOC	SEQUENCE NO.	T.B. STUD		TIME	DWG. No.
RECIR. TO CHG. PUMPS-MOV-LCV-1100D	18378	42-1378	LS-10 (1100C)	803	SEQ. 2	39	1,3	10+SEC	5150875
RECIR. TO CHG. PUMPS-MOV-LCV-1100B	18147	42-1147	LS-9 (1100C)	801	SEQ. 1	39	1,3	10+ SEC	5150874

W.R. 82016 (82297)

SONGS 1
SAFETY RELATED
REACTOR AUXILIARIES
REDRAWN FROM N-1542 SH. 8

Reference Drawings	
5102165	MOTOR CONTROL CENTER 1
5102171	MOTOR CONTROL CENTER 3
63715	SAFETY INJECTION SYSTEM, SH. 2

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	I.O. No.
3	AS BUILT INCORP CCE CANC CC #3, 4	5/29/84				JP	FL	8881
2	REC. REV. - REVISED TITLE	11-10-77				MK	EACo	6500
1	INCORP CCN 1 EFFECT DATE 10-1-76	10-4-76						0736
0	ISSUED FOR CONST.; RMV'D. WL RELAY CONTACTS; ADD'D SEQ. CONTACTS	3-29-76						0736

Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
MOV-LCV-1100B
RECIR. TO CHARGING PUMPS

Southern California Edison Company SCE

455369-3

Southern California Edison Company

FIELD CHANGE NOTICE (FCN)

FCN: 52881E	Document No.: 455371 Rev. 4	86083368
Title: Elementary Diagram	Safety Related	JUL 28 1987
		DCN 6 DWG. REV. 4

1. Responsible Discipline Electrical

Originating Engr. James M. Lyle PAX 89425 Date 5-23-87

PFC Required— Yes [X] No [ ] 1-86-022 Units 1 DRADM I.D. E-~~25~~10 5-27-87

Description of Change and Reason

MOV – 866A, 866B, 880, 356, 357, 358, 18, 19

Add torque switch and rotor settings to limit switch contact development.

Initiating Document (NCR, SPR, Other) IE BULLETIN 85-03

2. Other Affected Documents

The associated document/source initiating change on Form SO(123) 183 is (check one):

[X] This FCN SO(123) 183 (attached)

[ ] The following document(s):

Specific affected documents are listed on the SO(123) 184 associated with the above checked source document(s).

3. Affected Systems CRS, SIS, RCP

4. SCE Design Approvals

NUCLEAR GENERATION SITE DEPARTMENT	Date	ENGINEERING AND CONSTRUCTION DEPARTMENT	Date
Other: N/A		Other: A. Rajeswaralgam	6-24-1987
Other:		Checker: M. Modadey	6-24-87
Independent Review Engr.: [signature]	6-18-87	Independent Review Engr.: N/A	
Responsible Engineer: James M. Lyle	6-16-87	Responsible Engineer: N/A	
Supervising Engineer: H. McLandrich	6/22/87	Discipline Group Leader:	
Supervising Engineer: K. Johnson	6/25/87	Discipline Supervisor: [signature]	6/24/87
Manager Station Technical: K. Johnson for J. Reilly	6/25/87	Discipline Chief: N/A	
Quality Assurance: P. Steudle	7-2-87	Quality Assurance: N/A	

5. Construction Completion Verification/DCN Conversion

James M. Lyle — C.W.O. or M.O. CLOSEOUT — DATE 7/23/87

APPROVAL FOR INCORPORATION ONLY AFTER RECEIPT OF NOTIFICATION OF CHANGE COMPLETION FROM STARTUP

JUL 28 1987 — D K Babb — SCE/CONTRACTOR PROJECT ADMINISTRATOR

SCE 26-224-1 REV 3/83

16X

MICROFILMED FROM BEST AVAILABLE COPY

8711100274-17/01

Southern California Edison Company SCE

FIELD CHANGE NOTICE (FCN)

SUPPLEMENTAL PAGE

FCN NUMBER					
DOCUMENT NO.	SHEET NO.	REV. NO.	DOC. REV.	DCN NO.	QUALITY CLASS
455371	—	4	4	6	Safety Related

FCN NUMBER 52881E

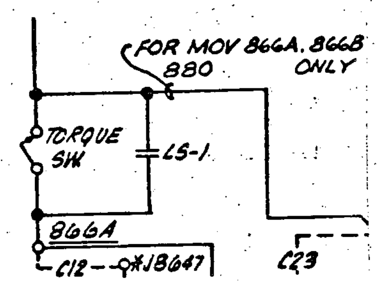
JUL 28 1987

Date 5-23-87 Page 2 of 15 Page

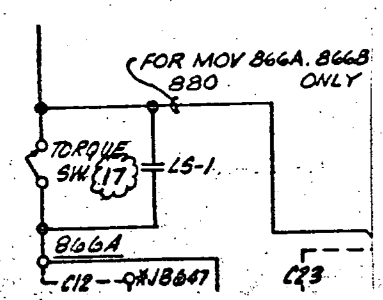
By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

BEFORE



AFTER



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FIELD CHANGE NOTICE (FCN)

SUPPLEMENTAL PAGE

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FCN NUMBER 52881E

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

BEFORE

5149454	ED SAFETY INJECTION CIRCUITRY
5149629	DEVICE FUNC NOS & SYMBOLS
5149964	EQUIP LOCATION INDEX
5102165	MOTOR CONTROL CENTER 1
5102167	MOTOR CONTROL CENTER 2
5102170	MOTOR CONTROL CENTER 3
64374	E D MOV 883
63715	SAFETY INJECTION SYSTEM, SH2
Reference Drawings	

AFTER

5149454	ED SAFETY INJECTION CIRCUITRY
5149629	DEVICE FUNC NOS & SYMBOLS
5149964	EQUIP LOCATION INDEX
5102165	MOTOR CONTROL CENTER 1
5102167	MOTOR CONTROL CENTER 2
5102170	MOTOR CONTROL CENTER 3
568250	WIRING DIAGRAM
64374	E D MOV 883
63715	SAFETY INJECTION SYSTEM, SH2
Reference Drawings	

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

BEFORE

CONTACT	CONTACT DEVELOPMENT		
	OPEN	INTERMEDIATE	CLOSE
LS-1			
LS-2			
LS-3			
LS-4			
LS-5			
LS-6			
LS-7			
LS-8			
LS-9			
LS-10			
LS-11			
LS-12			
LS-13			
LS-14			
LS-15			
LS-16			

LIMIT SWITCH

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FIELD CHANGE NOTICE (FCN)

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

AFTER

LIMIT SWITCH

ROTOR	CONTACT	CONTACT DEVELOPMENT			
		OPEN	INTERMEDIATE	CLOSE	
1	LS-1				
	LS-2				
	LS-3				SP
	LS-4				SP
2	LS-5				SP
	LS-6				SP
	LS-7				SP
	LS-8				
3	LS-9				SP
	LS-10				SP
	LS-11				SP
	LS-12				SP
4	LS-13				SP
	LS-14				SP
	LS-15				SP
	LS-16				SP

TORQUE SW	17	OPENS ON MECHANICAL OVERLOAD DURING CLOSING CYCLE	Set @ 2 to 2 1/4
TORQUE SW	18	OPENS ON MECHANICAL OVERLOAD DURING OPENING CYCLE	SPARE

NOTES:

— SOLID LINE DENOTES CONTACT IS CLOSED

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455371	-	4	4	6	Safety Related

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON: BEFORE

R	LOCATION					*J.B.
2	866A	801	C09	EPC1	EPC2	647
4	18	802	C09	—	—	
0	19	801	C09	—	—	
9	866B	802	C09	WPC9	WPC3	648
9	356	801	C09	WPC5	WPC4	
3	357	802	C09	WPC7	WPC3	
5	358	803	C09	EPC4	EPC2	
2	880	802	C09	—	—	

S 647 & 648 (DASH LINES)

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FIELD CHANGE NOTICE (FCN)

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON: AFTER

R	LOCATION					*J.B.	Torque Switch Settings TS 17	TS 18
2	866A	801	C09	EPC1	EPC2	647	2 to 2¼	SPARE
4	18	802	C09	—	—		6500 lb min 11800 lb max	SPARE
0	19	801	C09	—	—		6500 lb min 11800 lb max	SPARE
9	866B	802	C09	WPC9	WPC3	648	2 to 2¼	SPARE
9	356	801	C09	WPC5	WPC4		5900 lb min 11800 lb max	SPARE
3	357	802	C09	WPC7	WPC3		5900 lb min 11800 lb max	SPARE
5	358	803	C09	EPC4	EPC2		5900 lb min 11800 lb max	SPARE
2	880	802	C09	—	—		1¼ to 3	SPARE

S 647 & 648 (DASH LINES)

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FCN NUMBER 528812					
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JUL 29 1987

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

FOR INFORMATION ONLY

THRUST SETPOINT DETERMINATION SHEET

VALVE NUMBER MOV-866A VALVE TYPE GATE
ACTUAL TEST PRESS *225 PSI DESIGN BASIS PRESS 250 PSI
AS LEFT DATA OPEN SPARE LB CLOSE *LSW(2½) LB
PRESSURE TEST DATA * OPEN SPARE LB CLOSE LSW(2) LB
(UNSEATING THRUST) (TOTAL THRUST)
CALCULATION DATA FOR MINIMUM REQUIRED THRUST OPEN 1257 LB CLOSE 2148 LB
RUNNING THRUST OPEN <400 LB CLOSE <400 LB

TIME AT TRANSITION TO RUNNING THRUST @NA SECONDS
VALVE STROKE TIME 112.1 SECONDS
TIME AT WHICH TORQUE SWITCH BYPASS LIMIT SWITCH DROPS OUT OF CIRCUIT @NA SECONDS @100 %

****

* MINIMUM REQUIRED THRUST OPEN "SPARE" LB CLOSE *LSW(2) LB*

****

PULLOUT THRUST AT 100% VOLTAGE 28991 LB
STALL THRUST AT 80% VOLTAGE 29157 LB
STALL THRUST AT 100% VOLTAGE 45558 LB

****

* MAXIMUM ALLOWABLE THRUST OPEN "SPARE" LB CLOSE *LSW(2½) LB*

****

CORRESPONDING MAXIMUM STEM STRESS INTENSITY $93597 PSI
MAXIMUM ALLOWABLE STEM STRESS INTENSITY 48300 PSI
TORQUE SWITCH BYPASS SETPOINT TO BE SET AT @NA PERCENT OPEN ON THE OPEN CYCLE. SET AT 99±1 % ON THE CLOSE CYCLE.

COMMENTS : * DESIGN BASIS TEST PERFORMED ON MOV-880. VALVE OPENED AGAINST D/P. VALVE IS LIMIT SWITCH (LSW) CLOSED; NO CLOSE TORQUE SWITCH TRIP OCCURS. SET CLOSE TORQUE SWITCH @ 2 TO 2½.
@ OPEN TORQUE SWITCH NOT PART OF VALVE CONTROL. THEREFORE OPEN TORQUE SWITCH BYPASS IS N/A. AND 100% BYPASS.
$ CALCULATED MAXIMUM STRESS INTENSITY IN STEM AT THREAD ROOT FOR A MOTOR STALL OF 45558 LB THRUST. THE CORRESPONDING MAXIMUM STEM STRESS INTENSITY IS LESS THAN YIELD AS FOLLOWS:
93597 PSI 111435 PSI =0.839*100 = 83.9% OF YIELD STRENGTH AT TEMPERATURE.

SCE 26-264-2 REV 12/83

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

FOR INFORMATION ONLY

THRUST SETPOINT DETERMINATION SHEET

VALVE NUMBER #MOV-18 VALVE TYPE GATE
ACTUAL TEST PRESS *20 PSI DESIGN BASIS PRESS 20 PSI
AS LEFT DATA OPEN SPARE LB CLOSE 9192 LB
PRESSURE TEST DATA * OPEN SPARE LB CLOSE 12265 LB
(UNSEATING THRUST) (TOTAL THRUST)
CALCULATION DATA FOR MINIMUM REQUIRED THRUST OPEN 9222 LB CLOSE 16647 LB
RUNNING THRUST * OPEN <2600 LB CLOSE <2600 LB

TIME AT TRANSITION TO RUNNING THRUST @NA SECONDS
VALVE STROKE TIME *62.02 SECONDS
TIME AT WHICH TORQUE SWITCH BYPASS LIMIT SWITCH DROPS OUT OF CIRCUIT @NA SECONDS @100 %

****

* MINIMUM REQUIRED THRUST OPEN "SPARE" LB CLOSE 6500 LB*

****

PULLOUT THRUST AT 100% VOLTAGE 34126 LB
STALL THRUST AT 80% VOLTAGE 33367 LB
STALL THRUST AT 100% VOLTAGE 52136 LB

****

* MAXIMUM ALLOWABLE THRUST OPEN "SPARE" LB CLOSE 11800 LB*

****

CORRESPONDING MAXIMUM STEM STRESS INTENSITY $82934 PSI
MAXIMUM ALLOWABLE STEM STRESS INTENSITY 45000 PSI
TORQUE SWITCH BYPASS SETPOINT TO BE SET AT @NA PERCENT OPEN ON THE OPEN CYCLE. SET AT 99±1 % ON THE CLOSE CYCLE.

COMMENTS : *DBT PERFORMED ON MOV-18. VALVE OPENED AGAINST D/P.
@ OPEN TORQUE SWITCH NOT PART OF VALVE CONTROL. THEREFORE OPEN TORQUE SWITCH BYPASS IS N/A. AND 100% BYPASS.
\# MOV-18 RECIEVES NO SAFETY SIGNAL AND COULD BE OPENED POST LOCA DURING RECIRCULATION WHERE IT WILL ONLY SEE D/P OF <20 PSID. THE CALCULATED VALUES ARE AT 2500 PSIG.
$ CALCULATED MAXIMUM STRESS INTENSITY IN STEM AT THREAD ROOT FOR A MOTOR STALL OF 52136 LB THRUST. THE CORRESPONDING MAXIMUM STEM STRESS INTENSITY IS LESS THAN YIELD AS FOLLOWS:
82934 PSI 115600 PSI =0.717*100 = 71.7% OF YIELD STRENGTH AT TEMPERATURE.

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By J.M. Lyle

DESCRIPTION OF CHANGE AND REASON

FOR INFORMATION ONLY

THRUST SETPOINT DETERMINATION SHEET

VALVE NUMBER MOV-19 VALVE TYPE GATE
ACTUAL TEST PRESS *20 PSI DESIGN BASIS PRESS 20 PSI
AS LEFT DATA OPEN SPARE LB CLOSE 7461 LB
PRESSURE TEST DATA * OPEN SPARE LB CLOSE 12265 LB
(UNSEATING THRUST) (TOTAL THRUST)
CALCULATION DATA FOR MINIMUM REQUIRED THRUST OPEN 9222 LB CLOSE 16647 LB
RUNNING THRUST OPEN <2780 LB CLOSE <2780 LB

TIME AT TRANSITION TO RUNNING THRUST @NA SECONDS VALVE STROKE TIME 61.94 SECONDS
TIME AT WHICH TORQUE SWITCH BYPASS LIMIT SWITCH DROPS OUT OF CIRCUIT @NA SECONDS @100 %
****
* MINIMUM REQUIRED THRUST OPEN "SPARE" LB CLOSE 6500 LB*
****
PULLOUT THRUST AT 100% VOLTAGE 34126 LB
STALL THRUST AT 80% VOLTAGE 33367 LB
STALL THRUST AT 100% VOLTAGE 52136 LB
****
* MAXIMUM ALLOWABLE THRUST OPEN "SPARE" LB CLOSE 11800 LB*
****
CORRESPONDING MAXIMUM STEM STRESS INTENSITY $82934 PSI
MAXIMUM ALLOWABLE STEM STRESS INTENSITY 45000 PSI
TORQUE SWITCH BYPASS SETPOINT TO BE SET AT @NA PERCENT OPEN ON THE OPEN CYCLE. SET AT 99±1 % ON THE CLOSE CYCLE.

COMMENTS : *DBT PERFORMED ON MOV-18. VALVE OPENED AGAINST D/P.
@ OPEN TORQUE SWITCH NOT PART OF VALVE CONTROL. THEREFORE OPEN TORQUE SWITCH BYPASS IS N/A. AND 100% BYPASS.
# MOV-19 RECIEVES NO SAFETY SIGNAL AND COULD BE OPENED POST LOCA DURING RECIRCULATION WHERE IT WILL ONLY SEE D/P OF <20 PSID. THE CALCULATED VALUES ARE AT 2500 PSIG.
$ CALCULATED MAXIMUM STRESS INTENSITY IN STEM AT THREAD ROOT FOR A MOTOR STALL OF 52136 LB THRUST. THE CORRESPONDING MAXIMUM STEM STRESS INTENSITY IS LESS THAN YIELD AS FOLLOWS:
82934 PSI / 115600 PSI =0.717*100 = 71.7% OF YIELD STRENGTH AT TEMPERATURE.

SCE 26-264-2 REV 12/85

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FIELD CHANGE NOTICE (FCN)

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DESCRIPTION OF CHANGE AND REASON

FOR INFORMATION ONLY

THRUST SETPOINT DETERMINATION SHEET

VALVE NUMBER MOV-866B VALVE TYPE GATE
ACTUAL TEST PRESS *225 PSI DESIGN BASIS PRESS 250 PSI
AS LEFT DATA OPEN SPARE LB CLOSE *LSW(2)LB
PRESSURE TEST DATA * OPEN SPARE LB CLOSE LSW(2)LB
(UNSEATING THRUST) (TOTAL THRUST)
CALCULATION DATA FOR MINIMUM REQUIRED THRUST OPEN 1257 LB CLOSE 2148 LB
RUNNING THRUST OPEN <700 LB CLOSE <700 LB

TIME AT TRANSITION TO RUNNING THRUST @NA SECONDS VALVE STROKE TIME 126.25 SECONDS
TIME AT WHICH TORQUE SWITCH BYPASS LIMIT SWITCH DROPS OUT OF CIRCUIT @NA SECONDS @100 %
****
* MINIMUM REQUIRED THRUST OPEN "SPARE" LB CLOSE *LSW(2) LB*
****
PULLOUT THRUST AT 100% VOLTAGE 28991 LB
STALL THRUST AT 80% VOLTAGE 29157 LB
STALL THRUST AT 100% VOLTAGE 45558 LB
****
* MAXIMUM ALLOWABLE THRUST OPEN "SPARE" LB CLOSE *LSW(2½) LB*
****
CORRESPONDING MAXIMUM STEM STRESS INTENSITY $93597 PSI
MAXIMUM ALLOWABLE STEM STRESS INTENSITY 48300 PSI
TORQUE SWITCH BYPASS SETPOINT TO BE SET AT @NA PERCENT OPEN ON THE OPEN CYCLE. SET AT 99±1 % ON THE CLOSE CYCLE.

COMMENTS : * DESIGN BASIS TEST PERFORMED ON MOV-880. VALVE OPENED AGAINST D/P. VALVE IS LIMIT SWITCH (LSW) CLOSED; NO CLOSE TORQUE SWITCH TRIP OCCURS. SET CLOSE TORQUE SWITCH @ 2 TO 2½.
@ OPEN TORQUE SWITCH NOT PART OF VALVE CONTROL. THEREFORE OPEN TORQUE SWITCH BYPASS IS N/A. AND 100% BYPASS.
$ CALCULATED MAXIMUM STRESS INTENSITY IN STEM AT THREAD ROOT FOR A MOTOR STALL OF 45558 LB THRUST. THE CORRESPONDING MAXIMUM STEM STRESS INTENSITY IS LESS THAN YIELD AS FOLLOWS:
93597 PSI / 111435 PSI =0.839*100 = 83.9% OF YIELD STRENGTH AT TEMPERATURE.

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

FOR INFORMATION ONLY

THRUST SETPOINT DETERMINATION SHEET

VALVE NUMBER MOV-356 VALVE TYPE GLOBE
ACTUAL TEST PRESS *2500 PSI DESIGN BASIS PRESS 2485 PSI
AS LEFT DATA OPEN SPARE LB CLOSE 11360 LB
PRESSURE TEST DATA * OPEN SPARE LB CLOSE 25829 LB
(UNSEATING THRUST) (TOTAL THRUST)

CALCULATION DATA FOR MINIMUM REQUIRED THRUST OPEN 6990 LB CLOSE 18867 LB

RUNNING THRUST * OPEN ≤2360 LB CLOSE ≤2360 LB

TIME AT TRANSITION TO RUNNING THRUST @NA SECONDS VALVE STROKE TIME 27.18 SECONDS
TIME AT WHICH TORQUE SWITCH BYPASS LIMIT SWITCH DROPS OUT OF CIRCUIT @NA SECONDS @100 % BYPASS
****
* MINIMUM REQUIRED THRUST OPEN "SPARE" LB CLOSE 5900 LB*
****
PULLOUT THRUST AT 100% VOLTAGE 22791 LB
STALL THRUST AT 80% VOLTAGE 34167 LB
STALL THRUST AT 100% VOLTAGE 53387 LB
****
* MAXIMUM ALLOWABLE THRUST OPEN "SPARE" LB CLOSE 11800 LB*
****
CORRESPONDING MAXIMUM STEM STRESS INTENSITY §43488 PSI
MAXIMUM ALLOWABLE STEM STRESS INTENSITY 41667 PSI
TORQUE SWITCH BYPASS SETPOINT TO BE SET AT @NA PERCENT OPEN ON THE OPEN CYCLE. SET AT 99±1 % ON THE CLOSE CYCLE.

COMMENTS : *DBT PERFORMED ON MOV-356. VALVE OPENED AGAINST D/P.
@ OPEN TORQUE SWITCH NOT PART OF VALVE CONTROL. THEREFORE OPEN TORQUE SWITCH BYPASS IS N/A. AND 100% BYPASS.
§THE CORRESPONDING MAXIMUM STEM STRESS INTENSITY IS AT LESS THAN 2/3 OF YIELD AS FOLLOWS:
43488 PSI / 100000 PSI = .435*100 = 43.5% OF YIELD STRENGTH AT TEMPERATURE.

SCE 26-264-2 REV 11/81

Southern California Edison Company SCE

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

FOR INFORMATION ONLY

THRUST SETPOINT DETERMINATION SHEET

VALVE NUMBER MOV-357 VALVE TYPE GLOBE
ACTUAL TEST PRESS *2500 PSI DESIGN BASIS PRESS 2485 PSI
AS LEFT DATA OPEN SPARE LB CLOSE 8606 LB
PRESSURE TEST DATA * OPEN SPARE LB CLOSE 25829 LB
(UNSEATING THRUST) (TOTAL THRUST)

CALCULATION DATA FOR MINIMUM REQUIRED THRUST OPEN 6990 LB CLOSE 18867 LB

RUNNING THRUST OPEN ≤2400 LB CLOSE ≤2400 LB

TIME AT TRANSITION TO RUNNING THRUST @NA SECONDS VALVE STROKE TIME 25.57 SECONDS
TIME AT WHICH TORQUE SWITCH BYPASS LIMIT SWITCH DROPS OUT OF CIRCUIT @NA SECONDS @100 % BYPASS
****
* MINIMUM REQUIRED THRUST OPEN "SPARE" LB CLOSE 5900 LB*
****
PULLOUT THRUST AT 100% VOLTAGE 22791 LB
STALL THRUST AT 80% VOLTAGE 34167 LB
STALL THRUST AT 100% VOLTAGE 53387 LB
****
* MAXIMUM ALLOWABLE THRUST OPEN "SPARE" LB CLOSE 11800 LB*
****
CORRESPONDING MAXIMUM STEM STRESS INTENSITY §43488 PSI
MAXIMUM ALLOWABLE STEM STRESS INTENSITY 41667 PSI
TORQUE SWITCH BYPASS SETPOINT TO BE SET AT @NA PERCENT OPEN ON THE OPEN CYCLE. SET AT 99±1 % ON THE CLOSE CYCLE.

COMMENTS : *DBT PERFORMED ON MOV-356. VALVE OPENED AGAINST D/P.
@ OPEN TORQUE SWITCH NOT PART OF VALVE CONTROL. THEREFORE OPEN TORQUE SWITCH BYPASS IS N/A. AND 100% BYPASS.
§THE CORRESPONDING MAXIMUM STEM STRESS INTENSITY IS AT LESS THAN 2/3 OF YIELD AS FOLLOWS:
43488 PSI / 100000 PSI = .435*100 = 43.5% OF YIELD STRENGTH AT TEMPERATURE.

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FIELD CHANGE NOTICE (FCN)

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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

FOR INFORMATION ONLY

THRUST SETPOINT DETERMINATION SHEET

```
VALVE NUMBER   MOV-358              VALVE TYPE  GLOBE
ACTUAL TEST PRESS *2500  PSI  DESIGN BASIS PRESS 2485 PSI
AS LEFT DATA              OPEN SPARE  LB   CLOSE 9781    LB
PRESSURE TEST DATA      * OPEN SPARE  LB   CLOSE 25829   LB
                         (UNSEATING THRUST)   (TOTAL THRUST)

CALCULATION DATA FOR      OPEN  6990  LB   CLOSE  18867 LB
MINIMUM REQUIRED THRUST

RUNNING THRUST            OPEN <1700  LB   CLOSE <1700 LB

TIME AT TRANSITION                      VALVE STROKE
TO RUNNING THRUST  @NA    SECONDS         TIME  22.41 SECONDS
TIME AT WHICH TORQUE SWITCH BYPASS
LIMIT  SWITCH DROPS OUT OF CIRCUIT @NA    SECONDS @100 % BYPASS
*****************************************************************
* MINIMUM REQUIRED THRUST   OPEN "SPARE" LB  CLOSE   5900    LB*
*****************************************************************
PULLOUT THRUST AT 100%     22791 LB
               VOLTAGE
STALL   THRUST AT  80%     34167 LB
               VOLTAGE
STALL   THRUST AT 100%     53387 LB
               VOLTAGE
*****************************************************************
* MAXIMUM ALLOWABLE THRUST  OPEN "SPARE" LB  CLOSE  11800    LB*
*****************************************************************
CORRESPONDING MAXIMUM STEM STRESS INTENSITY §43488  PSI
MAXIMUM  ALLOWABLE  STEM  STRESS  INTENSITY  41667  PSI
TORQUE SWITCH BYPASS SETPOINT TO BE SET AT @NA  PERCENT OPEN ON
THE OPEN CYCLE.  SET AT 99±1 % ON THE CLOSE CYCLE.
```

COMMENTS : *DBT PERFORMED ON MOV-356. VALVE OPENED AGAINST D/P.
@ OPEN TORQUE SWITCH NOT PART OF VALVE CONTROL. THEREFORE OPEN TORQUE SWITCH BYPASS IS N/A. AND 100% BYPASS.
§THE CORRESPONDING MAXIMUM STEM STRESS INTENSITY IS AT LESS THAN 2/3 OF YIELD AS FOLLOWS:

43488 PSI 100000 PSI = .435*100 = 43.5% OF YIELD STRENGTH AT TEMPERATURE.

SCE 26-264-2 REV 12/83

Southern California Edison Company SCE

FIELD CHANGE NOTICE (FCN)

SUPPLEMENTAL PAGE

FCN NUMBER 52881E					
DOCUMENT NO.	SHEET NO.	REV. NO.	DCN CONV. JUL 28 1987 DOC. REV.	SUB. NO.	QUALITY CLASS
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By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

FOR INFORMATION ONLY

THRUST SETPOINT DETERMINATION SHEET

```
VALVE NUMBER   MOV-880              VALVE TYPE  GATE
ACTUAL TEST PRESS  *225  PSI  DESIGN BASIS PRESS 250 PSI
AS LEFT DATA              OPEN SPARE  LB   CLOSE LSW(1½)LB
PRESSURE TEST DATA      * OPEN SPARE  LB   CLOSE LSW(2) LB
                         (UNSEATING THRUST)   (TOTAL THRUST)

CALCULATION DATA FOR      OPEN  1257  LB   CLOSE  2148  LB
MINIMUM REQUIRED THRUST

RUNNING THRUST            OPEN  37    LB   CLOSE  651   LB

TIME AT TRANSITION                      VALVE STROKE
TO RUNNING THRUST  @NA    SECONDS         TIME  12.135 SECONDS
TIME AT WHICH TORQUE SWITCH BYPASS
LIMIT  SWITCH DROPS OUT OF CIRCUIT  @NA   SECONDS @100 %
*****************************************************************
* MINIMUM REQUIRED THRUST   OPEN "SPARE" LB  CLOSE *LSW(1½)  LB*
*****************************************************************
PULLOUT THRUST AT 100%     28991 LB
               VOLTAGE
STALL   THRUST AT  80%     29157 LB
               VOLTAGE
STALL   THRUST AT 100%     45558 LB
               VOLTAGE
*****************************************************************
* MAXIMUM ALLOWABLE THRUST  OPEN "SPARE" LB  CLOSE *LSW(3)   LB*
*****************************************************************
CORRESPONDING MAXIMUM STEM STRESS INTENSITY §93597  PSI
MAXIMUM  ALLOWABLE  STEM  STRESS  INTENSITY  48300  PSI
TORQUE SWITCH BYPASS SETPOINT TO BE SET AT @NA  PERCENT OPEN ON
THE OPEN CYCLE.  SET AT 99±1 % ON THE CLOSE CYCLE.
```

COMMENTS : * DESIGN BASIS TEST PERFORMED ON MOV-880. VALVE OPENED AGAINST D/P. VALVE IS LIMIT SWITCH (LSW) CLOSED; NO CLOSE TORQUE SWITCH TRIP OCCURS. SET CLOSE TORQUE SWITCH @ 1½ TO 3.
@ OPEN TORQUE SWITCH NOT PART OF VALVE CONTROL. THEREFORE OPEN TORQUE SWITCH BYPASS IS N/A. AND 100% BYPASS.
§ CALCULATED MAXIMUM STRESS INTENSITY IN STEM AT THREAD ROOT FOR A MOTOR STALL OF 45558 LB THRUST. THE CORRESPONDING MAXIMUM STEM STRESS INTENSITY IS LESS THAN YIELD AS FOLLOWS:

93597 PSI 111435 PSI =0.839*100 = 83.9% OF YIELD STRENGTH AT TEMPERATURE.

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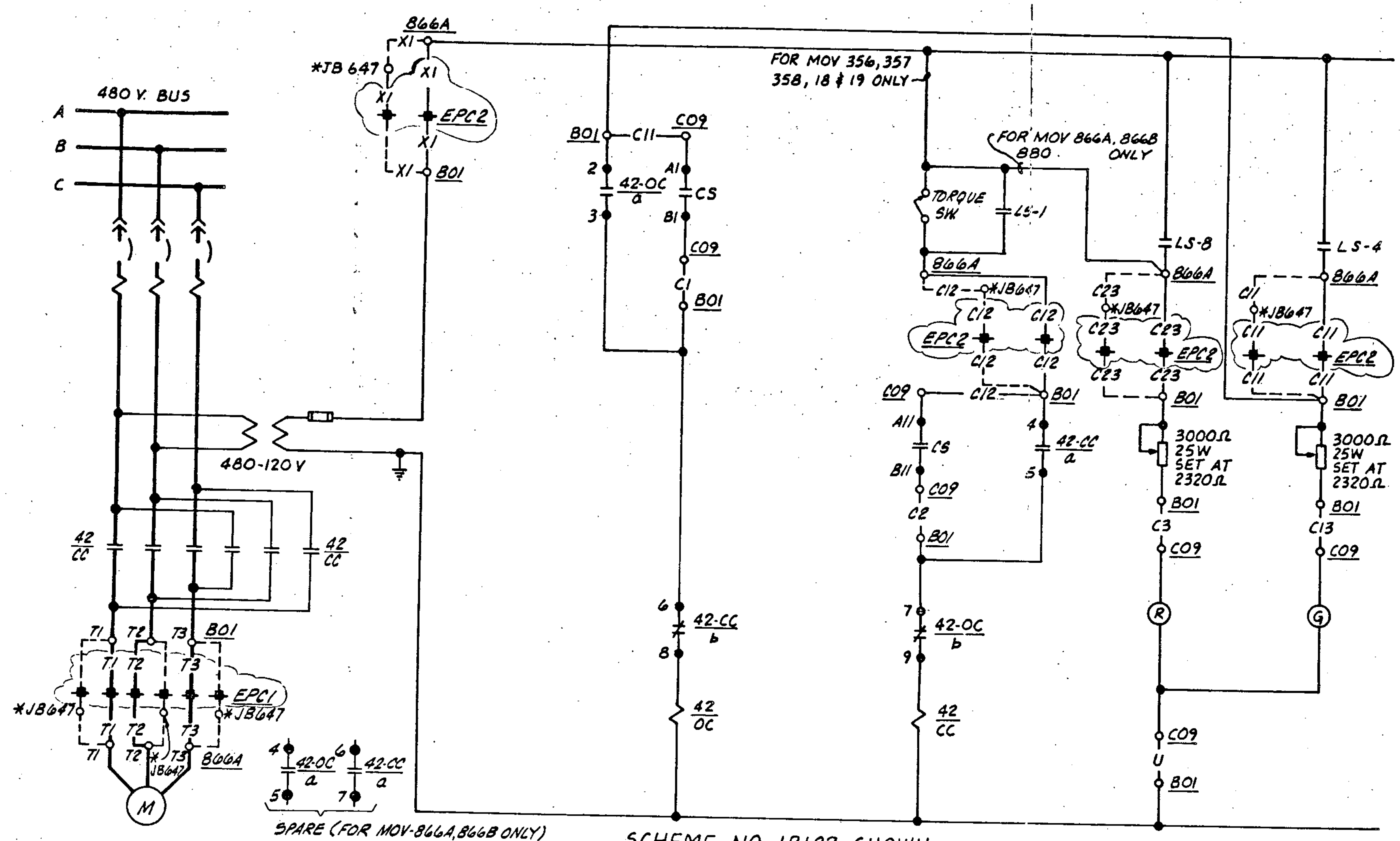
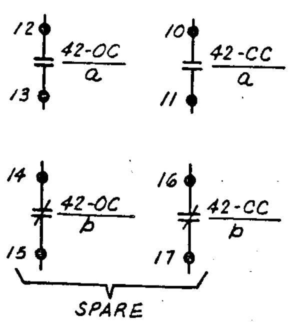
TI APERTURE CARD

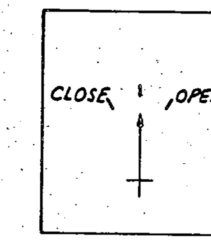
Also Available On Aperture Card



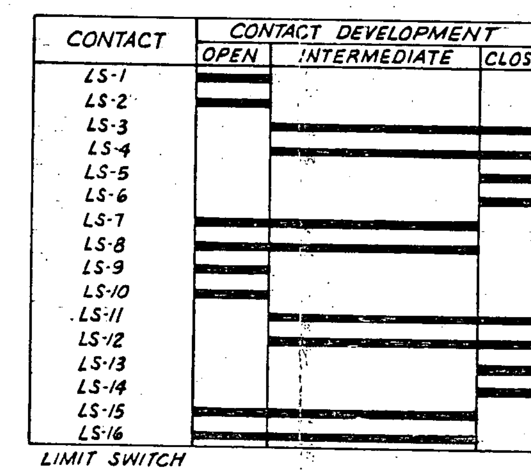
SCHEME NO. 1B182 SHOWN



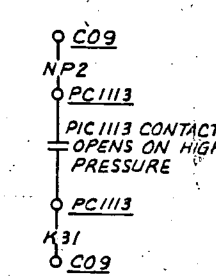
CONTACT	POSITION: CLOSE	AFTER CLOSE	AFTER OPEN	OPEN
A11-B11	X			
A12-B12		X	X	
A1-B1				X
A5-A6	X	X		
A6-A7			X	X
B5-B6	X	X		
B6-B7			X	X



CONTROL SWITCH
WEST TYPE "W-2" SPRING RETURN
GREEN OVAL FIXED HANDLE



LIMIT SWITCH



FOR MOV 18 & 19 ONLY
REACTOR PLANT ANN NO. 1
DWG 5112392

EQUIPMENT	SCHEME NO.	STARTER NO.	LOCATION					*J.B.
SAFETY INJECTION RECIRCULATION MOV-866A	1B182	42-1182	866A	B01	C09	EPC1	EPC2	647
RC PUMP INJECTION FILTER MOV-18	1B294	42-1294	18	B02	C09	—	—	
RC PUMP INJECTION FILTER MOV-19	1B146	42-1146	19	B01	C09	—	—	
SAFETY INJECTION RECIRCULATION MOV-866B	1B278	42-1278	866B	B02	C09	WPC9	WPC3	648
S.I. RECIRCULATION TO LOOP A MOV-356	1B158	42-1158	356	B01	C09	WPC5	WPC4	
S.I. RECIRCULATION TO LOOP B MOV-357	1B243	42-1243	357	B02	C09	WPC7	WPC3	
S.I. RECIRCULATION TO LOOP C MOV-358	1B385	42-1385	358	B03	C09	EPC4	EPC2	
CROSS-TIE FROM REFUELING WTR. PUMP MOV-880	1B262	42-1262	880	B02	C09	—	—	

* FOR MOV'S 866A & 866B ONLY, WIRE TO VALVES THRU JB'S 647 & 648 (DASH LINES) AND NOT DIRECTLY (SOLID LINES)

SONGS 1
SAFETY RELATED (MOV'S 866A 866B, 356, 357, 358, 18, 19 ONLY)
REACTOR AUXILIARIES

REDRAWN FROM N-1542 SH. 31

Reference Drawings	
5149454	ED SAFETY INJECTION CIRCUITRY
5149629	DEVICE FUNC. NOS & SYMBOLS
5149964	EQUIP. LOCATION INDEX
5102165	MOTOR CONTROL CENTER 1
5102167	MOTOR CONTROL CENTER 2
5102170	MOTOR CONTROL CENTER 3
64374	E.D. MOV 883
63715	SAFETY INJECTION SYSTEM, SH2

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	J.O. No.
4	AS BUILT - INCORP DCN 5	3-26-86					EACo	3066
3	AS-BUILT-INCORP. CC 4	5-22-84					EACo	3872
2	INCORP DCN 3 EFF DATE 10-1-76	10/8/76						0736
1	INCORP DCN 1 & CCN 2 EFF DATE 11-1-76, 10-1-76	10-4-76						0736
0	ISSUED FOR CONST. & MVID WL RELAY CONTACTS, MOVED MOV 883 TO MCC 3	3-24-76						0736

Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

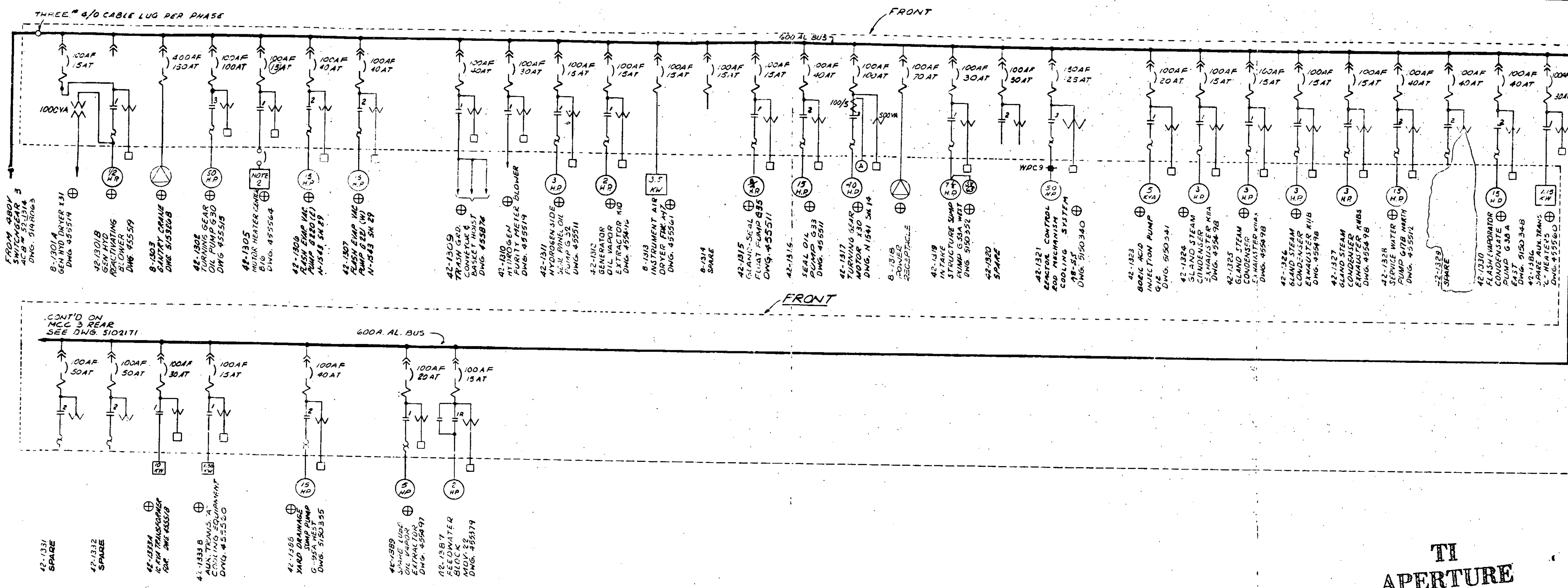
ELEMENTARY DIAGRAM
MOV-866A, B, 880,
356, 357, 358, 18 & 19

Southern California Edison Company SCE

8711100274-25

455371-4

SDCS

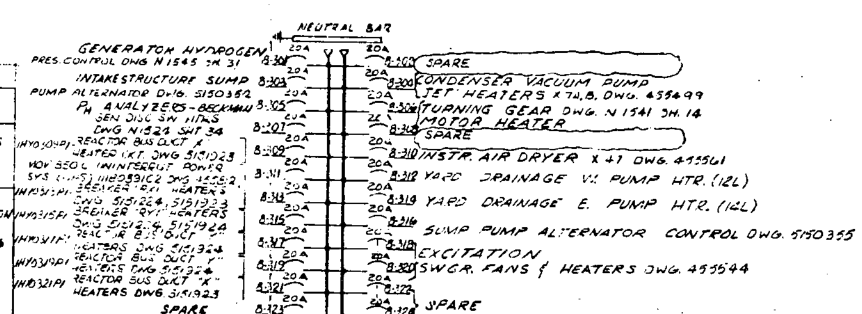


TI APERTURE CARD

Also Available On Aperture Card

WIRE WAY								
RELAY COMP	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP	RELAY COMP	RELAY COMP.	RELAY COMP.	RELAY COMP.
42-1388	8-1301A	42-1301B	42-1309	8-1314 SPARE	8-1318	42 1323	42-1328	42 1333B
	42-1302	42-1305	42-1310	42-1315	42-1319	42-1324	42-1329 SPARE	DISTRIBUTION PANEL 120-240V 1φ
42-1389		42-1306	42-1311	42-1316	42-1320 SPARE	42-1325	42-1330	
42-1387	8-1303	42-1307	42-1312	42-1317	42-1321	42-1326	42-1331 SPARE	42-1386
		42-1333A	8-1313			42-1327	42-1332 SPARE	10 KVA TRANSFORMER 480-240/120 V. 1φ 3W.

FRONT



DETAIL "A"
DISTRIBUTION PANEL
120-240V, 1φ, 3 WIRE

NOTE:
1. FOR GENERAL NOTES SEE DWG. 5102165
2. SEE DWG. 5151654 FOR MOTOR HEATER CENTER 3

8711100274-26

SONGS 1
SAFETY RELATED
(EXCEPT AS NOTED ⊕)

SUPERSEDES DWG. N1540 SH. 13

BECHTEL CORPORATION
ENGINEERS & CONSTRUCTORS
LOS ANGELES, CALIF.
JOB NO. 3246 DATE 2-3-65

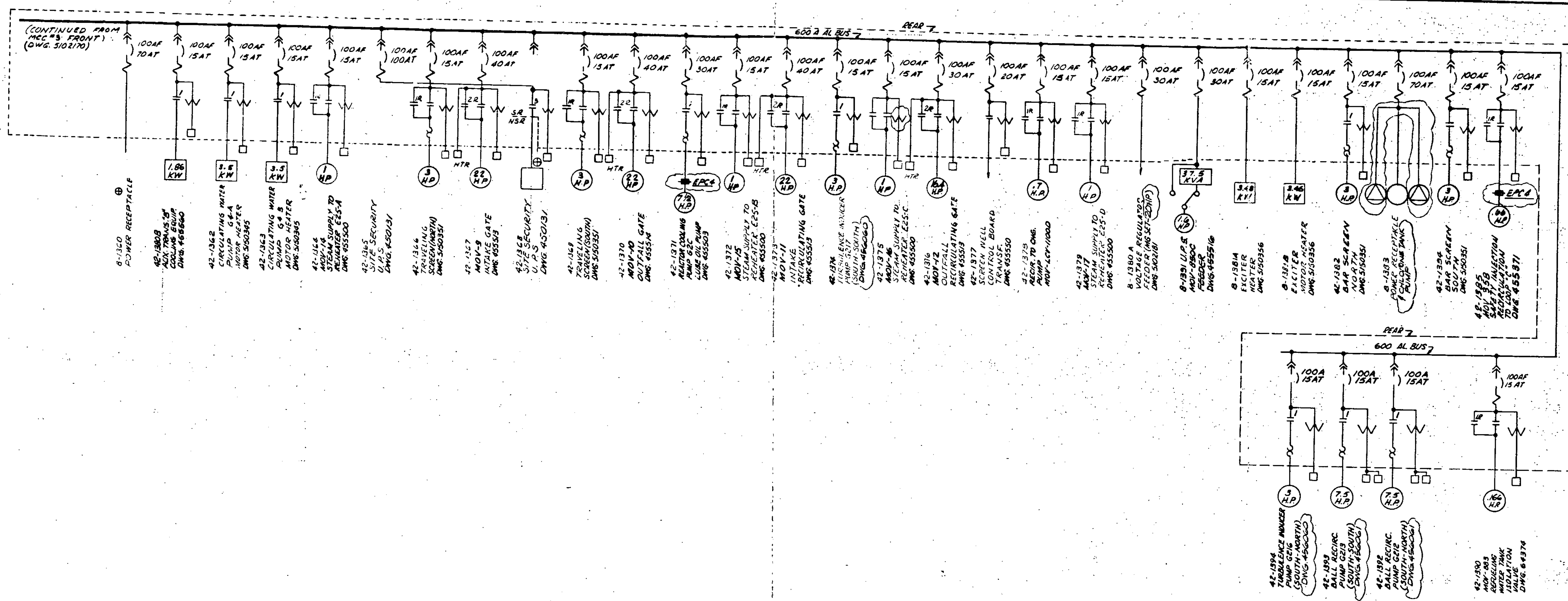
DWG. NO.	CROSS REFERENCES
5150050	480V MCC-3 RELAY DATA
5148093	ONE LINE DIAG. SWGR 2 & 3
5146825	MAIN ONE LINE DIAGRAM
5102171	ONE LINE DIAG. MCC 3 (REAR)
5149958	LOP-S1S-S1S/LOP TRAIN 2

NO.	REVISIONS
31	AS BUILT-INCORP DCN 24
30	AS BUILT-INCORP DCN 22,23
29	AS BUILT-INCORP DCN 21
28	AS BUILT-INCORP DCN 17 TO 14&640
27	AS BUILT INCORP DCN's

NO.	REVISIONS
26	AS BUILT
25	INCORP. CCN #13 EFFECT DATE IMMED.
24	INCORP. CCN #12 EFFECT DATE IMMED.
23	INCORP. CCN 11, EFF. DATE IMMED.
22	INCORP. CCN 10 EFFECT DATE IMMED.
0	ISSUED FOR CONSTRUCTION

LOCATION SAN ONOFRE NUCLEAR GENERATING STATION
ONE LINE DIAGRAM
480V MCC-3 FRONT
SOUTHERN CALIFORNIA EDISON COMPANY
SCALE NONE LOS ANGELES, CALIF.

5102170-31



86-M3-4 (NOTE 2)						86-M3-3 (NOTE 2)	86-M3-2 (NOTE 2)	86-M3-1 (NOTE 2)
WIRE WAY								
RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.	RELAY COMP.
8-1360	42-1380B	42-1365	42-1368	42-1371	42-1374	42-1377	8-1380A, 8-1391	42-1390
42-1335	42-1362	42-1366	42-1369	42-1372	42-1375	42-1378	8-1381A, 8-1381B	
	42-1363						42-1382	42-1392
10 KVA TRANSFORMER (SEE FRONT)	42-1364	42-1367	42-1370	42-1373	42-1376	42-1379	8-1383	42-1393
							42-1384	42-1394

FRONT

TI APERTURE CARD

Also Available On Aperture Card

NOTES:
1. FOR GENERAL NOTES SEE DWG. 5102165
2. FOR DETAILS SEE DWG. 455872

8711100274-27

W.P.#S 82-016 & 82-169 (82-297)

SONGS I
SAFETY RELATED
(EXCEPT AS NOTED ⊕)

SUPERSEDES DWG. N1540 SH. M

BECHTEL CORPORATION
ENGINEERS & CONSTRUCTORS
LOS ANGELES, CALIF.

JOB NO.	DATE	APPROVED
3246	2-3-65	

DWG. NO.	CROSS REFERENCES
5150050	480V MCC-3 RELAY DATA
5148063	ONE LINE DIAGRAM SWGR 2 & 3
5146828	MAIN ONE LINE DIAGRAM
5102170	ONE LINE DIAGRAM MCC 3 (FRONT)
5149958	LOP-SIS - SIS/LOP TRAIN 2

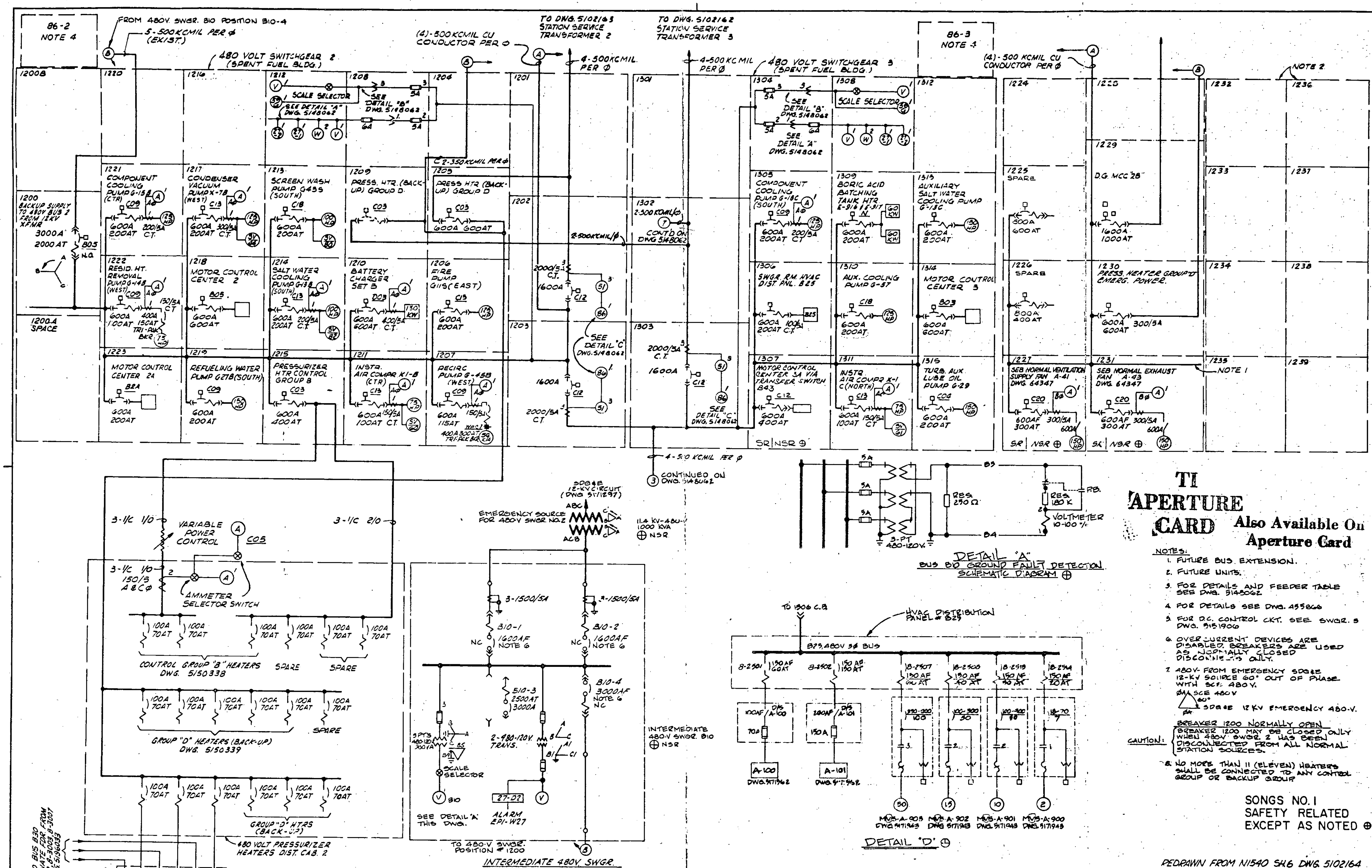
NO.	REVISIONS	DATE	J.O. NO.
22	AS BUILT-INCORP. CC 12, DCNS 1-14, T.O.#169606	9/5/90	8881
21	INCORP. CCN 10 & 11 EFF. DATE: IMMED.	4-3-79	6522
20	INCORP. CCN 9 EFF. DATE: IMMEDIAT.	3-27-78	6522
19	RECORD REVISION		6522
18	INCORP CCN 8, EFF. DATE IMMED.	4-21-77	6500
17	INCORP CCN 7 EFF DATE IMMED.	2-10-77	0736
16	INCORP DCN 4 DCNS 5 & 6 EFFECT DATE 11-1-76 & IMMED.	1-13-77	0736
15	INCORP CCN 3 - EFFECT DATE 10-1-76	10-4-76	0736
25	AS BUILT-INCORP DCN 17 & 18		3083
24	AS BUILT INCORP DCN 16		3040
23	AS BUILT INCORP DCN #15		8881

LOCATION SAN ONOFRE NUCLEAR GENERATING STATION

ONE LINE DIAGRAM 480V MCC-3 REAR

SOUTHERN CALIFORNIA EDISON COMPANY
SCALE NONE
LOS ANGELES, CALIF.

5102171-25



TI APERTURE CARD

Also Available On Aperture Card

NOTES:

1. FUTURE BUS EXTENSION.
2. FUTURE UNITS.
3. FOR DETAILS AND FEEDER TABLE SEE DWG. 5148062
4. FOR DETAILS SEE DWG. 455866
5. FOR D.C. CONTROL CKT. SEE SWGR. 3 DWG. 5151906
6. OVERCURRENT DEVICES ARE DISABLED, BREAKERS ARE USED AS NORMALLY CLOSED DISCONNECTS ONLY.
7. 480V FROM EMERGENCY SDG&E 12-KV SOURCE 60° OUT OF PHASE WITH SCE 480V.
8. NO MORE THAN 11 (ELEVEN) HEATERS SHALL BE CONNECTED TO ANY CONTROL GROUP OR BACKUP GROUP.

CAUTION: BREAKER 1200 NORMALLY OPEN. BREAKER 1200 MAY BE CLOSED ONLY WHEN 480V SWGR. 2 HAS BEEN DISCONNECTED FROM ALL NORMAL STATION SOURCES.

SONGS NO. 1
SAFETY RELATED
EXCEPT AS NOTED ⊕

REDRAWN FROM N1540 SH6 DWG 5102164

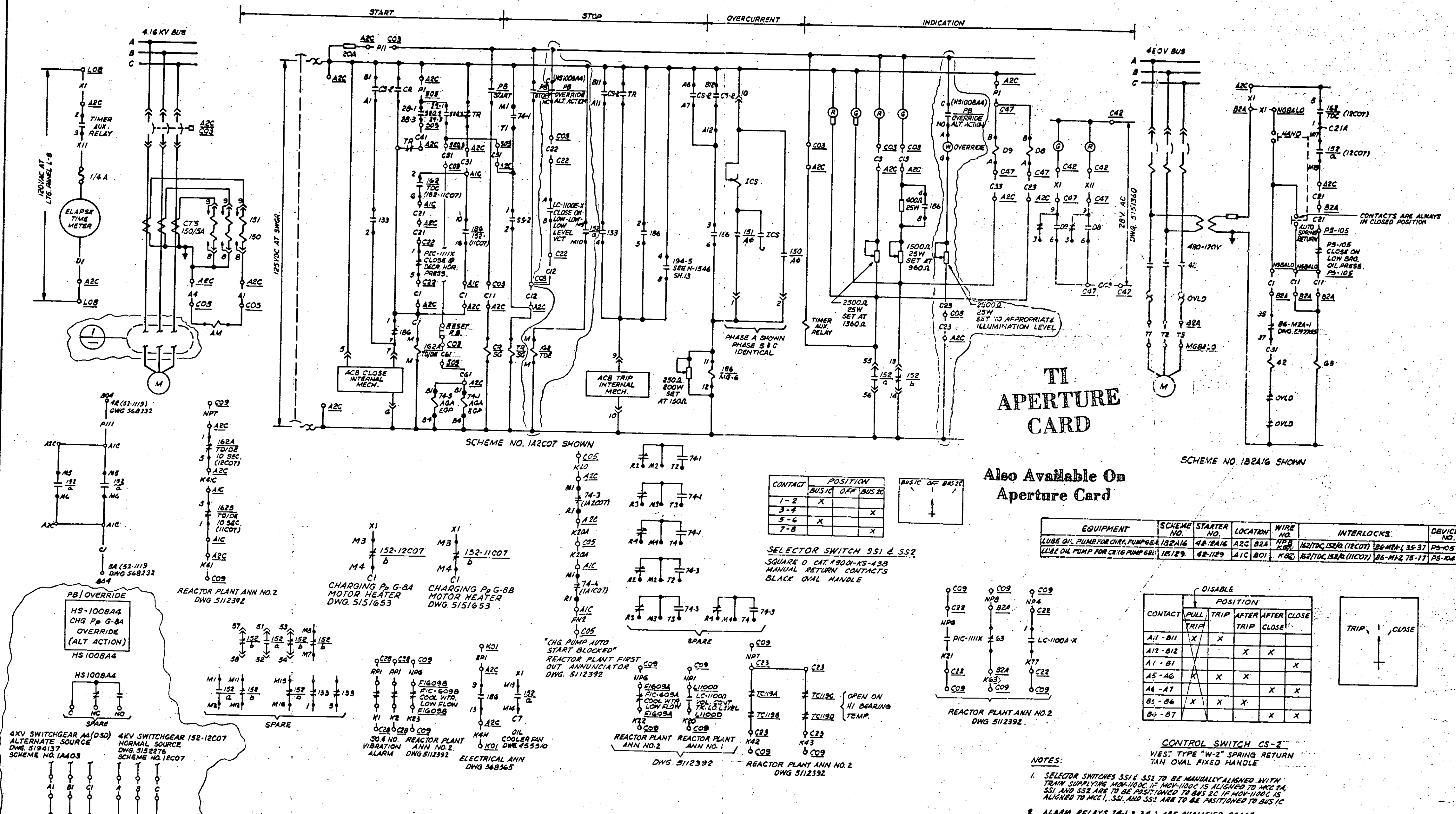
SAN ONOFRE NUCLEAR GEN. STA.

ONE LINE DIAGRAM 480V SWGR NO. 2&3

Southern California Edison Company

8711100274-28

5148063-11



SCHEME NO. 1A2C07 SHOWN

SCHEME NO. 1B2A16 SHOWN

TI APERTURE CARD

Also Available On Aperture Card

EQUIPMENT	SCHEME NO.	STARTER NO.	LOCATION		WIRE NO.	INTERLOCKS		DEVICE NO.
LUBE OIL PUMP FOR CHRG. PUMP G8A	1B2A16	48-12A16	A2C	B2A	NP8 K61	162/TDC, 152/a (12C07)	86-M2A-1, 35-37	PS-105
LUBE OIL PUMP FOR CHRG PUMP G8B	1B129	42-1129	A1C	B01	K62	162/TDC, 152/a (11C07)	86-M1-2, 75-77	PS-104

CONTACT	POSITION BUS 1C	OFF	BUS 2C
1-2	X		
3-4			X
5-6	X		
7-8			X

SELECTOR SWITCH SS1 & SS2

SQUARE D CAT. #9001-KS-43B MANUAL RETURN CONTACTS BLACK OVAL HANDLE

CONTACT	PULL TRIP	TRIP	AFTER TRIP	AFTER CLOSE	CLOSE
A11-B11	X	X			
A12-B12			X	X	
A1-B1					X
A5-A6	X	X	X		
A6-A7				X	X
B5-B6	X	X	X		
B6-B7				X	X

CONTROL SWITCH CS-2

WEST. TYPE "W-2" SPRING RETURN TAN OVAL FIXED HANDLE

NOTES:

1. SELECTOR SWITCHES SS1 & SS2 TO BE MANUALLY ALIGNED WITH TRAIN SUPPLYING MOV-1100C. IF MOV-1100C IS ALIGNED TO MCC 2A, SS1 AND SS2 ARE TO BE POSITIONED TO BUS 2C. IF MOV-1100C IS ALIGNED TO MCC1, SS1 AND SS2 ARE TO BE POSITIONED TO BUS 1C.
2. ALARM RELAYS 74-1, 2, 3 & 4 ARE QUALIFIED GRADE AGASTAT TYPE EGP RELAYS, PLUG-IN TYPE.

EQUIPMENT	SCHEME	BREAKER NO.	WIRE NO.	LOCATION					INTERLOCKS	152	186	DEVICE	MOV 1100C ALIGNMENT INTERLOCK SEL. SW.	SEQUENCER NO.	T.B.	STUD	SEQUENCER NO.	T.B.	STUD	TIME	DWG. NO.	ALARM RELAY		ELAPSED TIME METER	
CHRG. PUMP G-8A (NORTH)	1A2C07 1A403	152-12C07 152-1403	K4-H, K22	A2C	M6-8A	C47	C03	A4SI A4	194-5	152-11C07	152-11C07	TC-1119A & B	SS2-(1, 2)	2	29	1,3	2	28	1,3	20 SEC.	5150875	74-3	74-1	X11	U1
CHRG. PUMP G-8B (SOUTH)	1A1C07	152-11C07	K4-S, K22	A1C	M6-8B	C46	C03		194-1	152-12C07	152-12C07	TC-1119C & D	SS1-(3, 4)	1	28	9-11	1	28	1,3	20 SEC.	5150875	74-4	74-2	X11	U

SONGS I

SAFETY RELATED

REACTOR AUXILIARIES

8711100274-29

REDRAWN FROM DWG. 447492 (N-1542 SH 10) & DWG. 455135 (N-1542 SH 35)

Reference Drawings	
5149664	EQUIPMENT LOCATION INDEX
5149629	DEVICE FUNCTION NO'S & SYMBOLS
5149974	4KV/LOP LOCKOUT RELAYS, TRAIN 1
5102163	1 LINE 4160V BUS 2C
5102162	1 LINE 4160V BUS 1C
5151028	E.O. MOV LCV-1100C

No.	Revisions	Date
8	AS BUILT - INCORP. DCN 16 THRU 21	9-23-[illegible]
7	AS-BUILT INCORP CC#14 & 15 7.0#1435-4/13	
6	CANCEL CC 12 & 13 (MOV-1100C) ... SAFETY FUNCTION, AS CONSTR'D FOR TMI, APRIL 30 OUTAGE TURN OVER PACKAGE	3-21-81
5	INCORP. CCN 719 - EFF 3-[illegible]	
4	INCORP. CCN 8 - EFF DATE IMMED.	3/2/77
3	INCORP. CCN 617 EFFECT. DATE IMMEDIATELY	
2	INCORP CCN 415 EFFECT. DATE IMMED.	
1	INCORP CCN 1123 EFFECT 5-14-76 & 10-1-76	
0	ISSUED FOR CUST. ADDED SRD LOCKOUT CONTACTS	2-17-76

Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM

CHARGING PUMPS G-8A & G-8B

Southern California Edison Company

DWG. LIST M

SDCS

5150626-8

Southern California Edison Company
FIELD CHANGE NOTICE (FCN)

FCN: 52878E	C.W.O. or M.O. No.: 86083132	DCN Conversion: JUL 28 1987
Document No.: 5151028 Rev. 7	Title: Elementary Diagram	DCN: 14 Dwg. Rev.: 7
1. Responsible Discipline: Electrical	Q.A.: Safety Related	
Originating Engr.: James M. Lyle	PAX 89425	Date 6-9-87
PFC Required— Yes [X] No [ ] 1-86-022	Units 1	DRADM I.D. E-~~25~~/0 6-9-87

Description of Change and Reason

MOV – 1100 C

Add torque switch and rotor settings to limit switch contact development.

Initiating Document (NCR, SPR, Other) IE BULLETIN 85-03

2. Other Affected Documents

The associated document/source initiating change on Form SO(123) 183 is (check one):

- [X] This FCN SO(123) 183 (attached)
- [ ] The following document(s):

Specific affected documents are listed on the SO(123) 184 associated with the above checked source document(s).

3. Affected Systems VCC

4. SCE Design Approvals

Nuclear Generation Site Department	Date	Engineering and Construction Department	Date
Other: N/A		Other: A. Rajeswaran	6-15-87
Other:		Checker: M. Moinuddin	6-17-87
Independent Review Engr.:	6-12-87	Independent Review Engr.: N/A	
Responsible Engineer: James M. Lyle	6-10-87	Responsible Engineer: N/A	
Supervising Engineer: R.M. McLandrick	6/13/87	Discipline Group Leader: Satyam Kundula	6-17-87
Supervising Engineer: K.E. Johnson	6/23/87	Discipline Supervisor:	6-19-87
Manager Station Technical: K.E. Johnson for J.T. Reilly	6/23/87	Discipline Chief: N/A	
Quality Assurance:	7-2-87	Quality Assurance: N/A	

5. Construction Completion Verification/DCN Conversion

James M. Lyle — C.W.O. or M.O. CLOSEOUT — DATE 7/23/87 JUL 28 1987

APPROVAL FOR INCORPORATION ONLY AFTER RECEIPT OF NOTIFICATION OF CHANGE COMPLETION FROM STARTUP

SCE/CONTRACTOR PROJECT ADMINISTRATOR

Southern California Edison Company SCE

FIELD CHANGE NOTICE (FCN)

SUPPLEMENTAL PAGE

Document No.	Sheet No.	Rev. No.	DCN Rev.	DCN No.	Quality Class
5151028	–	7	7	14	Safety Related

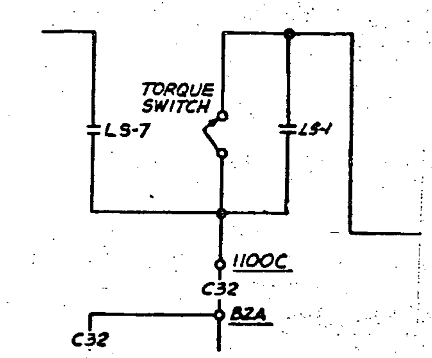
FCN Number 52878E — JUL 28 1987

Date 6-9-87 Page 2 of 6 Page

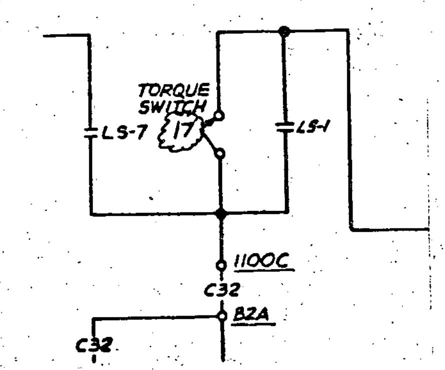
By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

BEFORE



AFTER



TI APERTURE CARD

Also Available On Aperture Card

16X

MICROFILMED FROM BEST AVAILABLE COPY

8711100274-30

Southern California Edison Company SCE

FIELD CHANGE NOTICE (FCN)

SUPPLEMENTAL PAGE

FCN NUMBER 52878E					
DOCUMENT NO.	SHEET NO.	REV. NO.	DCN CONV. DOC. REV.	DATE JUL 28 1987 DWG. NO.	QUALITY CLASS
5151028	—	7	7	14	Safety Related

Date 6-9-87 Page 3 of 6 Page

By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

BEFORE

63715	SAFETY INJECT. SYS. SH. 2
5102171	MOTOR CONTROL CENTER 3
5149964	EQUIP. LOCATION INDEX
5149629	DEVICE FUNCTION NOS. & SYMBOLS
Reference Drawings	

AFTER

568249	WIRING DIAGRAM
63715	SAFETY INJECT. SYS. SH. 2
5102171	MOTOR CONTROL CENTER 3
5149964	EQUIP. LOCATION INDEX
5149629	DEVICE FUNCTION NOS. & SYMBOLS
Reference Drawings	

Southern California Edison Company SCE

FIELD CHANGE NOTICE (FCN)

SUPPLEMENTAL PAGE

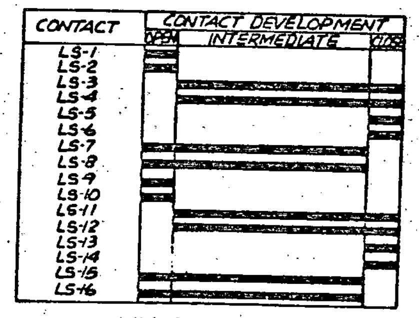
FCN NUMBER 52878E					
DOCUMENT NO.	SHEET NO.	REV. NO.	DCN CONV. DOC. REV.	DATE JUL 28 1987 DWG. NO.	QUALITY CLASS
5151028	—	7	7	14	Safety Related

Date 6-9-87 Page 4 of 6 Page

By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

BEFORE



LIMIT SWITCH

Southern California Edison Company SCE

FCN NUMBER 52874R

JUL 28 1987

FIELD CHANGE NOTICE (FCN)

SUPPLEMENTAL PAGE

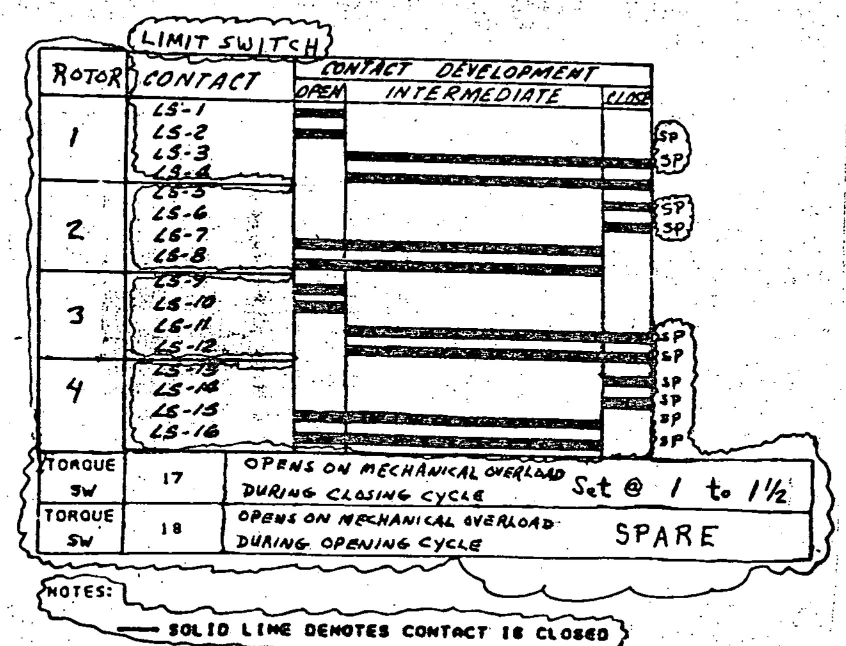
DOCUMENT NO.	SHEET NO.	REV. NO.	DCP REV	DCN NO.	QUALITY CLASS
5151028	—	7	7	14	Safety Related

Date 6-9-87 Page 5 of 6 Pages

By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

AFTER



Southern California Edison Company SCE

FCN NUMBER 52874R

JUL 28 1987

FIELD CHANGE NOTICE (FCN)

SUPPLEMENTAL PAGE

DOCUMENT NO.	SHEET NO.	REV. NO.	DCP REV	DCN NO.	QUALITY CLASS
5151028	—	7	7	14	Safety Related

Date 6-9-87 Page 6 of 6 Page

By J. M. Lyle

DESCRIPTION OF CHANGE AND REASON

FOR INFORMATION ONLY

THRUST SETPOINT DETERMINATION SHEET

VALVE NUMBER MOV-1100C VALVE TYPE GATE
ACTUAL TEST PRESS *150 PSI DESIGN BASIS PRESS 150 PSI
AS LEFT DATA OPEN SPARE LB CLOSE *LSW(1½)LB
PRESSURE TEST DATA OPEN SPARE LB CLOSE *LSW LB
(UNSEATING THRUST) (TOTAL THRUST)

CALCULATION DATA FOR MINIMUM REQUIRED THRUST OPEN 754 LB CLOSE 1645 LB

RUNNING THRUST OPEN 257 LB CLOSE 1372 LB

TIME AT TRANSITION TO RUNNING THRUST @NA SECONDS VALVE STROKE TIME 7.19 SECONDS
TIME AT WHICH TORQUE SWITCH BYPASS LIMIT SWITCH DROPS OUT OF CIRCUIT @NA SECONDS @100 %

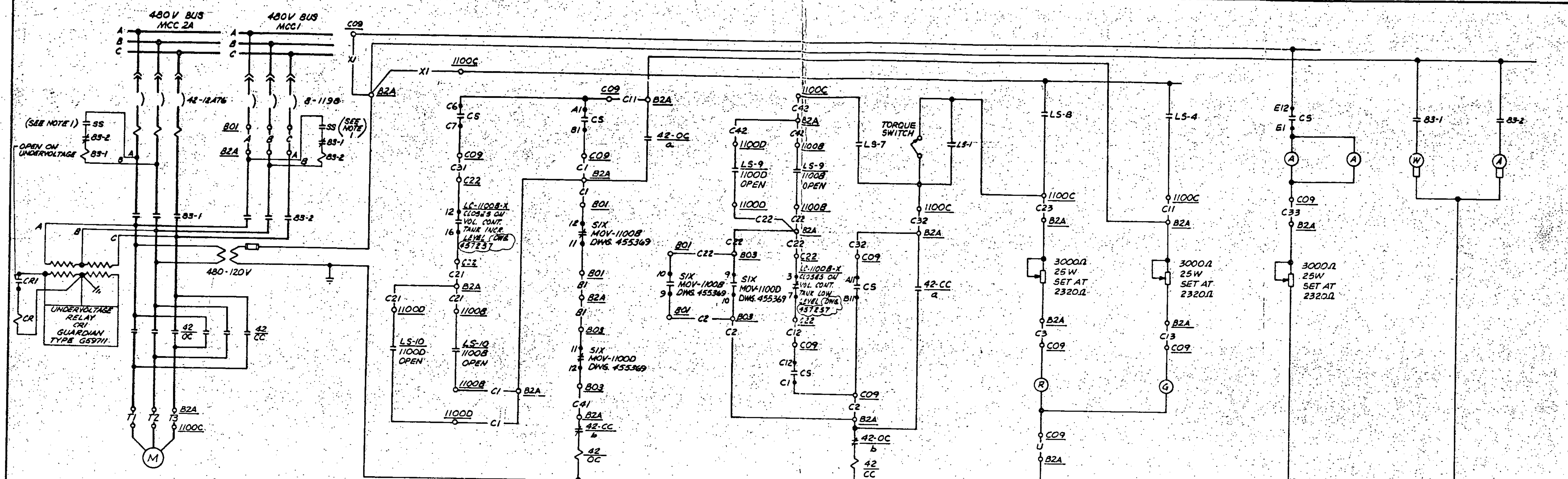
****
* MINIMUM REQUIRED THRUST OPEN "SPARE"LB CLOSE *LSW(1) LB*
****

PULLOUT THRUST AT 100% VOLTAGE 7804 LB
STALL THRUST AT 80% VOLTAGE 8139 LB
STALL THRUST AT 100% VOLTAGE 12717 LB

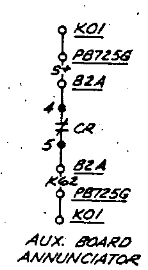
****
* MAXIMUM ALLOWABLE THRUST OPEN "SPARE"LB CLOSE *LSW(1½) LB*
****

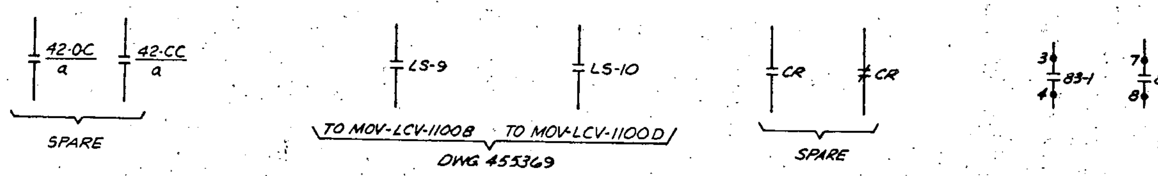
CORRESPONDING MAXIMUM STEM STRESS INTENSITY &26127 PSI
MAXIMUM ALLOWABLE STEM STRESS INTENSITY 48300 PSI
TORQUE SWITCH BYPASS SETPOINT TO BE SET AT @NA PERCENT OPEN ON THE OPEN CYCLE. SET AT 99±1 % ON THE CLOSE CYCLE.

COMMENTS : DBT PERFORMED ON MOV-1100B. VALVE OPENED AGAINST D/P.
* VALVE IS LIMIT SWITCH CLOSED. NO THRUST DATA REQUIRED. SET CLOSING TORQUE SWITCH AT VALUE RECOMMENDED BY LIMITORQUE.
@ OPEN TORQUE SWITCH NOT PART OF VALVE CONTROL. THEREFORE OPEN TORQUE SWITCH BYPASS IS N/A.
& CALCULATED MAXIMUM STRESS INTENSITY IN STEM AT THREAD ROOT FOR A MOTOR STALL OF 12717 LB. THRUST.



SCHEME NO. 182A76

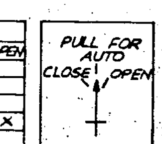




TI APERTURE CARD

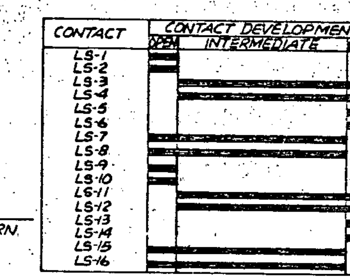
Also Available On Aperture Card

CONTACT	POSITION CLOSE	OFF	AUTO	OPEN
A11-B11	X			
A12-B12		X	X	
A1-B1				X
A5-B5	X			
A6-B6		X	X	
A7-B7				X
C12-C1			X	
D12-D1	X	X		X
C6-C7			X	
D6-D7	X	X		X
E12-E1			X	
F12-F1	X	X		X
E6-E7			X	
F6-F7	X	X		X



CONTROL SWITCH CS

WEST TYPE "W-2" SPRING RETURN. GREEN OVAL FIXED HANDLE



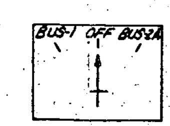
LIMIT SWITCH

NOTES:

1. SELECTOR SWITCH SS ALIGNS MOV-1100C TO EITHER MCC 1 OR MCC 2A IF BREAKERS 8-1198 OR 42-12A76 RESPECTIVELY, ARE CLOSED. BREAKER NOT SUPPLYING MOV-1100C WILL BE MAINTAINED IN OPEN POSITION

EQUIPMENT	SCHEME NO.	STARTER NO.	INTERLOCKS	LOCATION
VOLUME CONTROL TANK DISCHARGE MOV-LCV-1100C	182A76	42-12A76	LS-9, LS-10(1100B); LS-9, LS-10(1100D); SIX 9 & 10, 11 & 12(1100B); SIX 9 & 10, 11 & 12 (1100D)	B2A

CONTACT	POSITION BUS-1	OFF	BUS-2A
1-2	X		
3-4			X
5-6	X		
7-8			X



SELECTOR SWITCH SS

SQUARE-D CAT. #9001-KS-43B MANUAL RETURN CONTACTS BLACK OVAL HANDLE

W.P. # 82-016 (82-297)

SONGS 1
SAFETY RELATED
REACTOR AUXILIARIES

8711100274-33

REDRAWN FROM DWG. 449403 (N-1542 SH. 32)

Reference Drawings	
63715	SAFETY INJECT. SYS. SH. 2
5102171	MOTOR CONTROL CENTER 3
5149984	EQUIP. LOCATION INDEX
5149629	DEVICE FUNCTION NOS. & SYMBOLS

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	I.O. No.
7	AS BUILT - INCORP. DCN 13	7-18-[illegible]			GG		EAC	3083
6	AS BUILT - INCORP. CC 12, CANC. CC'S 10, 11	[illegible]				J.R.	EAC	3881
5	REC REV. - REVISED TITLE	4-19-76				DE	VK	6705

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	I.O. No.
4	INCORP. CCN. 7 EFF. DATE IMMED.	11-[illegible]					BC	7345
3	INCORP CCN 5 & 6 EFF DATE IMMED	5-12-77						0136
2	INCORP CCN 2, 3 & 4 (7-EFF 3-15, 3-22-77 & IMMED)	4-13-77						[illegible]
1	INCORP CCN 1 - EFFECT DATE 10-1-76	10-4-76						0736
0	ISSUED FOR CONSTR. ; REVISED & REDRAWN	3-30-76						0736

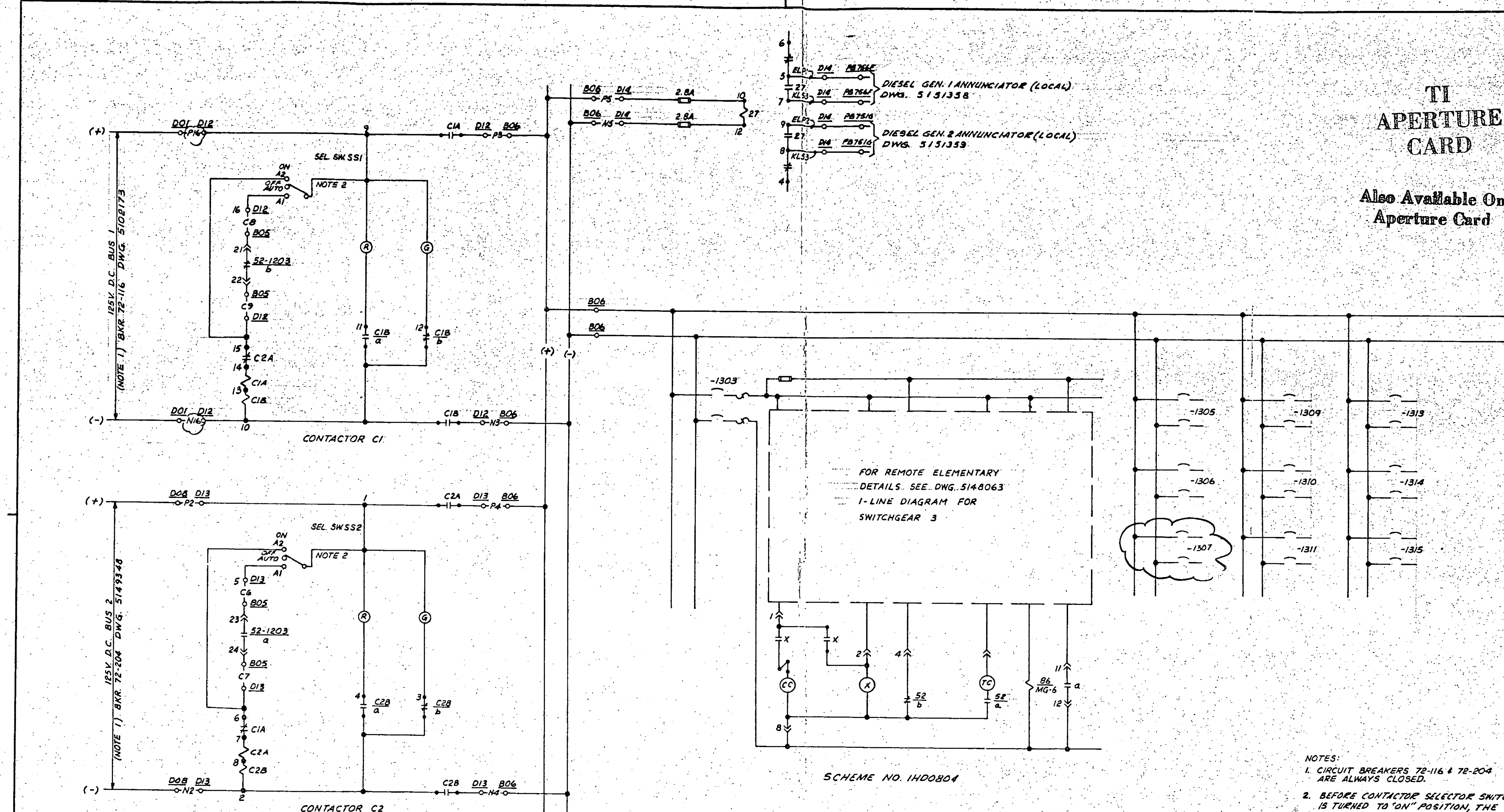
Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
MOV LCV 1100C & E
(VOLUME CONT. TANK DISCH.)

Southern California Edison Company

5151028-7



TI APERTURE CARD

Also Available On Aperture Card

NOTES:
1. CIRCUIT BREAKERS 72-116 & 72-204 ARE ALWAYS CLOSED.
2. BEFORE CONTACTOR SELECTOR SWITCH IS TURNED TO "ON" POSITION, THE OPPOSITE CONTACTOR MUST BE TURNED TO "OFF" POSITION.

EQUIPMENT	EQUIP LOC. NO.	SCHEME NO.	LOCATION		INTERLOCKS
125 V. CONTACTOR C1	D12	1FD0116	D12 D12	D01 B06	52-1203/b
125V. CONTACTOR C2	D13	1GD0204	D13 D13	D08 B06	52-1203/a

CONTACT	POSITION		
	AUTO	OFF	ON
A1	X	O	O
A2	O	O	X

SELECTOR SWITCH SS1 & SS2
X - CLOSED
O - OPEN

SONGS 1
SAFETY RELATED

8711100274-34

REDRAWN FROM DWG. 455304

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	I.O. No.
4	AS BUILT INCORP DCN #3	5-6-85						3083
3	INCORP CCN 3 EFFECT DATE IMMEDIATELY	3-18-77						0736
2	INCORP CCN 2 EFFECT DATE 11-18-76	1-20-77						0736
1	INCORP CCN 1 EFFECT DATE 10-1-76	10-4-76						0736
0	ISSUED FOR CONST. ADDED D.C. CONTACTORS C1, C2							0736

Reference Drawings		No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	I.O. No.
5149964	EQUIP. LOCATION INDEX									
5149629	DEVICE FUNC. NO'S & SYMBOLS	5	AS BUILT INCORP CC#4	7/11/85						3083

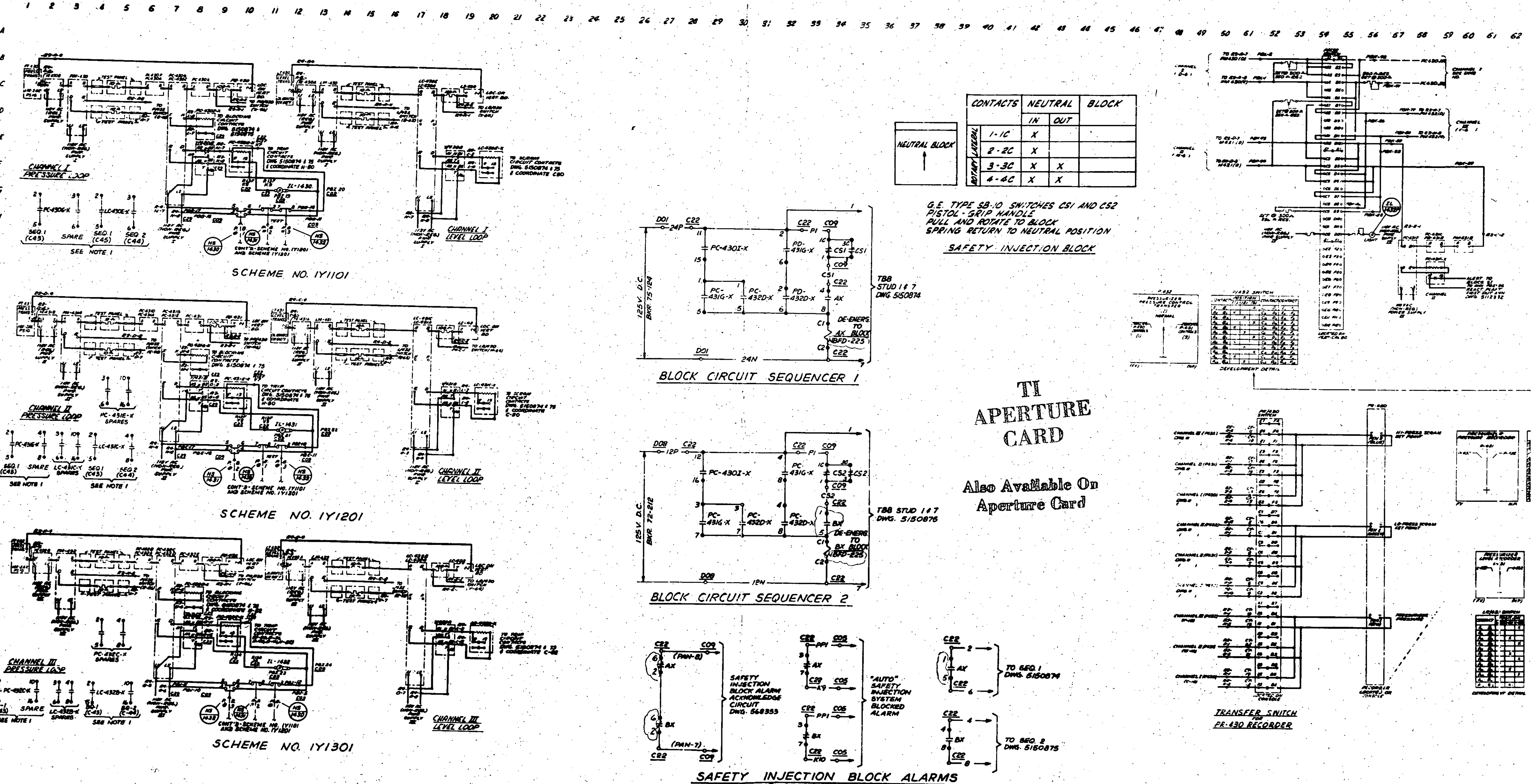
Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
480 V. SWGR. 3
125V. D.C. CONTROL

Southern California Edison Company

5151906-5



CONTACTS		NEUTRAL IN	NEUTRAL OUT	BLOCK
ROTARY LATERAL	1-1C	X		
	2-2C	X		
	3-3C	X	X	
	4-4C	X	X	

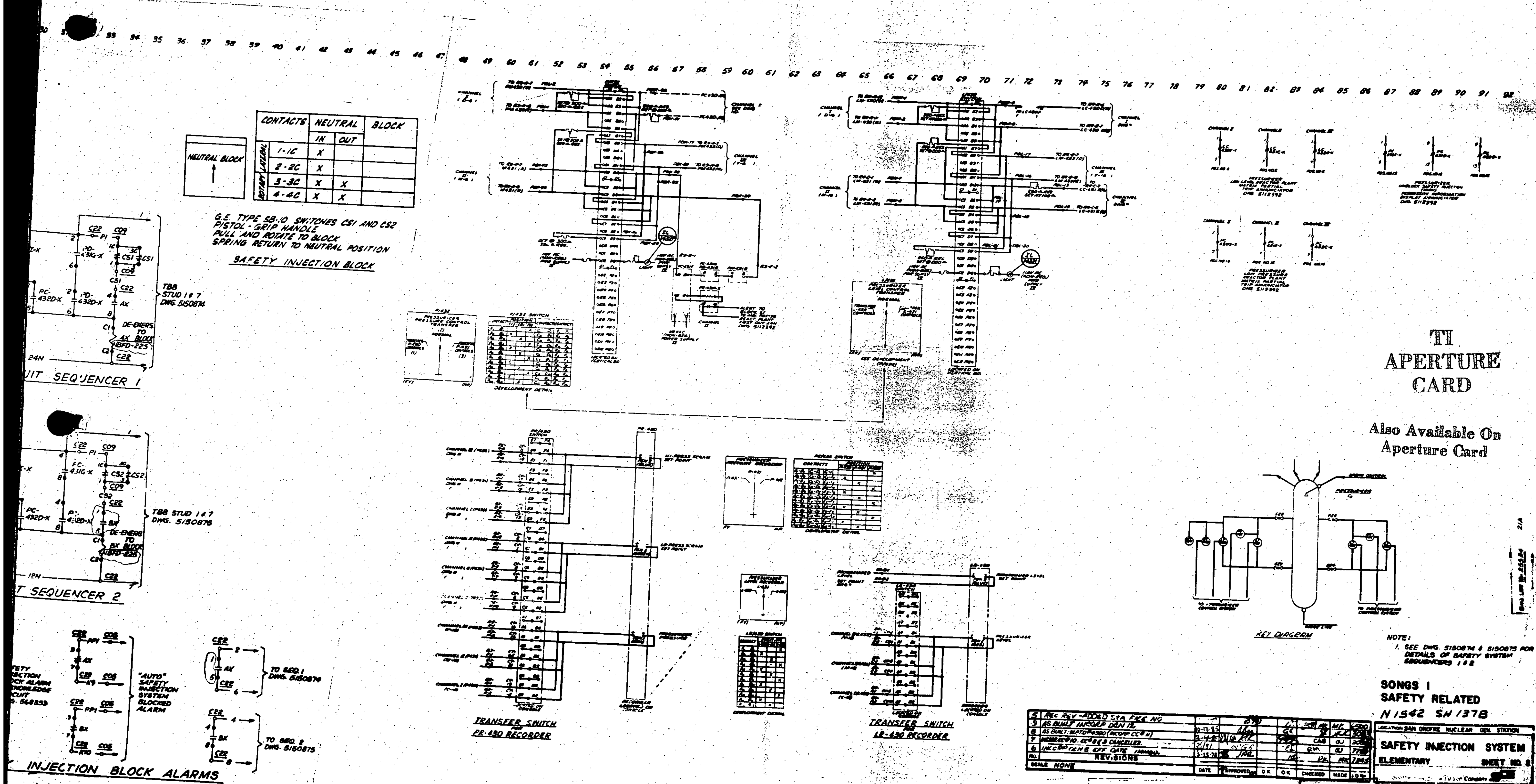
TI APERTURE CARD

Also Available On Aperture Card

24X

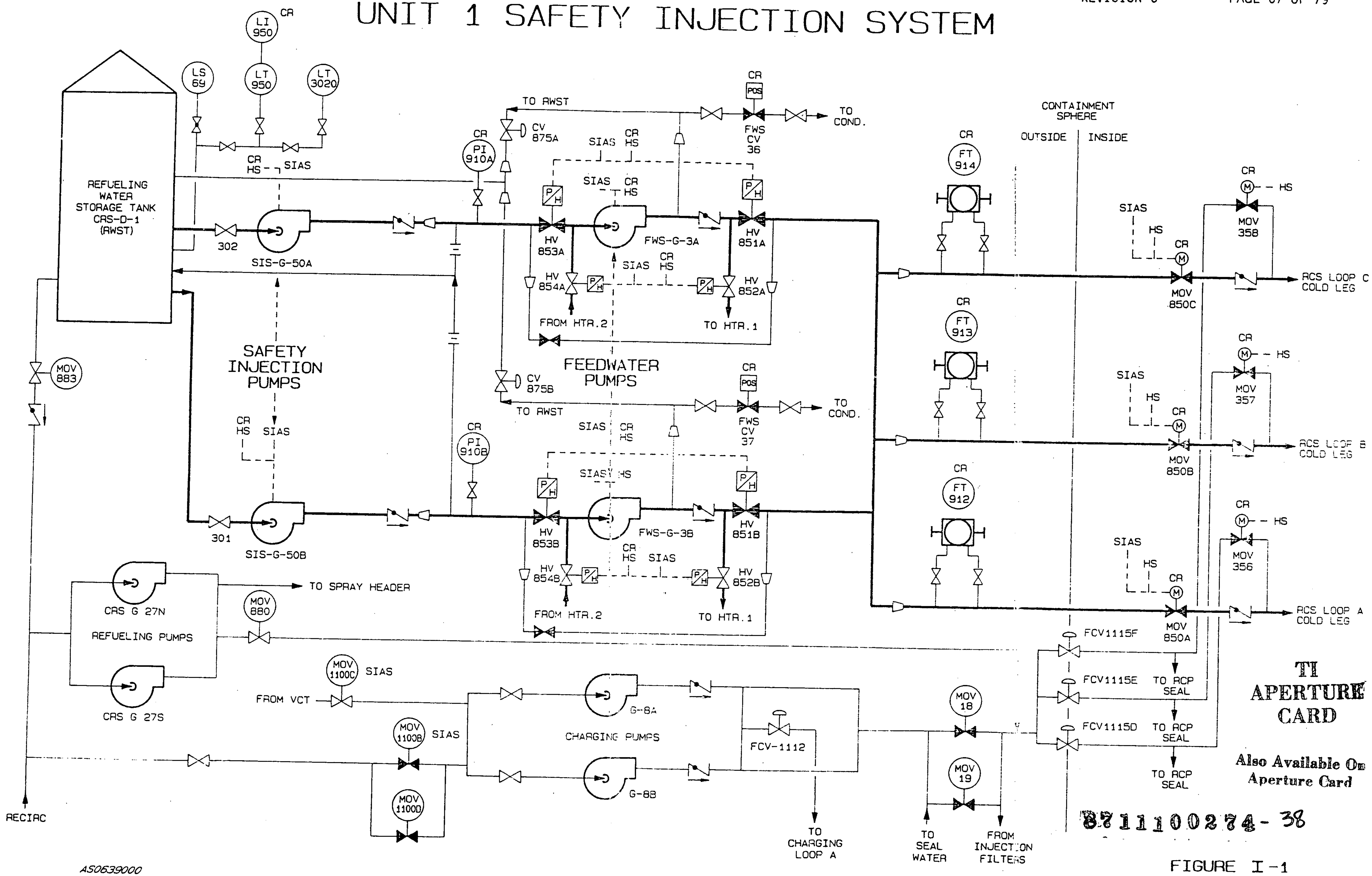
MICROFILMED FROM

8711100274-35



8711100274-36

UNIT 1 SAFETY INJECTION SYSTEM



TI APERTURE CARD

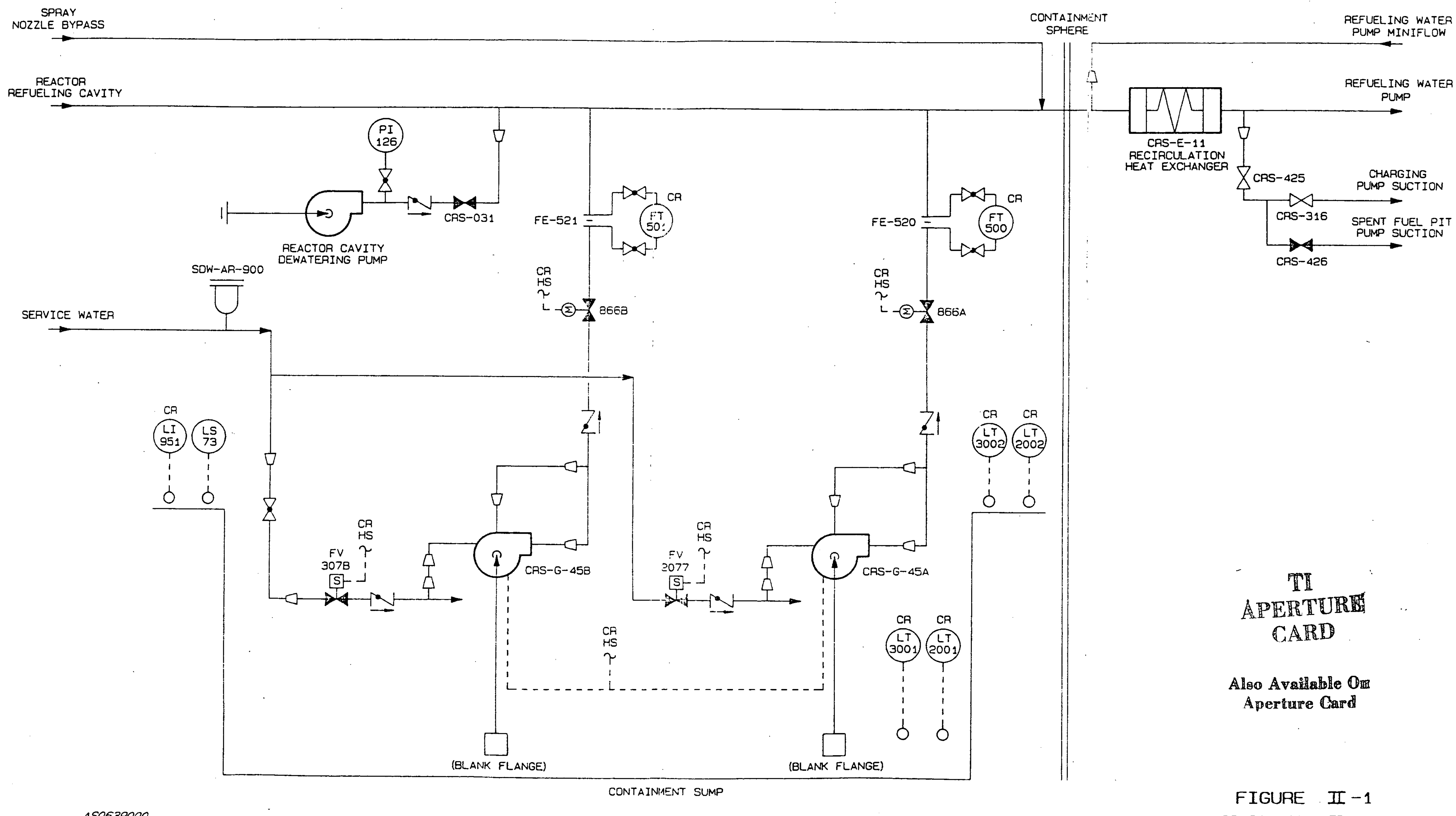
Also Available On Aperture Card

8711100274-38

FIGURE I-1

SD-SO1-580-I-1-1

RECIRCULATION SYSTEM



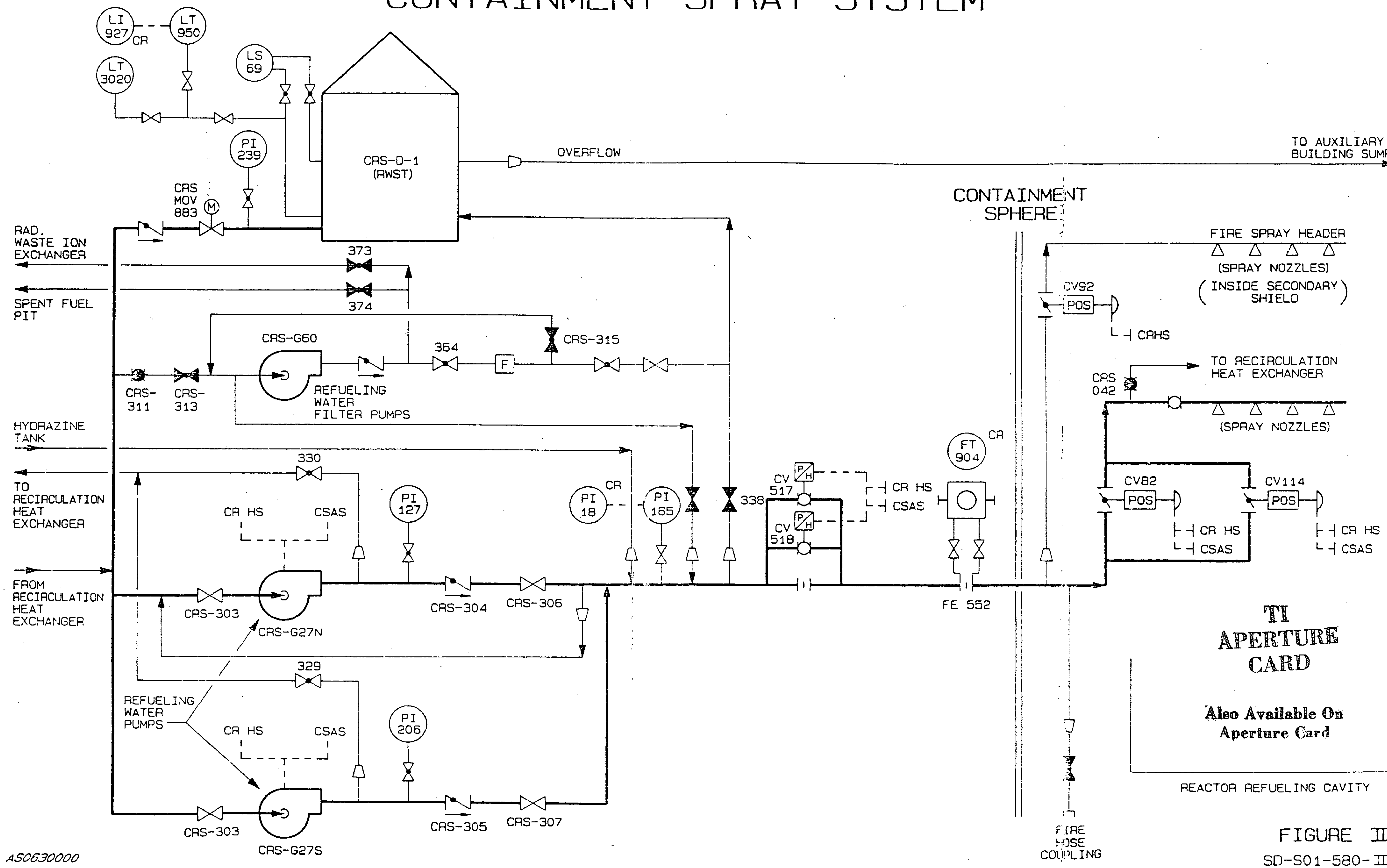
TI APERTURE CARD

Also Available On Aperture Card

FIGURE II-1
SD-S01-580-II-1-1

8711100274-39

CONTAINMENT SPRAY SYSTEM



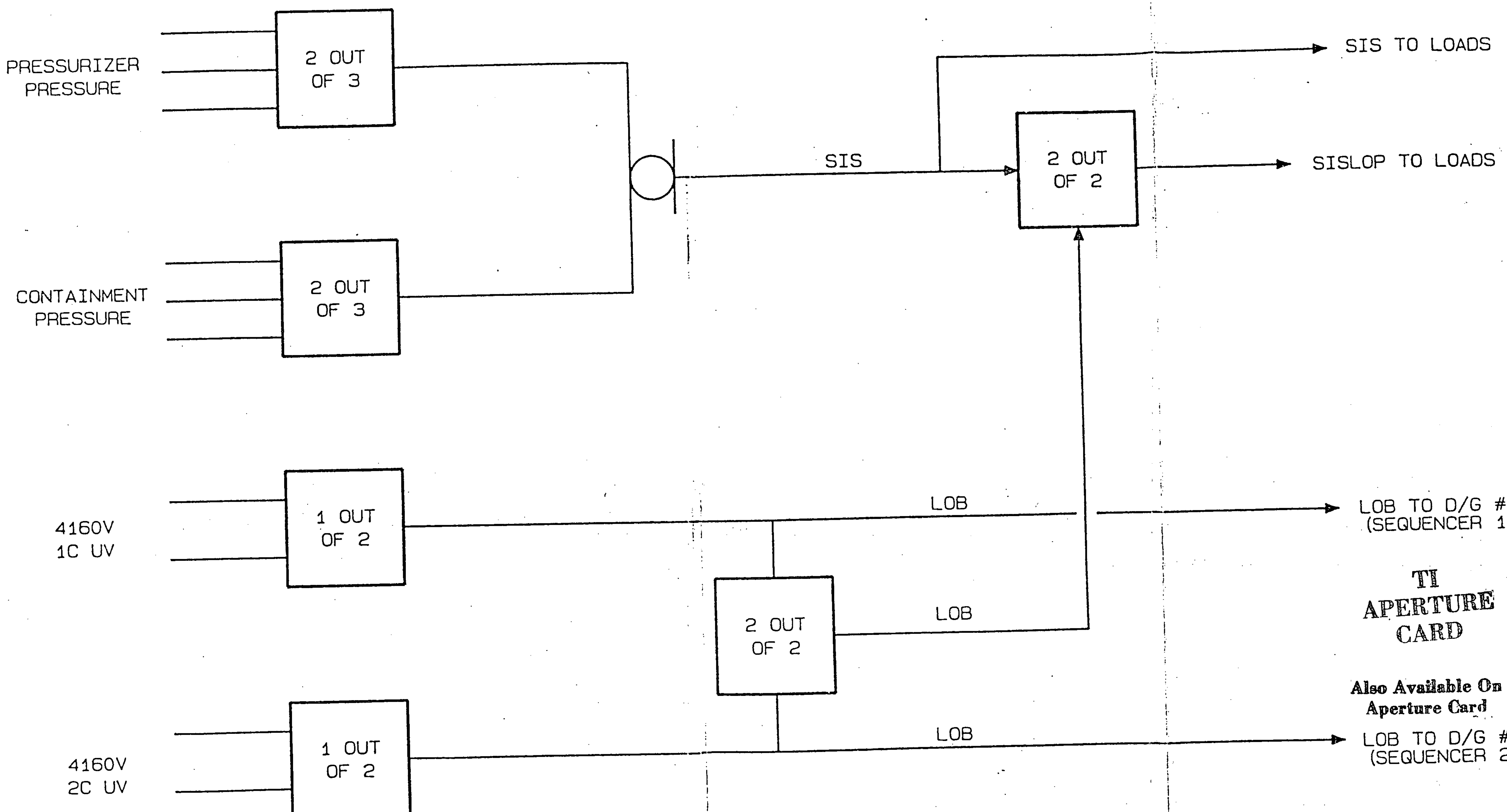
TI APERTURE CARD

Also Available On Aperture Card

FIGURE III -1
SD-S01-580-III -1-0

8711100274-40

BASIC SEQUENCER LOGIC



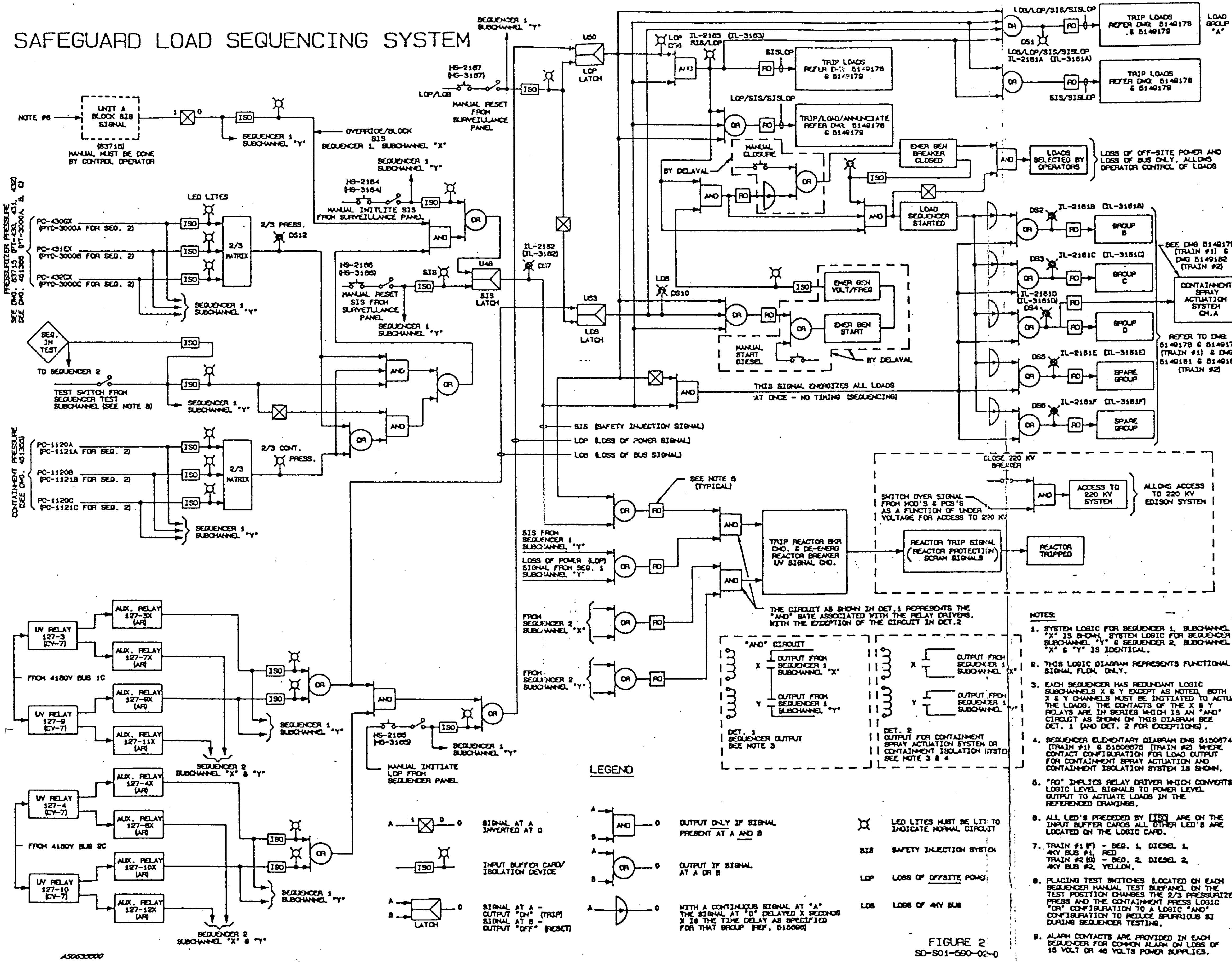
TI APERTURE CARD

Also Available On Aperture Card

FIGURE 1
SD-S01-590-01-2

8711100274-41

SAFEGUARD LOAD SEQUENCING SYSTEM



NOTES:

1. SYSTEM LOGIC FOR SEQUENCER 1, SUBCHANNEL "X" IS SHOWN. SYSTEM LOGIC FOR SEQUENCER 1, SUBCHANNEL "Y" & SEQUENCER 2, SUBCHANNEL "X" & "Y" IS IDENTICAL.
2. THIS LOGIC DIAGRAM REPRESENTS FUNCTIONAL SIGNAL FLOW, ONLY.
3. EACH SEQUENCER HAS REDUNDANT LOGIC SUBCHANNELS X & Y EXCEPT AS NOTED. BOTH X & Y CHANNELS MUST BE INITIATED TO ACTUATE THE LOADS. THE CONTACTS OF THE X & Y RELAYS ARE IN SERIES WHICH IS AN "AND" CIRCUIT AS SHOWN ON THIS DIAGRAM SEE DET. 1 (AND DET. 2 FOR EXCEPTIONS).
4. SEQUENCER ELEMENTARY DIAGRAM DWG 5150874 (TRAIN #1) & 51506675 (TRAIN #2) WHERE CONTACT CONFIGURATION FOR LOAD OUTPUT FOR CONTAINMENT SPRAY ACTUATION AND CONTAINMENT ISOLATION SYSTEM IS SHOWN.
5. "RD" IMPLIES RELAY DRIVER WHICH CONVERTS LOGIC LEVEL SIGNALS TO POWER LEVEL OUTPUT TO ACTUATE LOADS IN THE REFERENCED DRAWINGS.
6. ALL LED'S PRECEDED BY ISO ARE ON THE INPUT BUFFER CARDS ALL OTHER LED'S ARE LOCATED ON THE LOGIC CARD.
7. TRAIN #1 (F) - SEQ. 1, DIESEL 1, 4KV BUS #1, RED
TRAIN #2 (G) - SEQ. 2, DIESEL 2, 4KV BUS #2, YELLOW.
8. PLACING TEST SWITCHES (LOCATED ON EACH SEQUENCER MANUAL TEST SUBPANEL ON THE TEST POSITION CHANGES THE 2/3 PRESSURIZER PRESS AND THE CONTAINMENT PRESS LOGIC "OR" CONFIGURATION TO A LOGIC "AND" CONFIGURATION TO REDUCE SPURRIOUS SI DURING SEQUENCER TESTING.
9. ALARM CONTACTS ARE PROVIDED IN EACH SEQUENCER FOR COMMON ALARM ON LOSS OF 15 VOLT OR 48 VOLTS POWER SUPPLIES.

FIGURE 2
SD-S01-590-02-0

TI
APERTURE
CARD

Also Available On
Aperture Card

8711100274-42

CARD RACK

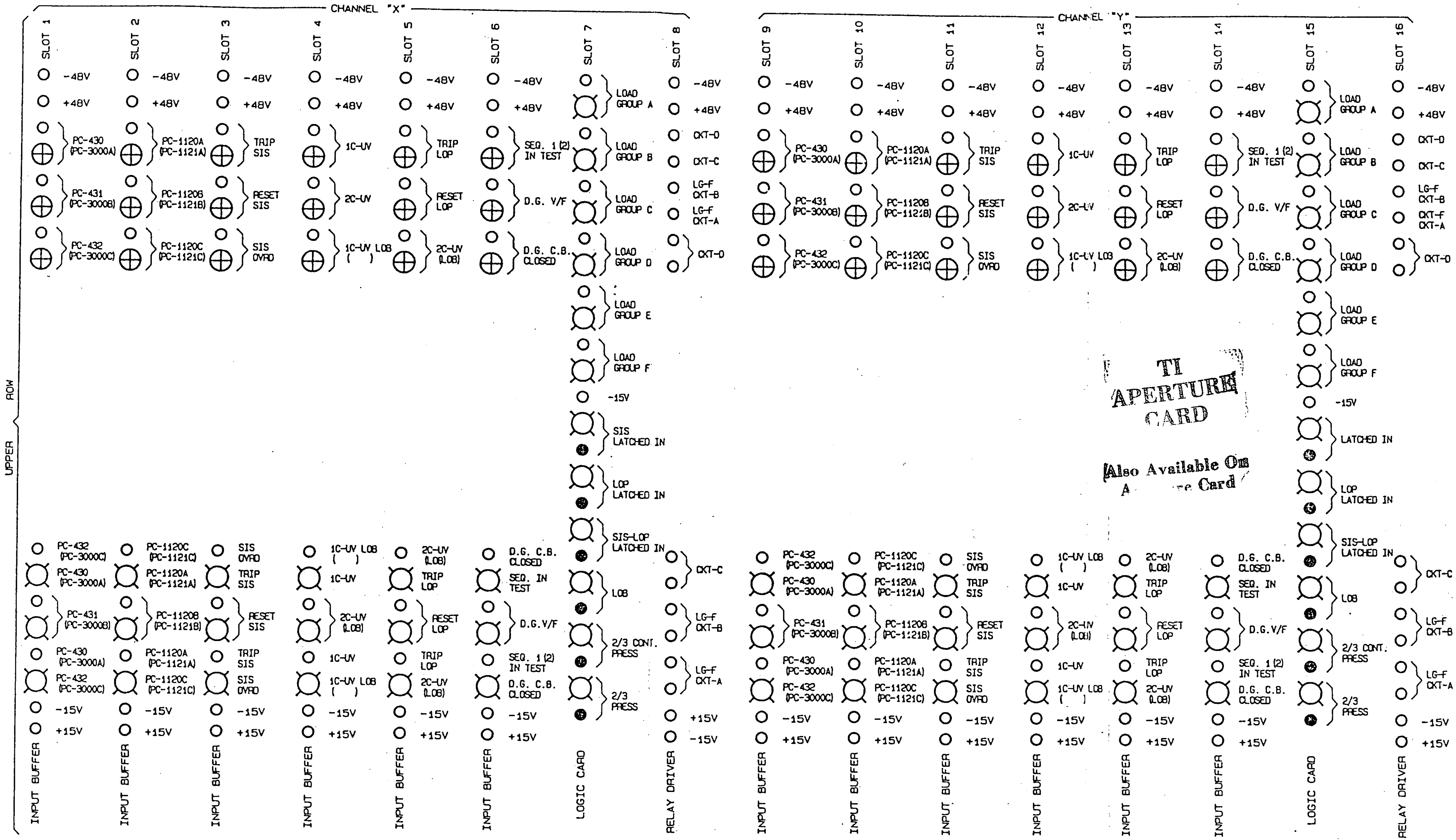


FIGURE 11
SD-S01-590-11-1

A50538500

8711100274-43

FIGURE 3: SAFETY INJECTION SIGNAL (SIS)

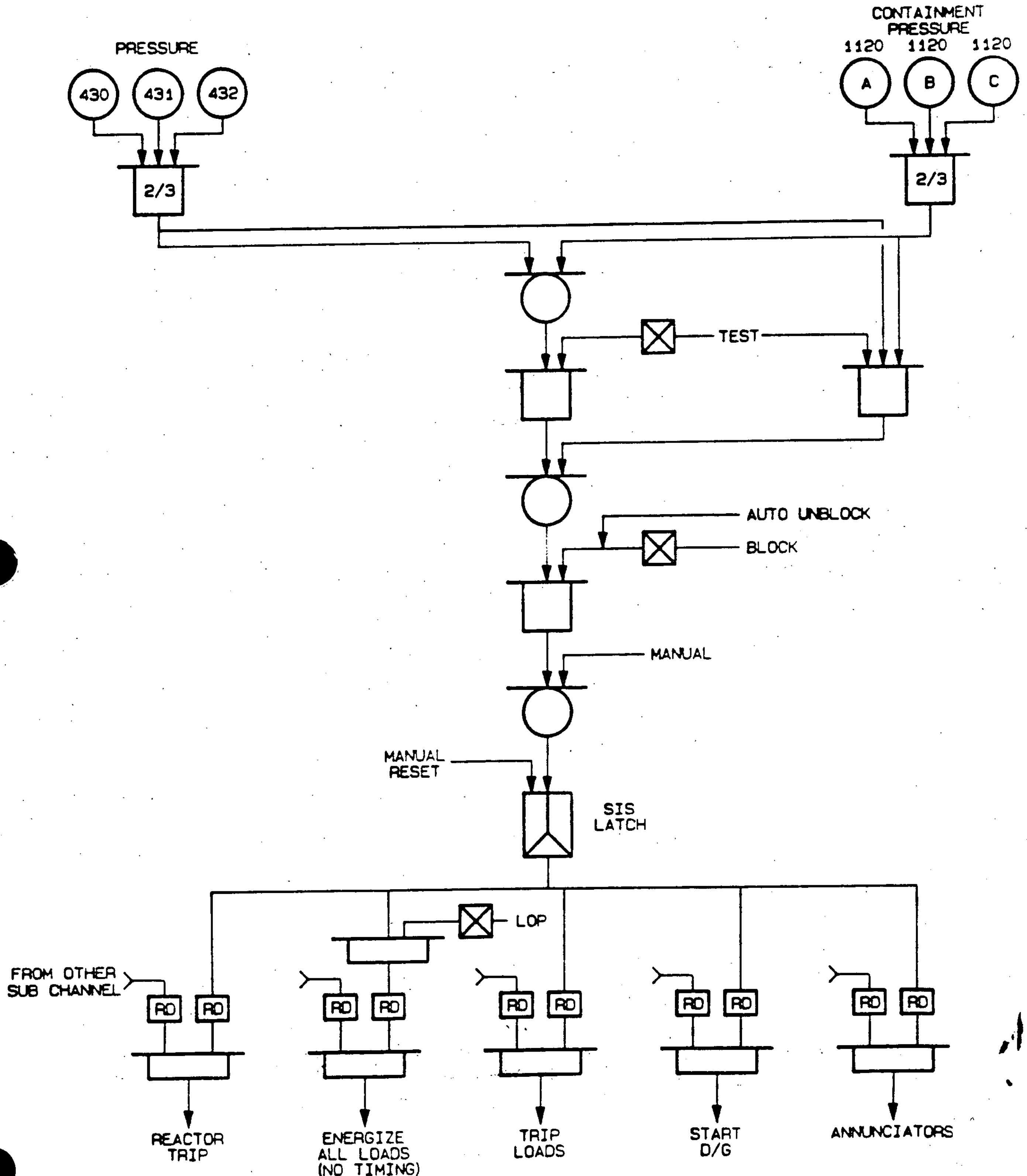
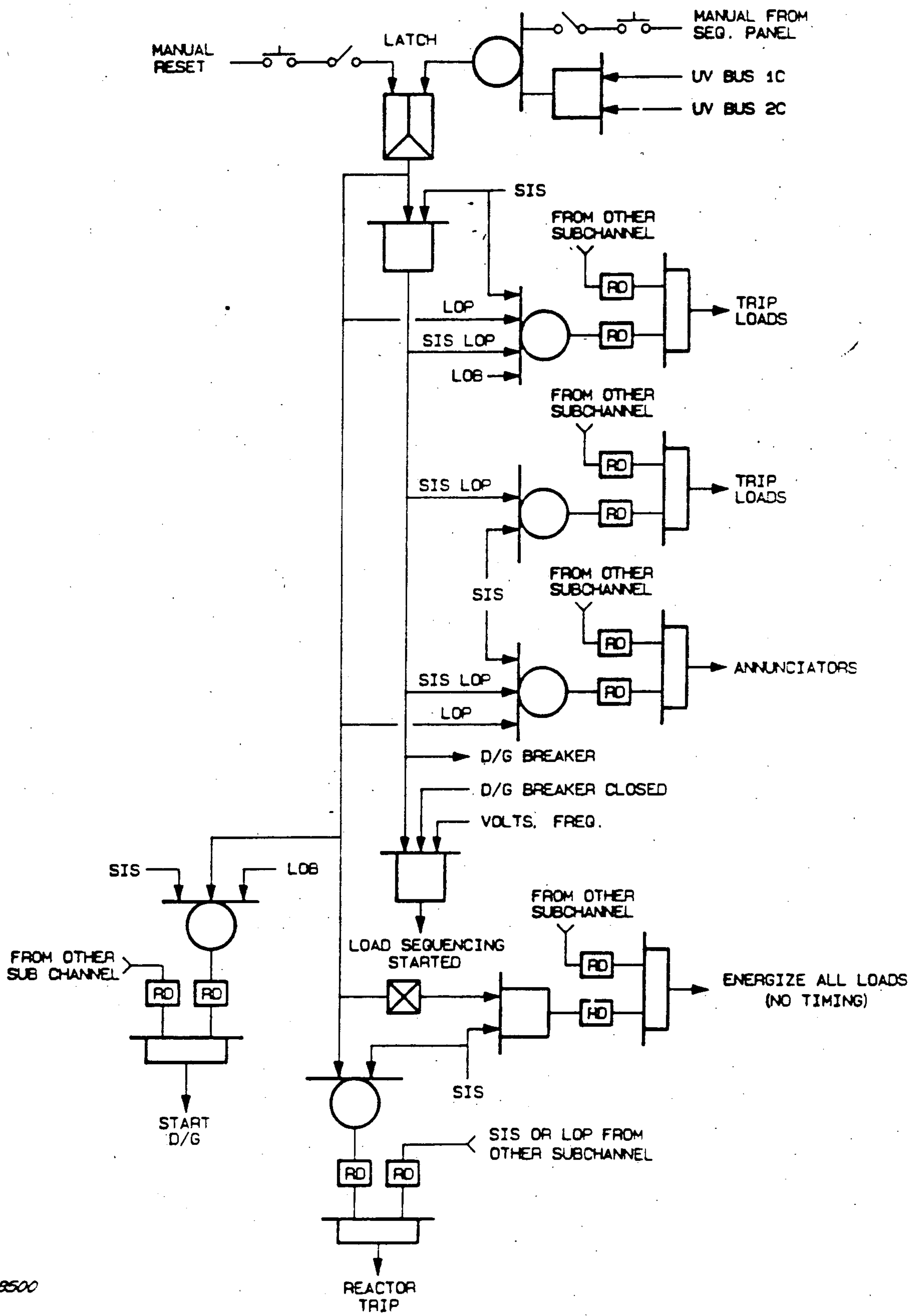


FIGURE 4: LOSS OF OFFSITE POWER (LOP)



A50538500

FIGURE 5: DIESEL GENERATOR (D/G)

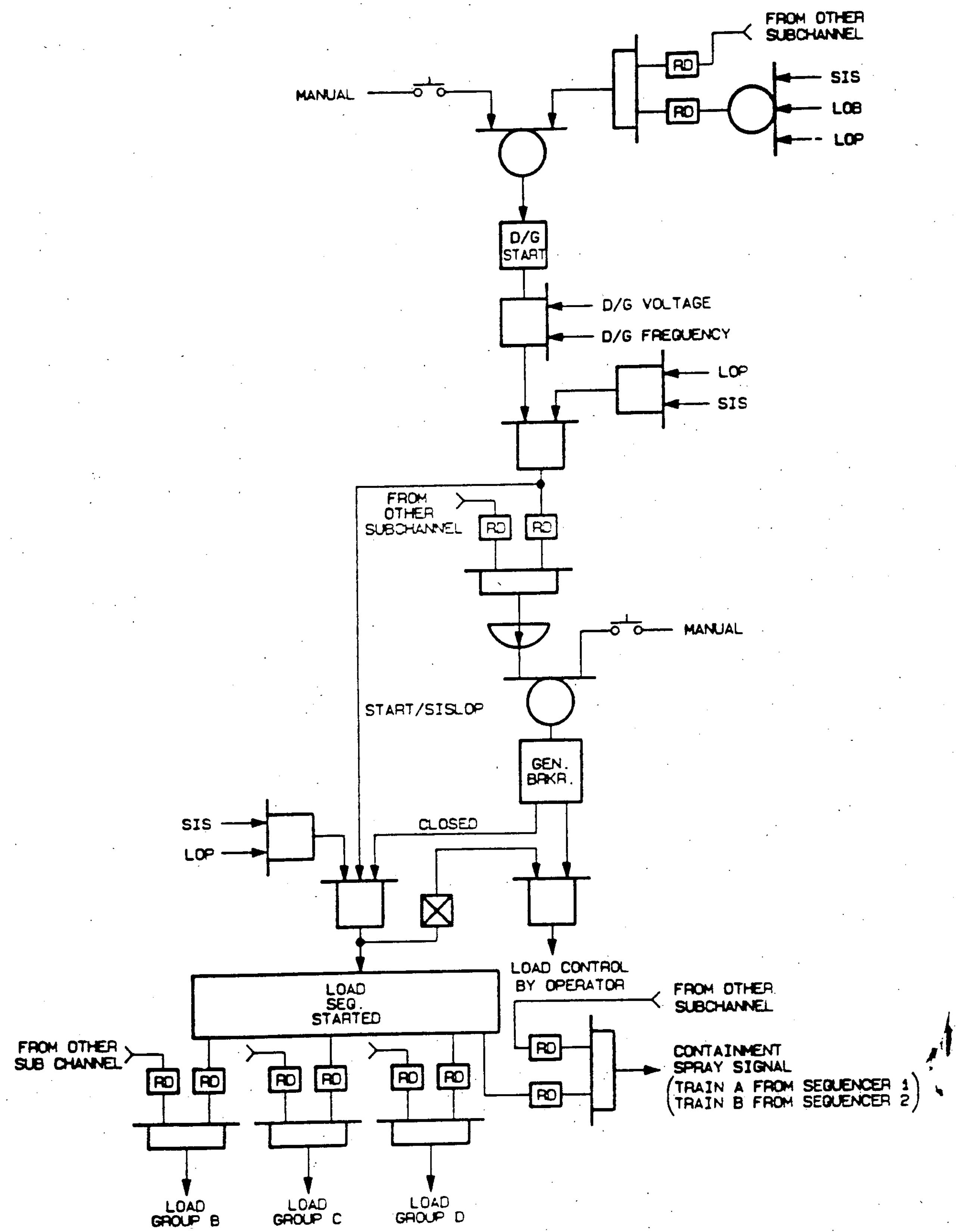


FIGURE 6: LOSS OF 4160 V BUS (LOB)

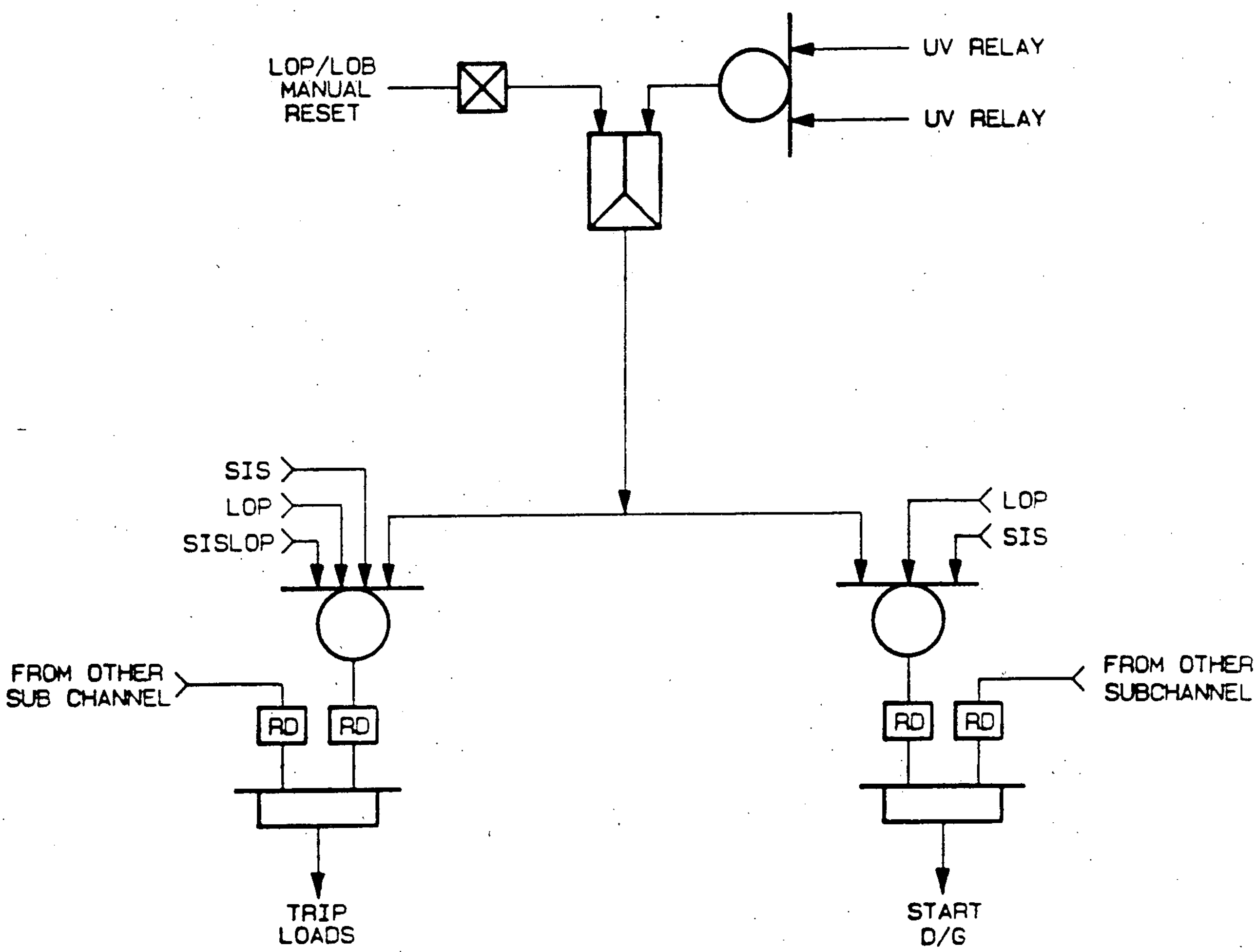


FIGURE 7: LOAD GROUP SEQUENCING

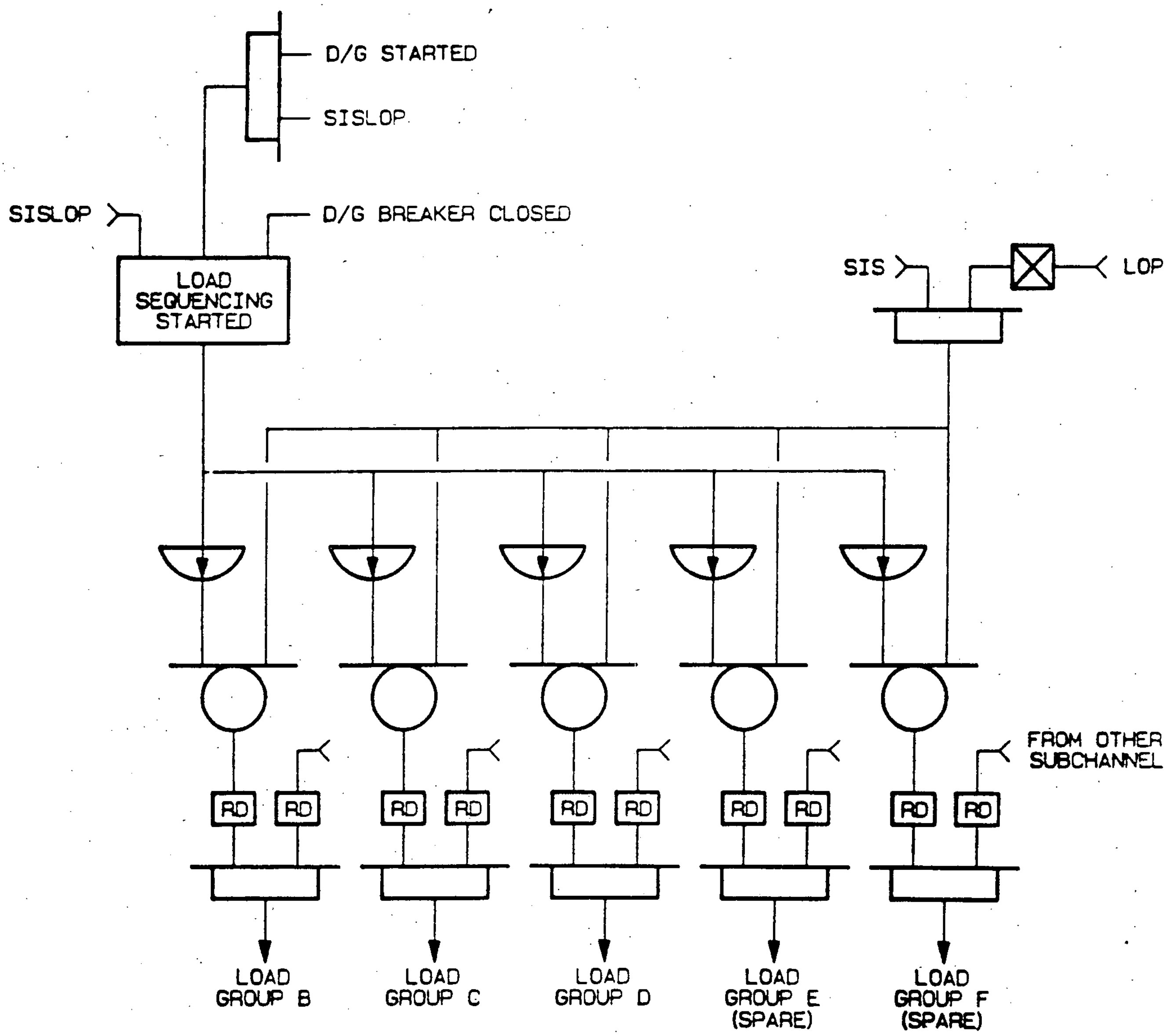


FIGURE 8: REMOTE SURVEILLANCE PANEL

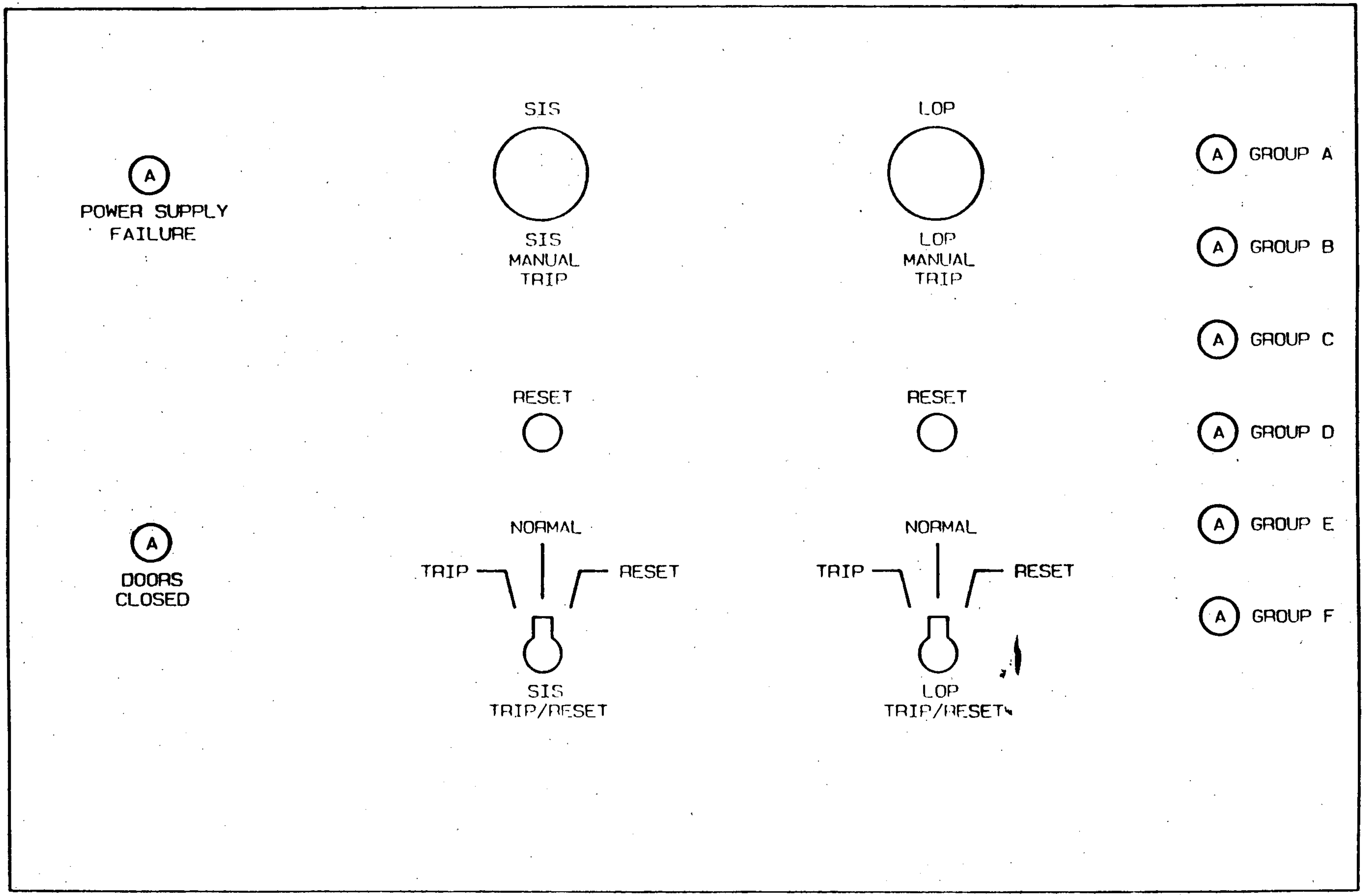


FIGURE 9: SEQUENCER TEST PANEL

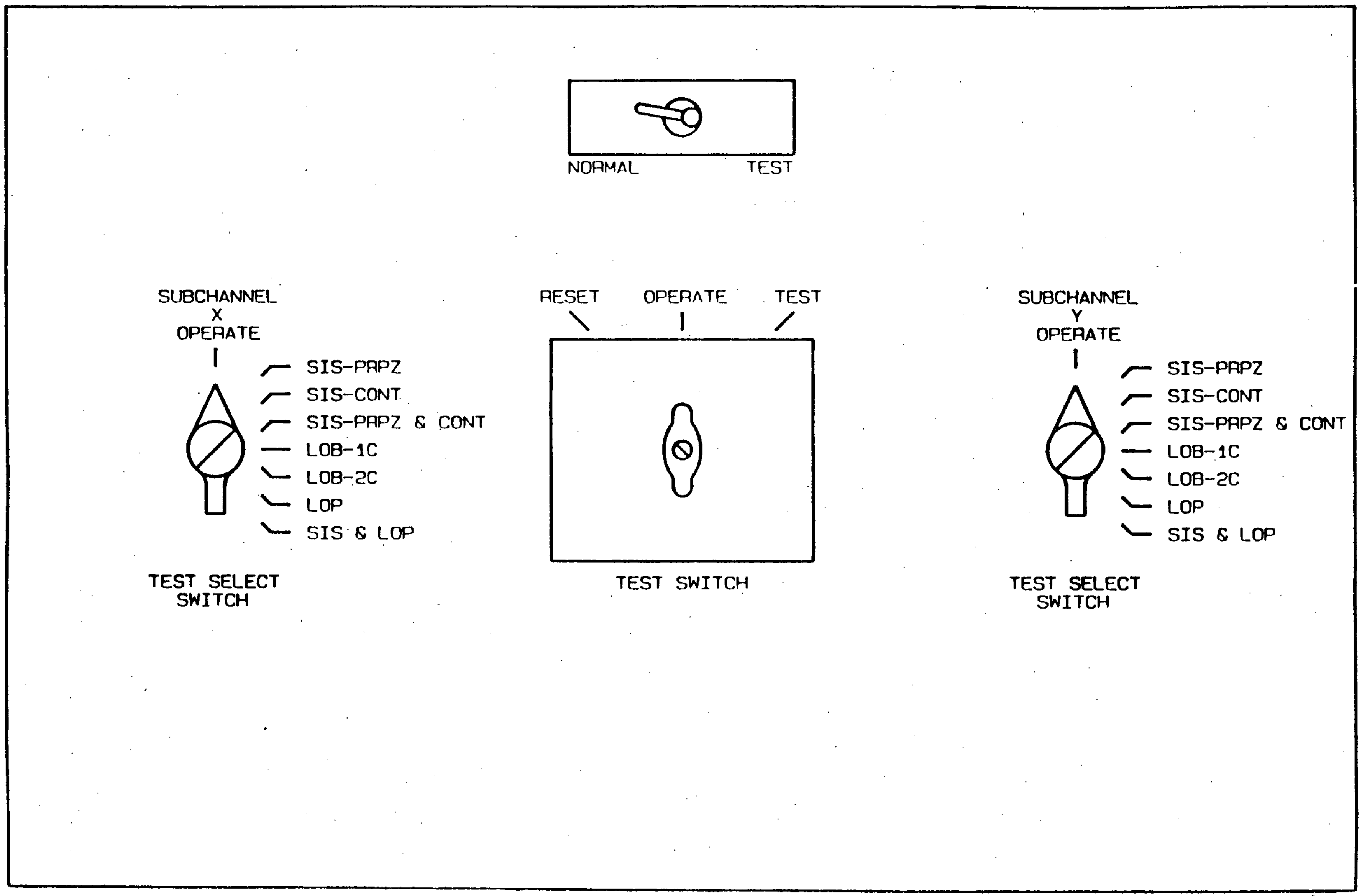
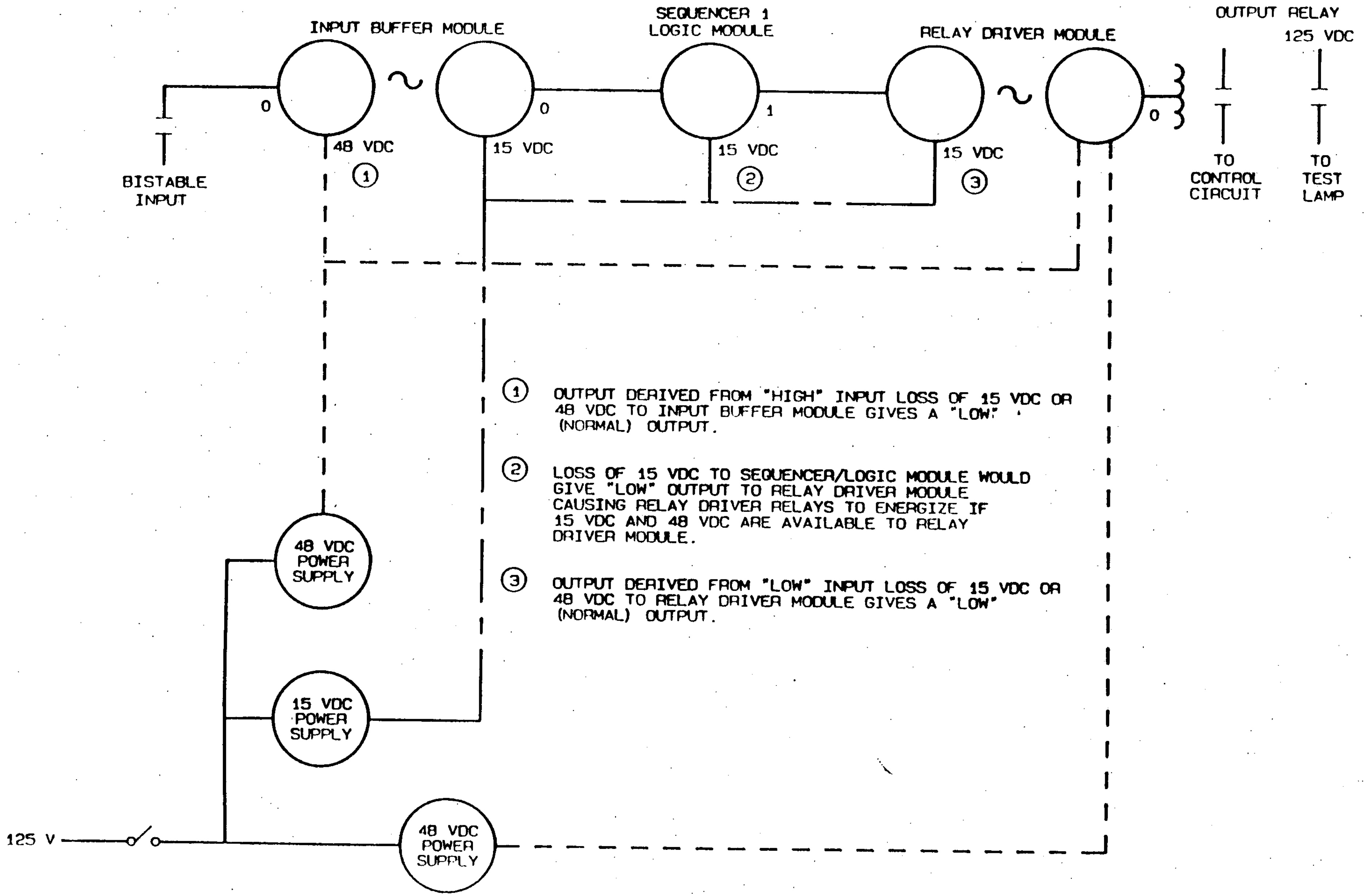


FIGURE 10: SEQUENCER POWER SUPPLY CIRCUITS



A50639000

MAIN FEEDWATER ISOLATION REFERENCES

Piping and Instrumentation Diagrams

5178201	Condensate System
5178205	Main Feedwater System
5178211	First, Second and Third Point Feedwater Htrs.
5178213	First, Second and Third Point Feedwater Htrs.

One Line Diagrams

5146828	Main One Line

Elementary Diagrams

455379	MOV-20, MOV-21, MOV-22
449408	FCV-456, CV-142 Solenoid Valves
5149858	Main Feedwater Pumps
5149918	Heater Drain Pumps
5149970	Condensate Pumps
5150874	Safeguards Sequencer #1
5150875	Safeguards Sequencer #2
5202910	FCV-457, FCV-458, CV-143, CV-144 Solenoid Valves

Other Documents

SD-S01-120	System Description: 4160 V System
SD-S01-210	System Description: Heater Vents and Drains
SD-S01-220	System Description: Condensate and Feedwater
SD-S01-260	System Description: Feedwater Control System
SD-S01-590	System Description: Safeguard Load Sequencing

AUXILIARY FEEDWATER /REACTOR PROTECTION SYSTEM REFERENCES

Piping and Instrumentation Diagrams

5178206	Main Feedwater System
5178220	Auxiliary Feedwater System
5178221	Auxiliary Feedwater System
5178222	Auxiliary Feedwater System
5178223	Auxiliary Feedwater System
5178225	Main Steam System
5178260	Feedwater Sampling System

One Line Diagrams

5146828	Main One Line

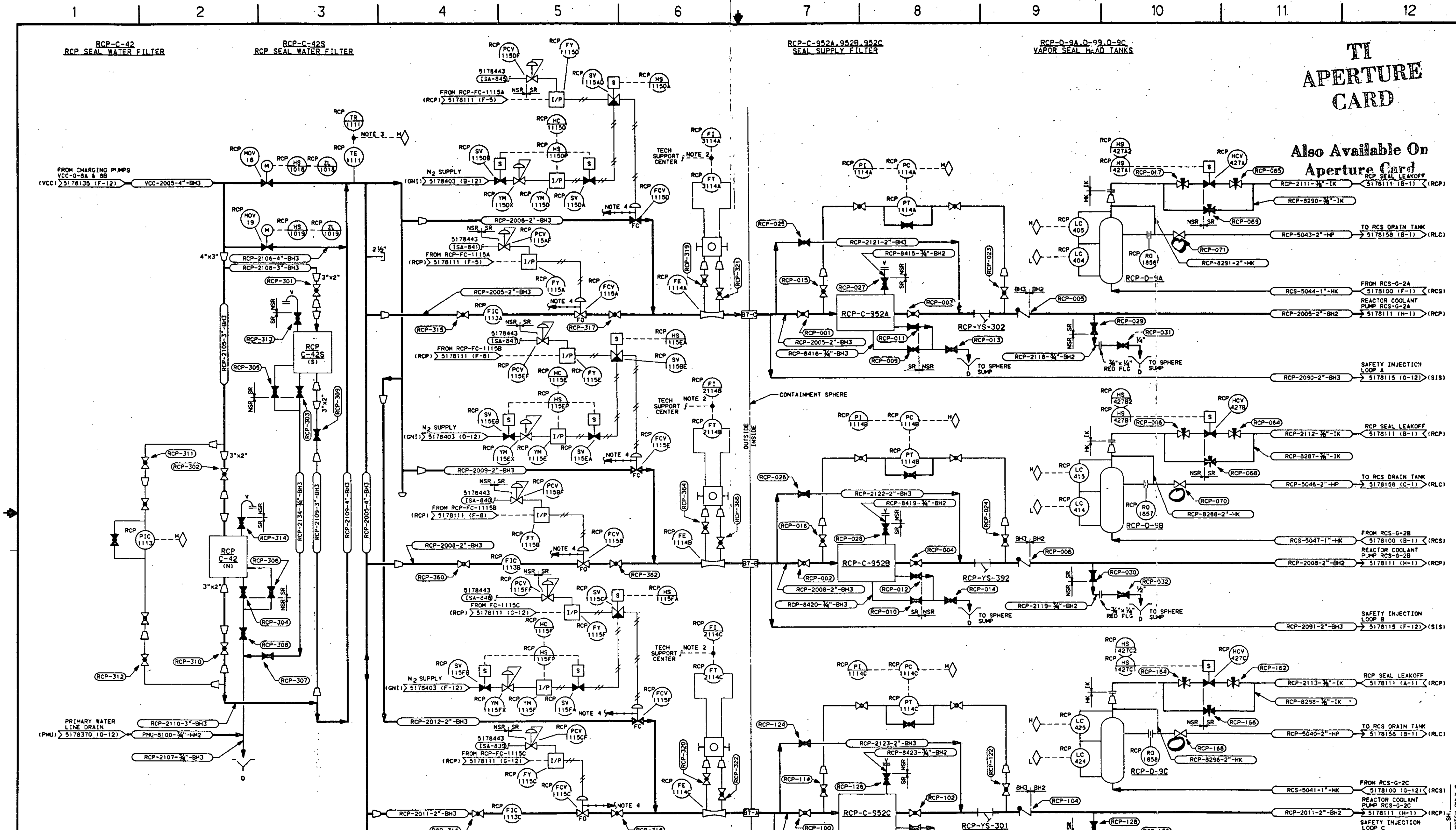
Elementary Diagrams

5151027	Auxiliary Feedwater Pump G-10W and CV-3110
5159558	Auxiliary Feedwater System Auto Initiation
5159559	MOV-1204
5159757	Steam and Blowdown Sample Isolation Valves
5159794	Auxiliary Feedwater Pump G-10 and Valves
5159841	MOV-1202
5159842	AFWAS Initiation - Train A
5159843	AFWAS Initiation - Train B
5180611	Auxiliary Feedwater Pump G-10S and MOV-1202

(See RPS Single Failure Analysis M39405 for elementary and loop diagrams applicable to the Steam/Feedwater Flow Mismatch Trip)

Other Documents

SD-S01-620	System Description: Auxiliary Feedwater System



NOTES:

1. SEE DWG 5178111 FOR SH 2.
2. SEE DWG 451410 FOR CONTROL DETAILS.
3. SEE DWG 63719 FOR CONTROL DETAILS.
4. SEE DWG 5178700 FOR STEM LEAKOFF DRAINS
5. THIS DRAWING SUPERSEDES DRAWINGS 568767 & 5130356 AND ALL CCN'S WHICH PERTAIN TO THEM.

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

5178000	P & I DIAGRAM LEGEND SH 1	456246	ELEM DIAGRAM - SEAL WATER SUPPLY CONTROL
5178001	P & I DIAGRAM LEGEND SH 2		BYPASS VALVE
5178002	P & I DIAGRAM LEGEND SH 3	5153166	CONTAINMENT SPRAY & SIS RECIRCULATION
63719	ELEM DIAG-CHEM & VOLUME CONTROL SYSTEM		SYSTEM FLOW DIAGRAM
451410	LOOP DIAG-RECIRC SI FLOW TSC SYSTEM		
455371	ELEM DIAGRAM - MOV'S 18 & 19		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
2	AS BUILT-INCORP DCN #2		4/15/87							GAC	3831
1	AS BUILT-INCORP DCN #1			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
REACTOR COOLANT PUMP
SEAL WATER SYSTEM SH 1

Southern California Edison

RCP

SHEET NO. M

SCALE: NONE

____ OF ____ SHTS.

DWG. LIST
• REVISE ON CADD SYSTEM ONLY •

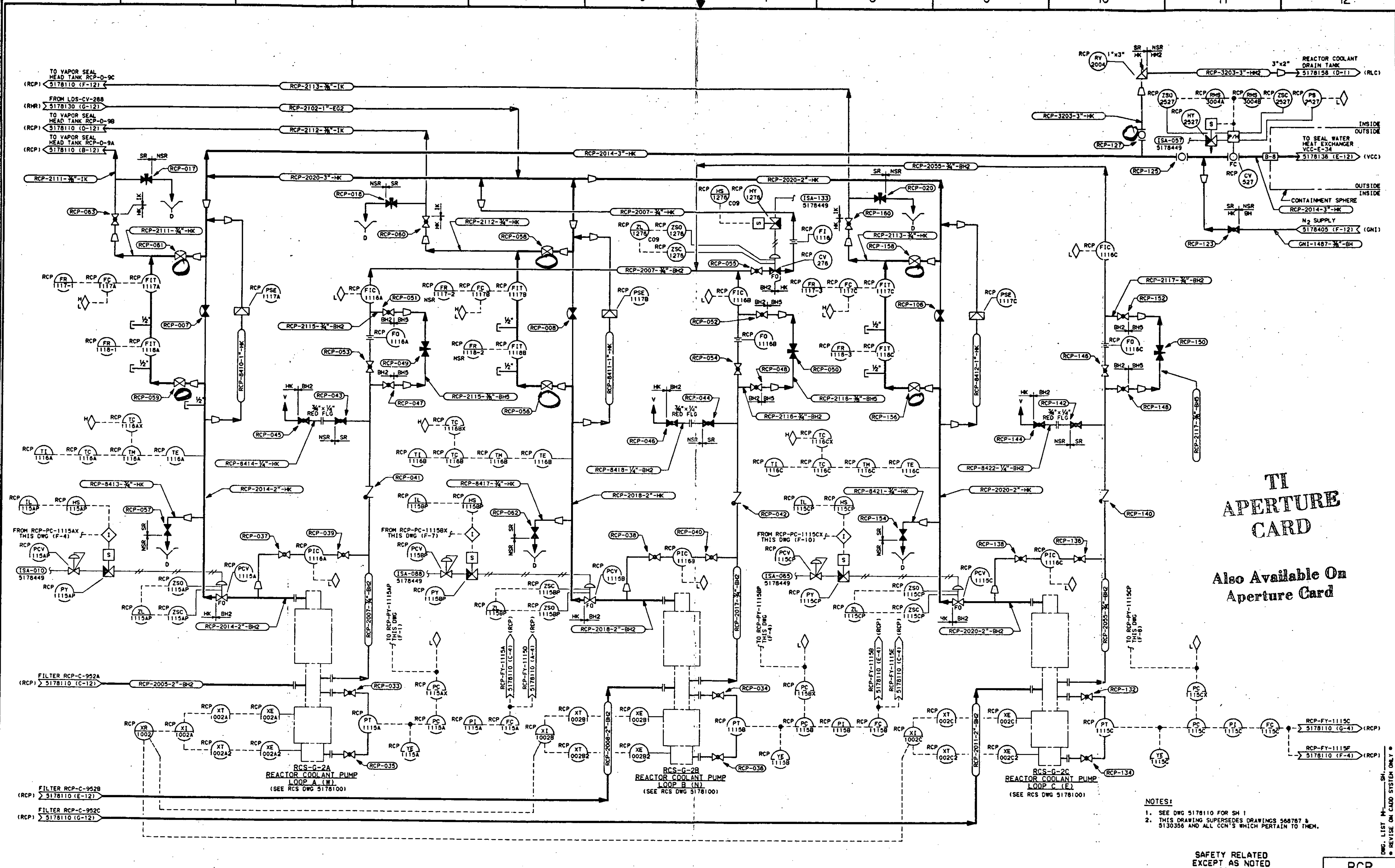
06-11-87 CASTRO

E4-652-CADD 03-87

568767

8711100274-44

5178110-2



TI APERTURE CARD

Also Available On Aperture Card

NOTES:

1. SEE DWG 5178110 FOR SH 1
2. THIS DRAWING SUPERSEDES DRAWINGS 568787 & 5130356 AND ALL CCN'S WHICH PERTAIN TO THEM.

SAFETY RELATED EXCEPT AS NOTED (SREAN) WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1	236710	CONTROL LOGIC DIAGRAM
5178001	P & I DIAGRAM LEGEND SH 2	236711	CONTROL LOGIC DIAGRAM
5178002	P & I DIAGRAM LEGEND SH 3	83719	CHEMICAL AND VOLUME CONTROL SYSTEM
455448	ELEM DIAGRAM-CONTROL VALVES	64350	ELEM DIAGRAM-CV-517, CV-525 & CV-527
455461	ELEM DIAGRAM-PCV'S 1115A, 1115B & 1115C		
64362	ELEM DIAGRAM-CV-525 & CV-527		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
9	AS BUILT-INCORP DCN #9		6/11/87							GAC	3831
8	AS BUILT-INCORP DCN #8			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
7	AS BUILT-INCORP DCN #7			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
6	AS BUILT-INCORP DCN #6			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
5	AS BUILT-INCORP DCN #5			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
4	AS BUILT-INCORP DCN #4			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #3			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
2	AS BUILT-INCORP DCN #2			SEE	CDM	FILES	FOR SIGNATURES			BLS	6881
1	AS BUILT-INCORP DCN #1			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM REACTOR COOLANT PUMP SEAL WATER SYSTEM SH 2

Southern California Edison

RCP

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

06-11-87 CASTRO

DWG. LIST M-___ SH.___

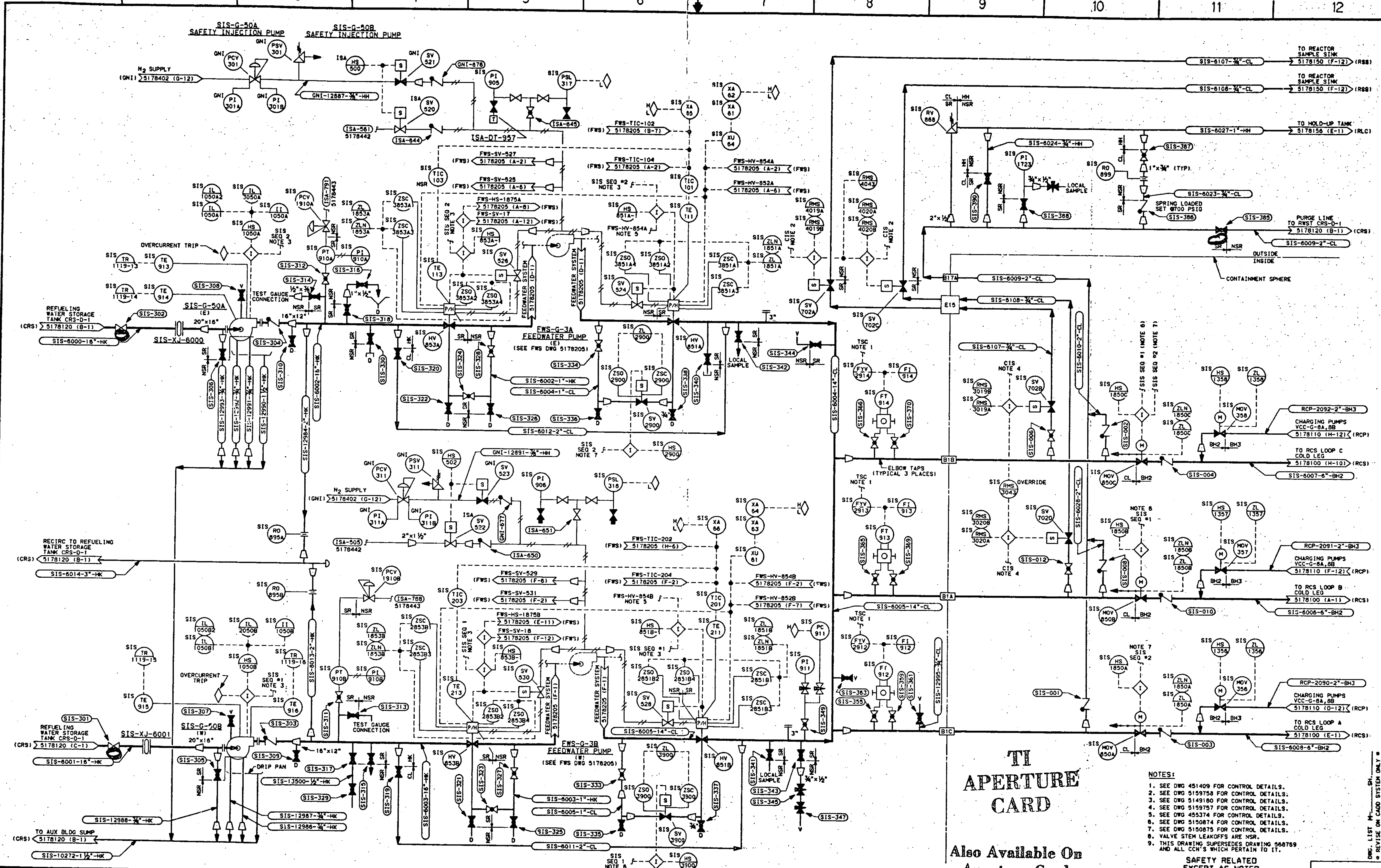
• REVISE ON CADD SYSTEM ONLY •

E4-632-CADD 03-85

5130356

8711100274-45

5178111-9



TI
APERTURE
CARD

Also Available On
Aperture Card

NOTES:

1. SEE DWG 451409 FOR CONTROL DETAILS.
2. SEE DWG 5159758 FOR CONTROL DETAILS.
3. SEE DWG 5149180 FOR CONTROL DETAILS.
4. SEE DWG 5159757 FOR CONTROL DETAILS.
5. SEE DWG 455374 FOR CONTROL DETAILS.
6. SEE DWG 5150874 FOR CONTROL DETAILS.
7. SEE DWG 5150875 FOR CONTROL DETAILS.
8. VALVE STEM LEAKOFFS ARE NSR.
9. THIS DRAWING SUPERSEDES DRAWING 568789 AND ALL CCN'S WHICH PERTAIN TO IT.

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-297

DWG. LIST M- SH.
* REVISE ON CADD SYSTEM ONLY *

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
455368	ELEM DIAG MOV-850A & MOV-850B
455516	ELEM DIAG MOV-850C
455371	ELEM DIAG MOV-356,357 & 358
REFERENCE DRAWINGS	

455370	ELEM DIAG G-50A & G-50B
455373	ELEM DIAG HV-851A & HV-851B
5159757	ELEM DIAG SY-702B & 702D
455372	ELEM DIAG HV-853A & HV-853B
451409	LOGIC DIAG SIS FLOW INDICATION
5149180	SEQUENCE SCHEDULE NO 1
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
7	AS BUILT-INCORP DCN #10		3/11/87							QAC	3831
6	AS BUILT-INCORP DCN #8 & #9			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
5	AS BUILT-INCORP DCN #7			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
4	AS BUILT-INCORP DCN #4 & #6 (DCN #5 NEVER USED)			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #3			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
2	AS BUILT-INCORP DCN #2			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
1	AS BUILT-INCORP DCN #1			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
SAFETY INJECTION
SYSTEM

Southern California Edison

SIS

SHEET NO.
M

SCALE: NONE

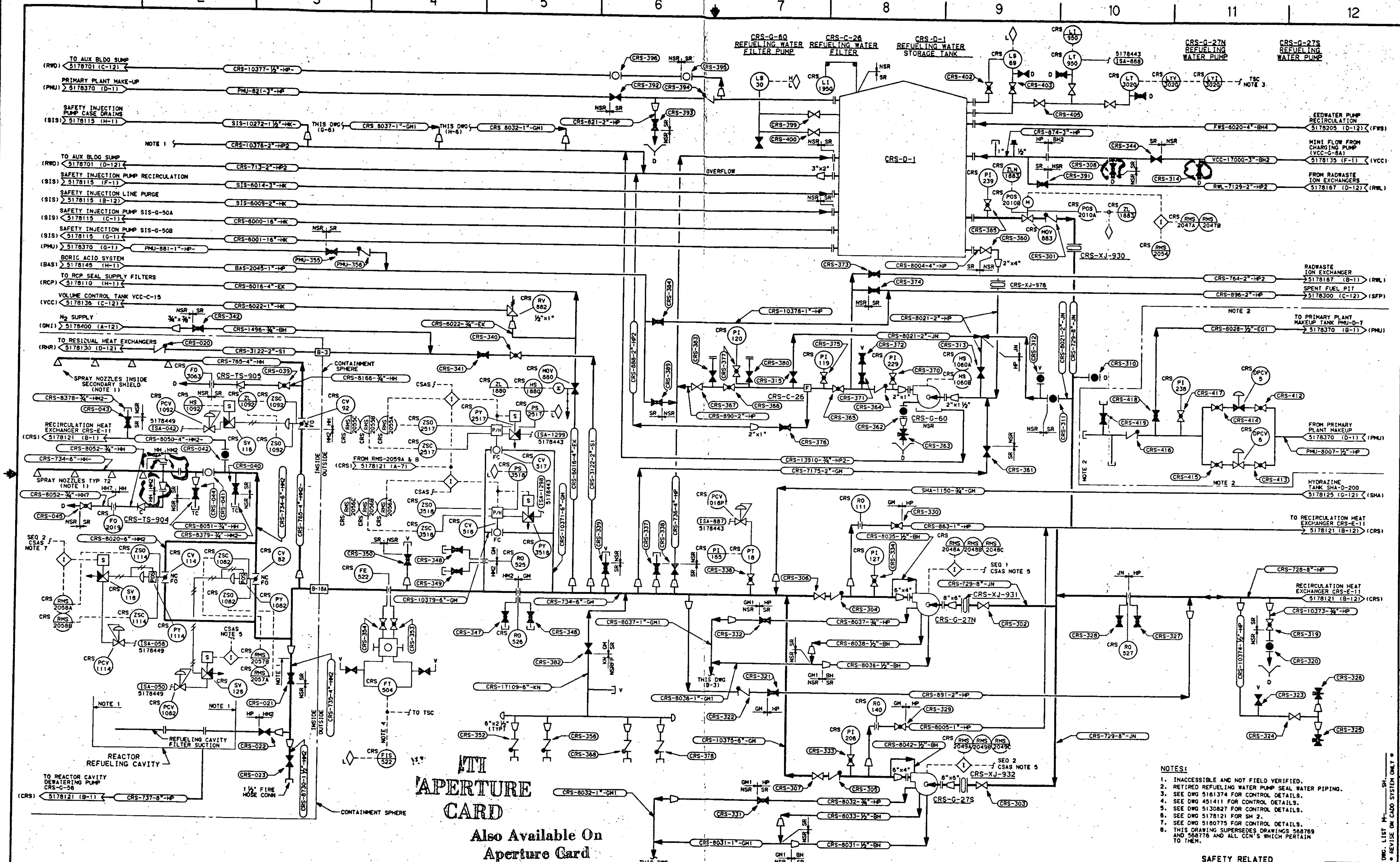
OF SHTS.

06-16-87
CASTRO

E4-632-CADD 03-68

8711100274-46 568789

5178115-7



NOTES:

1. INACCESSIBLE ANC NOT FIELD VERIFIED.
2. RETIRED REFUELING WATER PUMP SEAL WATER PIPING.
3. SEE DWG 5161374 FOR CONTROL DETAILS.
4. SEE DWG 451411 FOR CONTROL DETAILS.
5. SEE DWG 5130827 FOR CONTROL DETAILS.
6. SEE DWG 5178121 FOR SH 2.
7. SEE DWG 5180775 FOR CONTROL DETAILS.
8. THIS DRAWING SUPERSEDES DRAWINGS 568789 AND 568776 AND ALL CCN'S WHICH PERTAIN TO THEM.

ATI APERTURE CARD

Also Available On Aperture Card

SAFETY RELATED EXCEPT AS NOTED (SREAN)

WP 82-297

5178000	P&I DIAGRAM LEGEND SH 1
5178001	P&I DIAGRAM LEGEND SH 2
5178002	P&I DIAGRAM LEGEND SH 3
64356	ELEM DIAGRAM - CV 82 & 114
64374	ELEM DIAGRAM - MOV 833
455371	ELEM DIAGRAM - MOV 880
REFERENCE DRAWINGS	

455693	ELEM DIAGRAM - CV 92
5153166	CONTAINMENT SPRAY & SIS RECIRCULATION SYSTEM FLOW DIAGRAM
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
10	AS BUILT-INCORP DCN #20 & #21		12/87						AR	GAC	3831
9	AS BUILT-INCORP DCN #19			SEE	COM	FILES	FOR SIGNATURES			GAC	3831
8	AS BUILT-INCORP DCN #18			SEE	COM	FILES	FOR SIGNATURES			BLS	3083
7	AS BUILT-INCORP DCN #13 THRU #17 & MINOR CHGS			SEE	COM	FILES	FOR SIGNATURES			BLS	3083
6	AS BUILT-INCORP DCN #10,11 & 12			SEE	COM	FILES	FOR SIGNATURES			DVY	3083

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
5	AS BUILT-INCORP DCN #9 & MINOR CHANGES			SEE	COM	FILES	FOR SIGNATURES			DVY	3083
4	AS BUILT-INCORP DCN #7 & #8			SEE	COM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #6			SEE	COM	FILES	FOR SIGNATURES			DVY	3083
2	AS BUILT-INCORP CC#1,#2,DCN#4 & #5			SEE	COM	FILES	FOR SIGNATURES			DVY	8881
1	AS BUILT-INCORP DCN #3			SEE	COM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	COM	FILES	FOR SIGNATURES			BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
CONTAINMENT SPRAY &
RECIRCULATION SYSTEM SH 1

Southern California Edison

CRS

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

DWG. LIST M-___ SH.___

• REVISE ON CADD SYSTEM ONLY •

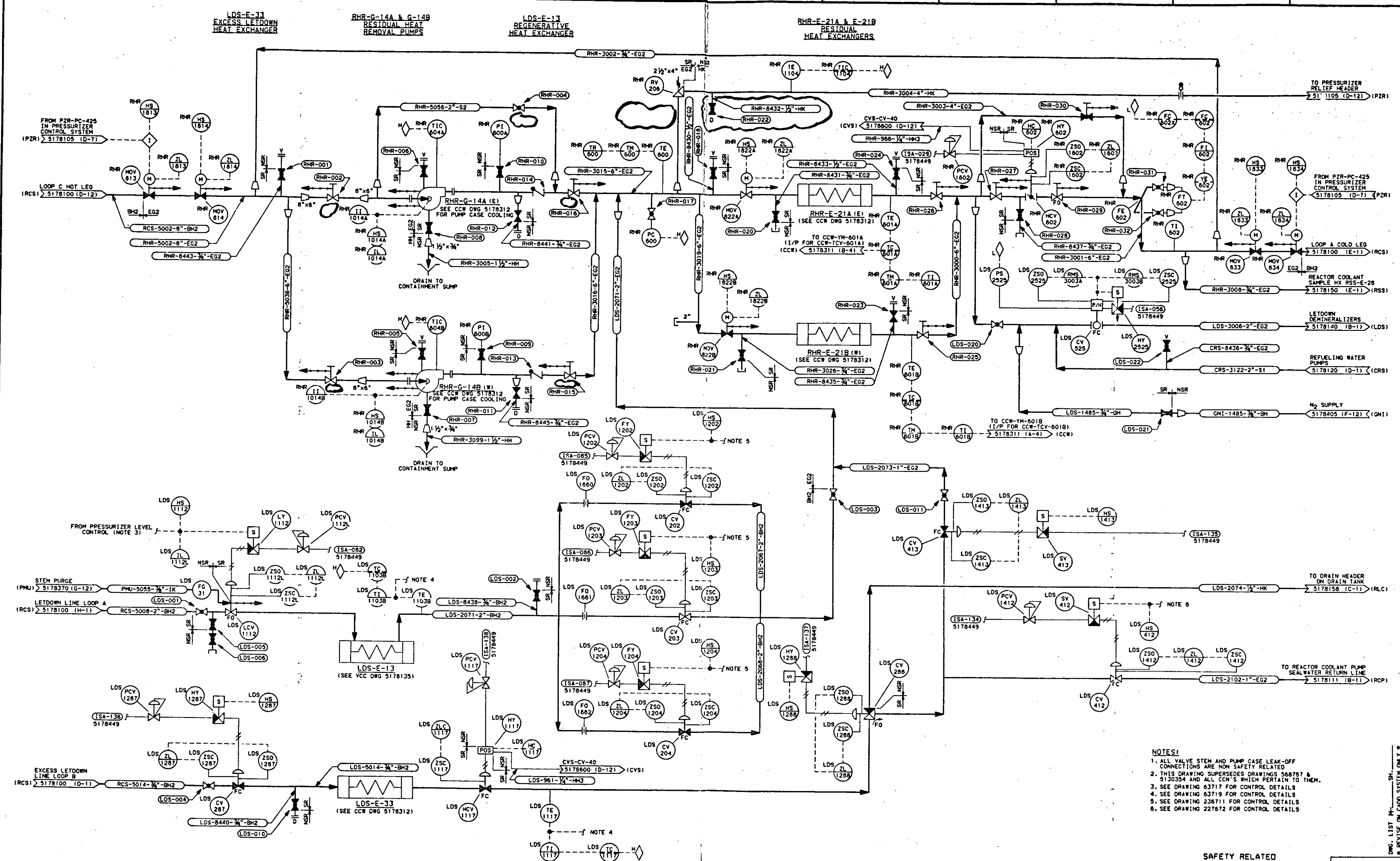
06-24-87 CASTRO

E4-862-CADD 03-86

568789
568776

8711100274-47

5178120-10



NOTES:

1. ALL VALVE STEM AND PUMP CASE LEAK-OFF CONNECTIONS ARE NON SAFETY RELATED
2. THIS DRAWING SUPERSEDES DRAWINGS 568767 & 5130354 AND ALL CCN'S WHICH PERTAIN TO THEM.
3. SEE DRAWING 63717 FOR CONTROL DETAILS
4. SEE DRAWING 63719 FOR CONTROL DETAILS
5. SEE DRAWING 236711 FOR CONTROL DETAILS
6. SEE DRAWING 227672 FOR CONTROL DETAILS

DWG. LIST M-____ SH.____
• REVISE ON CADD SYSTEM ONLY •

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-297

RHR

REFERENCE DRAWINGS		REFERENCE DRAWINGS	
5178000	P & I DIAGRAM LEGEND SH 1	5150336	ELEM DIAGRAM-RHR PUMPS
5178001	P & I DIAGRAM LEGEND SH 2	455452	ELEM DIAGRAM-LCV-1112
5178002	P & I DIAGRAM LEGEND SH 3	5153166	CONTAINMENT SPRAY & SIS RECIRCULATION
455448	ELEM DIAGRAM-LETDOWN CV'S		SYSTEM FLOW DIAGRAM
455438	ELEM DIAGRAM-HX E-33 STOP VALVES		
5151796	ELEM DIAGRAM-RHR MOV'S		

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
7	AS BUILT-INCORP DCN #11 & MINOR CHANGES		1/5/87							GAC	3831
6	AS BUILT-INCORP DCN #10	—		SEE	COM	FILES	FOR SIGNATURES			DVY	3083
5	AS BUILT-INCORP DCN #9			SEE	COM	FILES	FOR SIGNATURES			DVY	3083
4	AS BUILT-INCORP DCN #8 & MINOR CHANGES			SEE	COM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #5, #6 & #7			SEE	COM	FILES	FOR SIGNATURES			BLS	8881
2	AS BUILT-INCORP DCN #4			SEE	COM	FILES	FOR SIGNATURES			BLS	8744
1	AS BUILT-INCORP DCN #2 & #3-CC#1 CANCELED			SEE	COM	FILES	FOR SIGNATURES			DVY	8744
0	ISSUED AS BUILT			SEE	COM	FILES	FOR SIGNATURES			BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
LETDOWN & RESIDUAL
HEAT REMOVAL SYSTEMS

Southern California Edison

SHEET NO.
M

SCALE: NONE
____ OF ____ SHTS.

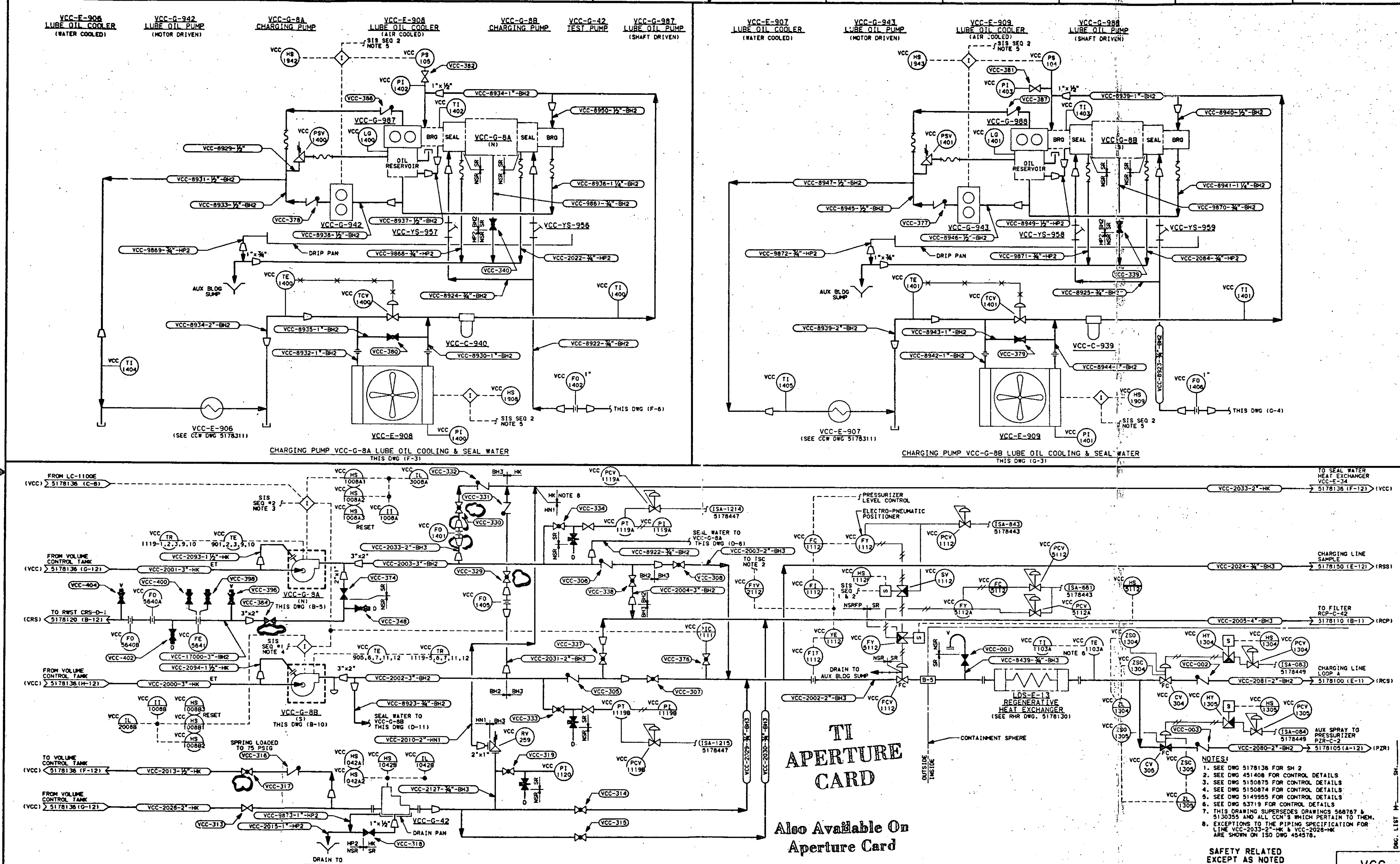
01-27-87

E4-632-CADD 03-86

568767

8711100274-42

5178130-7



NOTES:

1. SEE DWG 5178136 FOR SH 2
2. SEE DWG 451408 FOR CONTROL DETAILS
3. SEE DWG 5150875 FOR CONTROL DETAILS
4. SEE DWG 5150874 FOR CONTROL DETAILS
5. SEE DWG 5149955 FOR CONTROL DETAILS
6. SEE DWG 63719 FOR CONTROL DETAILS
7. THIS DRAWING SUPERSEDES DRAWINGS 568767 & 5130355 AND ALL CCN'S WHICH PERTAIN TO THEM.
8. EXCEPTIONS TO THE PIPING SPECIFICATION FOR LINE VCC-2033-2"-HK & VCC-2026-HK ARE SHOWN ON ISO DWG 454578.

DWG. LIST M- SH.

* REVISE ON CADD SYSTEM ONLY *

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-297

VCC

REFERENCE DRAWINGS		REFERENCE DRAWINGS	
5178000	P & I DIAGRAM LEGEND SH 1	236711	LOGIC DIAGRAM-CV-305
5178001	P & I DIAGRAM LEGEND SH 2	451408	LOOP DIAGRAM-CHARGING LINE FLOW
5178002	P & I DIAGRAM LEGEND SH 3	5150626	ELEM DIAGRAM-CHARGING PUMPS & LUBE OIL PUMPS
5150337	ELEM DIAGRAM-TEST PUMP G-42		
5149181	LOAD SEQUENCE SCHEDULE	455510	ELEM DIAGRAM-LUBE OIL COOLERS
455448	ELEM DIAGRAM-CV-305	5153166	CONT SPRAY & SIS RECIRC SYS FLOW DIAGRAM

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
9	AS BUILT-INCORP DCN #19,20 & MINOR CHNG.		11-14						AR	GAC	3831
8	AS BUILT-INCORP DCN #18			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
7	AS BUILT-INCORP DCN #15,16 & 17			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
6	AS BUILT-INCORP DCN #12,13 & 14			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
5	AS BUILT-INCORP DCN #7,8,9,10 & 11			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
4	AS BUILT-INCORP DCN #6			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
3	AS BUILT-INCORP CC #2 & DCN #5			SEE	CDM	FILES	FOR SIGNATURES			BLS	8881
2	AS BUILT-INCORP DCN #4			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
1	AS BUILT-INCORP DCN #3-CC #1 CANCELED			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM VOLUME CONTROL AND CHARGING SYSTEM SH 1

Southern California Edison

SHEET NO. M

SCALE: NONE

____ OF ____ SHTS.

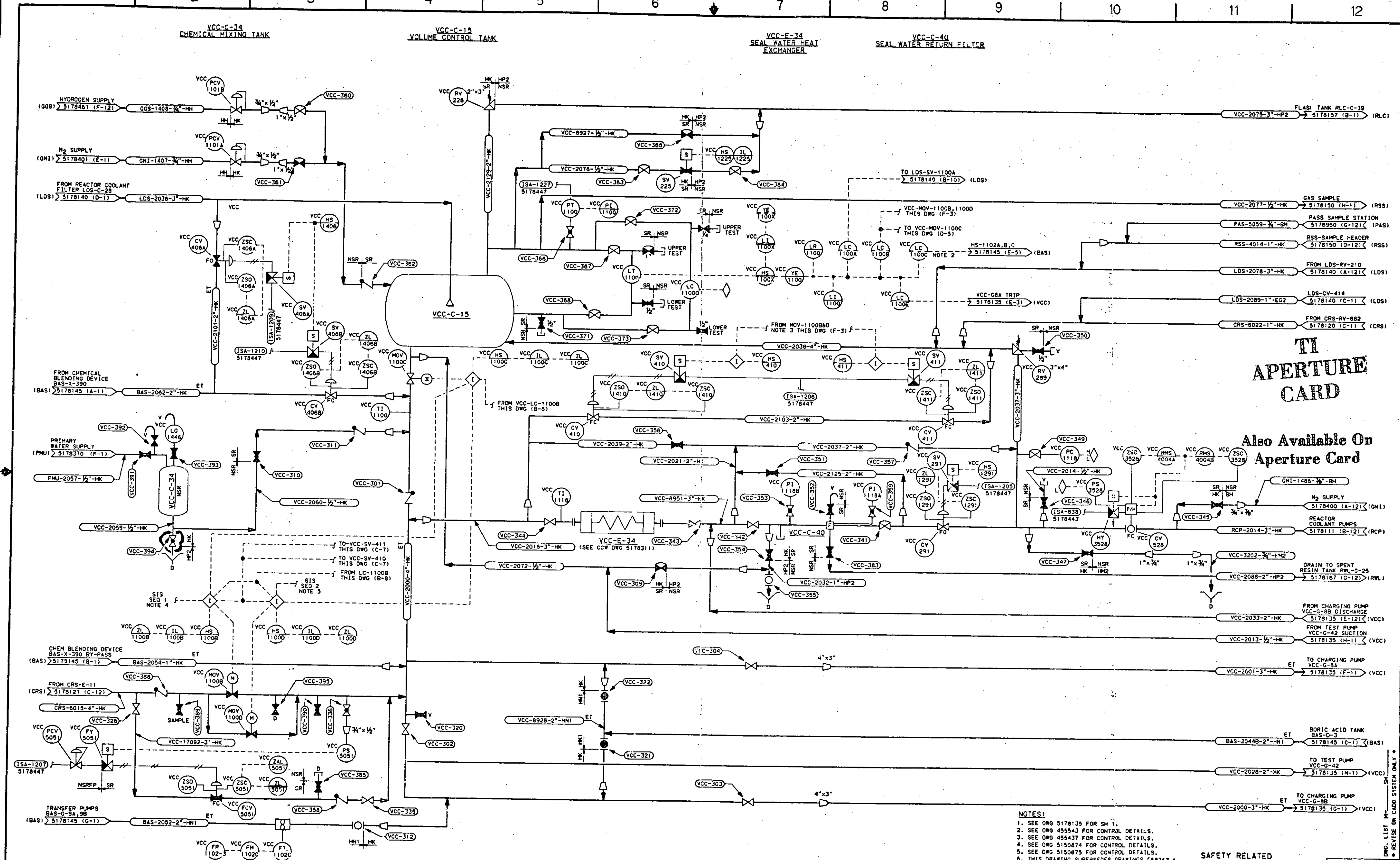
12-01-86

1-462-CADD 03-86

568767

8711100274-49

5178135-9



NOTES:
1. SEE DWG 5178135 FOR SH 1.
2. SEE DWG 455543 FOR CONTROL DETAILS.
3. SEE DWG 455437 FOR CONTROL DETAILS.
4. SEE DWG 5150874 FOR CONTROL DETAILS.
5. SEE DWG 5150875 FOR CONTROL DETAILS.
6. THIS DRAWING SUPERSEDES DRAWINGS 568767 & 5130355 AND ALL CCN'S WHICH PERTAIN TO THEM.

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
236710	CONTROL LOGIC DIAGRAM
457257	LOGIC DIAGRAM VOLUME CONTROL TANK
455369	ELEM DIAGRAM MOV-1100B & 1100D
REFERENCE DRAWINGS	

5151028	ELEM DIAGRAM MOV-1100C
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
8	AS BUILT-INCORP DCN #12 & MINOR CHANGE		3-3-87	4-8-87	[illegible]	[illegible]		[illegible]	AR	GAC	3831
7	AS BUILT-INCORP DCN #11 & MINOR CHANGES			SEE	CDM FILES		FOR SIGNATURES			GAC	3024
6	AS BUILT-INCORP DCN #10			SEE	CDM FILES		FOR SIGNATURES			DVY	3083
5	AS BUILT-INCORP DCN #7-#9 & MINOR CHNGS			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
4	AS BUILT-INCORP DCN #5,#6 & MINOR CHNGS			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
3	AS BUILT-INCORP DCN #4			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
2	AS BUILT-INCORP DCN #3 (DCN #2 NOT USED)			SEE	CDM	FILES	FOR SIGNATURES			BLS	8881
1	AS BUILT-INCORP DCN #1			SEE	CDM	FILES	FOR SIGNATURES			DVY	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
VOLUME CONTROL AND
CHARGING SYSTEM SH 2

Southern California Edison

VCC

SHEET NO.
M

SCALE: NONE

____ OF ____ SHTS.

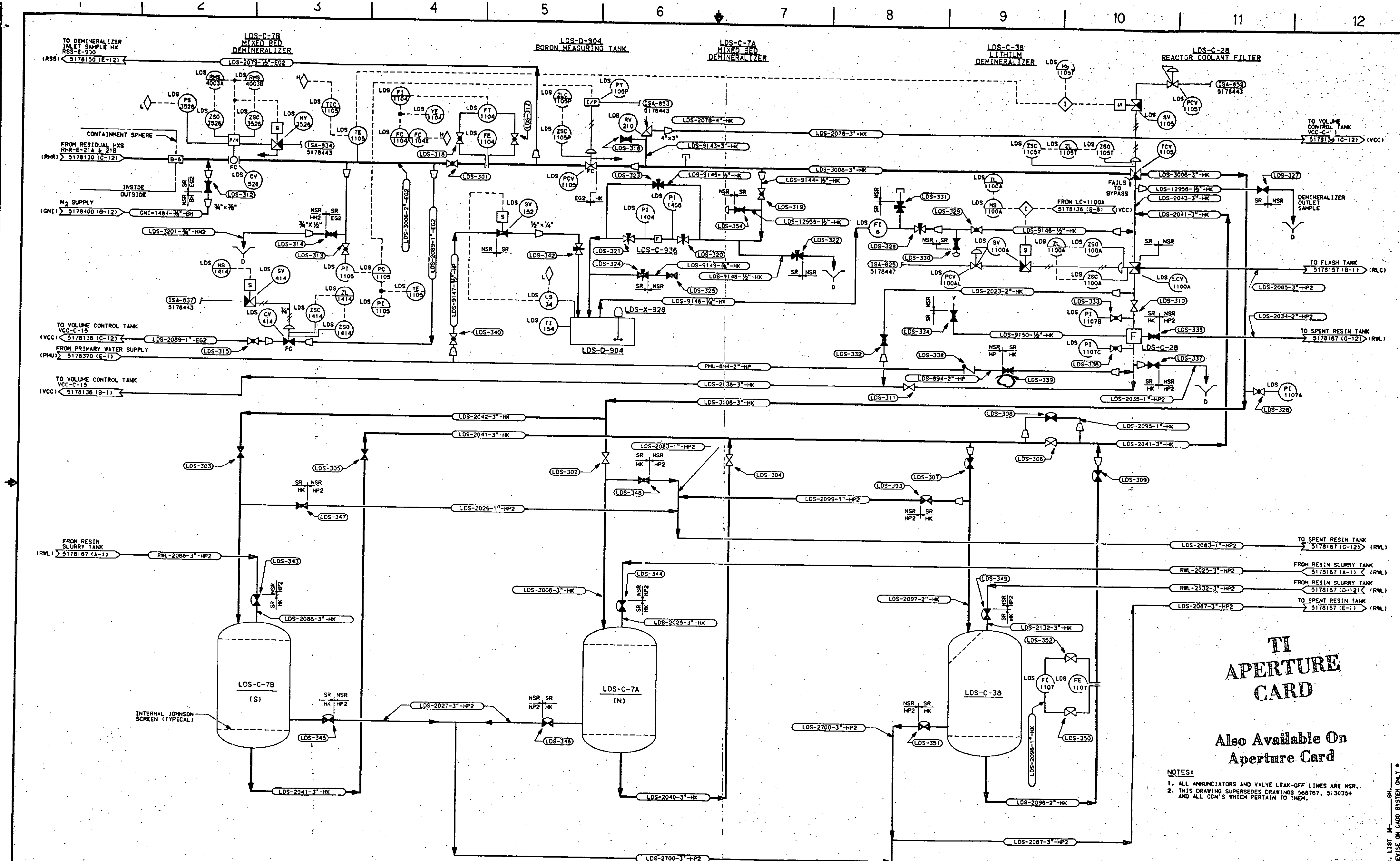
03-23-87

DWG. LIST M-____ SH.____
* REVISE ON CADD SYSTEM ONLY *

E4-652-CADD 03-85

568767

8711100274-56 5178136-8



NOTES:

1. ALL ANNUNCIATORS AND VALVE LEAK-OFF LINES ARE NSR.
2. THIS DRAWING SUPERSEDES DRAWINGS 568787, 5130354 AND ALL CCN'S WHICH PERTAIN TO THEM.

DWG. LIST M-____ SH.____
• REVISE ON CADD SYSTEM ONLY •

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1	63719	ELEM DIAGRAM-CVCS
5178001	P & I DIAGRAM LEGEND SH 2	64371	ELEM DIAGRAM-CV'S 516,526,528
5178002	P & I DIAGRAM LEGEND SH 3		
455448	ELEM DIAGRAM-CV-414		
455451	ELEM DIAGRAM-LCV-1100A		
455450	ELEM DIAGRAM-TCV-1105		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
4	AS BUILT-INCORP DCN #5		8/11/87						AR	GAC	3331
3	AS BUILT-INCORP DCN #3,#4 & MINOR CHG			SEE	CDM	FILES	FOR SIGNATURES			BLS	3063
2	AS BUILT-INCORP DCN #2			SEE	CDM	FILES	FOR SIGNATURES			DVY	6881
1	AS BUILT-INCORP DCN #1			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
LETDOWN
DEMINERALIZER SYSTEM

Southern California Edison

LDS

SHEET NO.
M

SCALE: NONE
____ OF ____ SHTS.

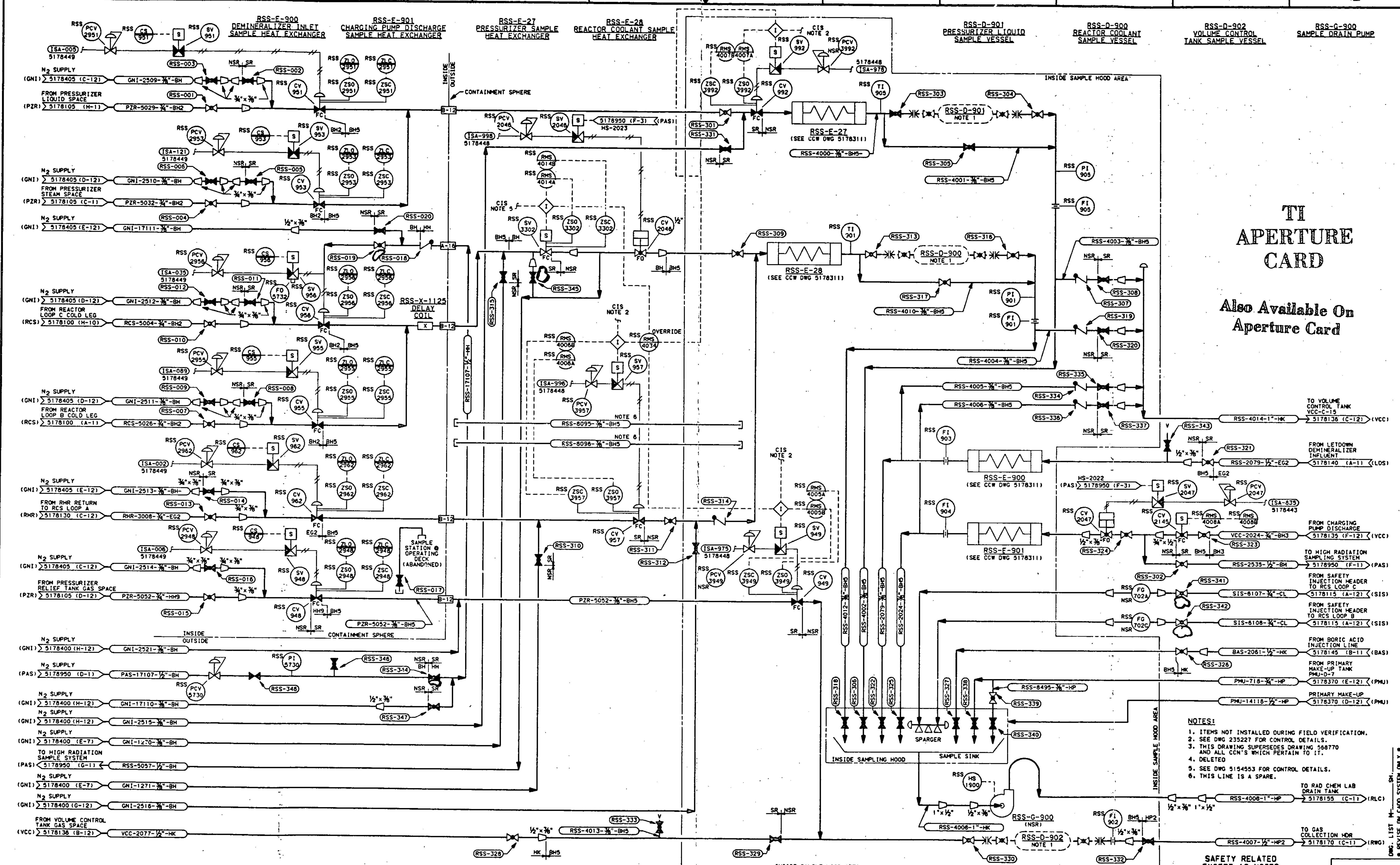
06-16-87
CASTRO

E4-652-CADD 03-86

568787

8711100274-51

5178140-4



5178000	P&I DIAGRAM LEGEND SH 1	5159887	ELEM DIAGRAM-PASS SOLENOID VALVES
5178001	P&I DIAGRAM LEGEND SH 2	5159802	ELEM DIAGRAM-PASS CONT ISO VALVES
5178002	P&I DIAGRAM LEGEND SH 3	5159781	ELEM DIAGRAM-CONT ISOLATION VALVES
5180605	ELEM DIAGRAM-CONT ISOLATION VALVES	235403	LOGIC DIAGRAM-CONT ISOLATION VALVES
5180714	ELEM DIAGRAM-VALVES CV-955 & CV-956		
5159756	ELEM DIAGRAM-VALVES CV-949 & CV-957		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
6	AS BUILT-INCORP DCN #14		6/15/87						AAR	GAC	3831
5	AS BUILT-INCORP DCN #12,13 & MINOR CHGS			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
4	AS BUILT-INCORP DCN #10 & #11			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
3	AS BUILT-INCORP CC #1,DCN #6,#7,#8,#9 & MINOR CHANGES			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
2	AS BUILT-INCORP DCN #3,#4 & #5			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
1	AS BUILT-INCORP DCN #2			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM REACTOR CYCLE SAMPLING SYSTEM

Southern California Edison

RSS

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

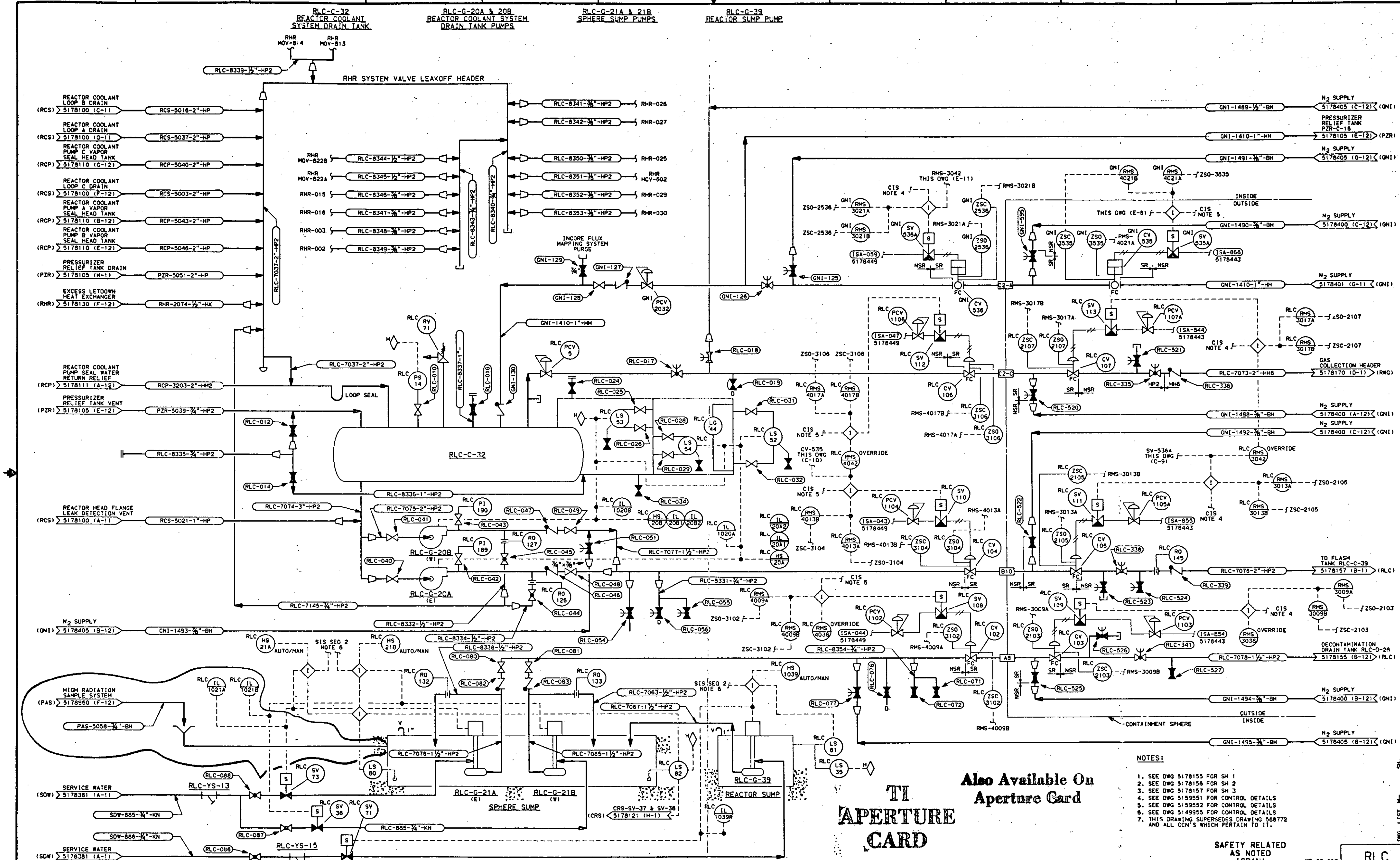
06-10-87 CASTRO

568770

E4-652-CADD 03-83

8711100274-52

5178150-6



5178000	P & I DIAGRAM LEGEND SH 1	5150344	ELEM DIAGRAM-SPHERE SUMP PUMPS
5178001	P & I DIAGRAM LEGEND SH 2	235232	LOGIC DIAGRAM-CV-536,CV-107 & CV-105
5178002	P & I DIAGRAM LEGEND SH 3	235226	LOGIC DIAGRAM-CV-104,CV-106 & CV-535
455501	ELEM DIAGRAM-RCS DRAIN TANK PUMPS	235222	LOGIC DIAGRAM-CV-102
5149890	ELEM DIAGRAM-VARIOUS CI VALVES	235408	LOGIC DIAGRAM-CV-103
5150334	ELEM DIAGRAM-PUMP G-39		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
3	AS BUILT-INCORP CC #1 & MINOR CHANGES									LAM	DVY 3083
2	AS BUILT-INCORP DCN #3 & MINOR CHANGES			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
1	AS BUILT-INCORP DCN #2			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
RADWASTE LIQUID
COLLECTION SYSTEM SH 4

Southern California Edison

RLC

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

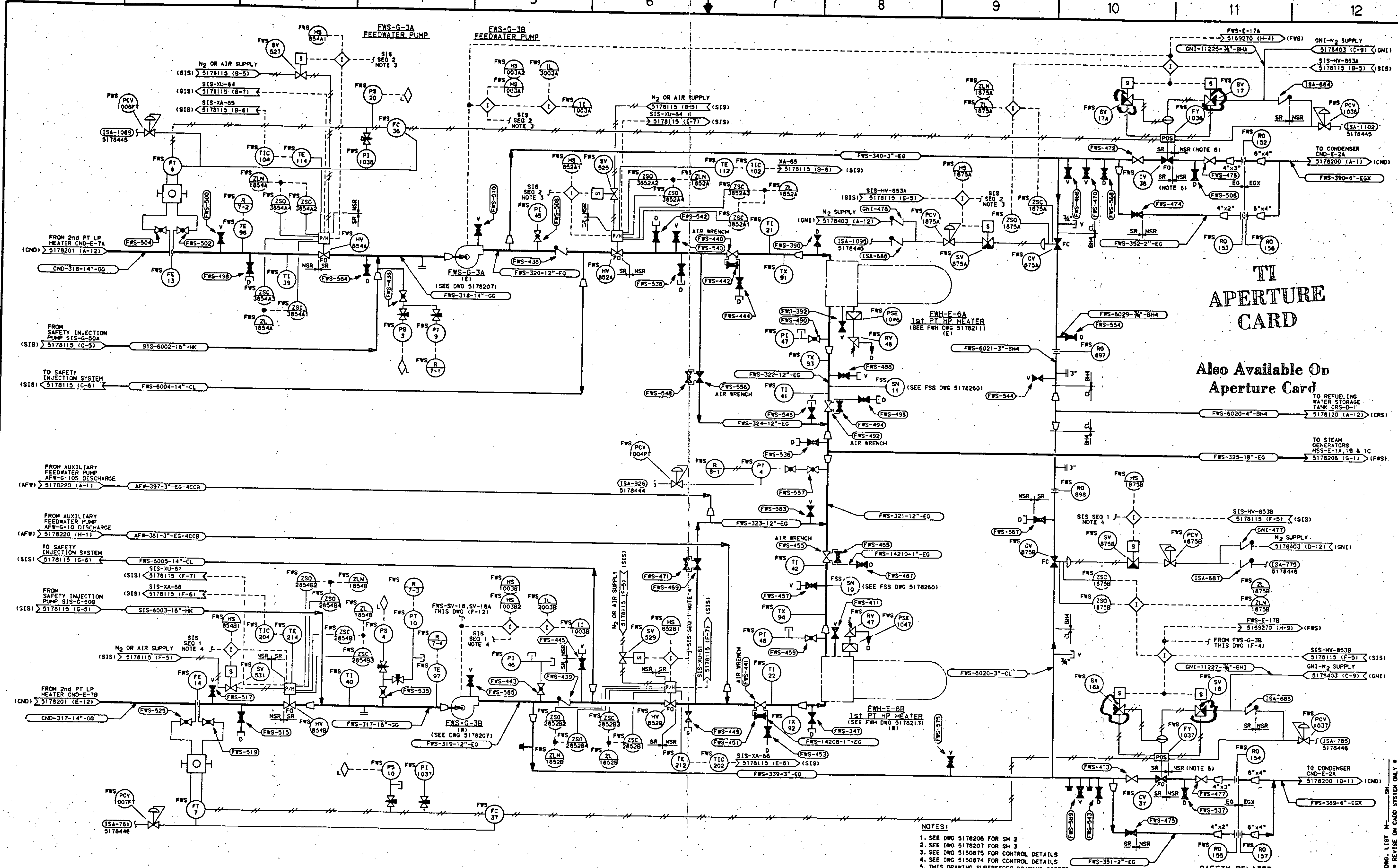
04-04-86

E4-652-CADD 03-86

8711100274-53

568772

5178158-3



NOTES:
1. SEE DWG 5178206 FOR SH 2
2. SEE DWG 5178207 FOR SH 3
3. SEE DWG 5150875 FOR CONTROL DETAILS
4. SEE DWG 5150874 FOR CONTROL DETAILS
5. THIS DRAWING SUPERSEDES DRAWING 568779 AND ALL CCN'S WHICH PERTAIN TO IT.
6. POSITIONER IS NON-SAFETY RELATED

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
5149858	ELEM DIAGRAM-PUMPS G-3A & G-3B
455374	ELEM DIAGRAM-HV-854A & B
455375	ELEM DIAGRAM-HV-852A & B
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
5	AS BUILT-INCORP DCN #9		12/30/86						AR	GAC	3183
4	AS BUILT-INCORP DCN #7 & #8			SEE	COM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #6 & MINOR CHANGES			SEE	COM	FILES	FOR SIGNATURES			GK	3083
2	AS BUILT-INCORP DCN #5			SEE	COM	FILES	FOR SIGNATURES			DVY	3083
1	AS BUILT-INCORP DCN #2,#3,#4-CC#1 CANCELED			SEE	COM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	COM	FILES	FOR SIGNATURES			DVY	8252

WP 82-063

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
FEEDWATER SYSTEM
SHEET 1

Southern California Edison

FWS

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

DWG. LIST M- ___ SH. ___
* REVISE ON CADD SYSTEM ONLY *

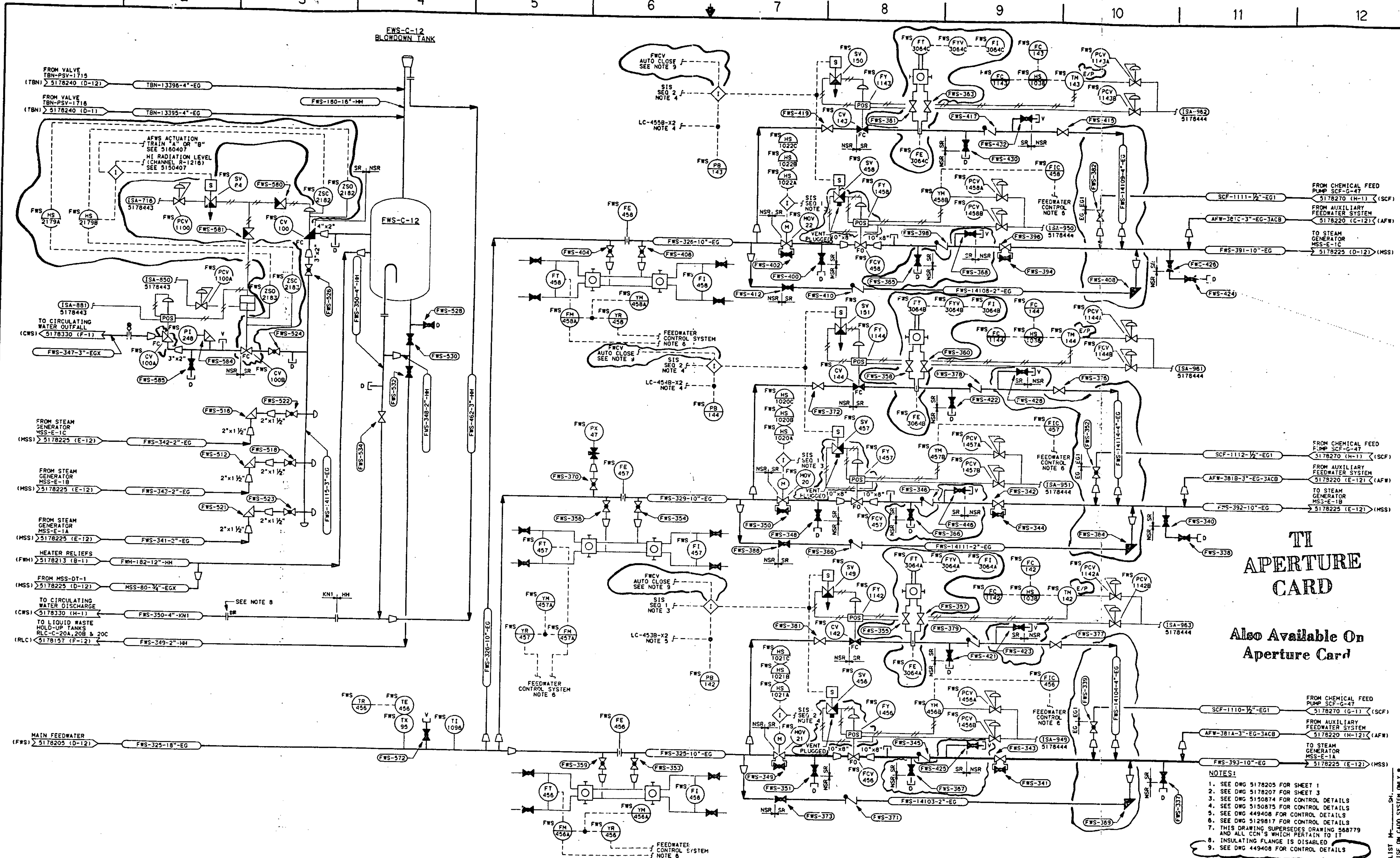
12-12-86

E4-652-CADD 03-85

8711100274-54

568779

5178205-5



NOTES:

1. SEE DWG 5178205 FOR SHEET 1
2. SEE DWG 5178207 FOR SHEET 3
3. SEE DWG 5150874 FOR CONTROL DETAILS
4. SEE DWG 5150875 FOR CONTROL DETAILS
5. SEE DWG 449408 FOR CONTROL DETAILS
6. SEE DWG 5129817 FOR CONTROL DETAILS
7. THIS DRAWING SUPERSEDES DRAWING 568779 AND ALL CCN'S WHICH PERTAIN TO IT
8. INSULATING FLANGE IS DISABLED
9. SEE DWG 449408 FOR CONTROL DETAILS

DWG. LIST M-____ SH.____
• REVISE ON CADD SYSTEM ONLY •

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
455379	ELEM DIAGRAM MOV'S 20,21 & 22
N1543	ELEM DIAGRAM-CV-100,SH 16
REFERENCE DRAWINGS	

REFERENCE DRAWINGS

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
7	AS BUILT-INCORP DCN #11,12,13,14,15 & 16		7/21/86								
8	AS BUILT-INCORP DCN #9,10 & MINOR CHG'S			SEE	COM	FILES	FOR SIGNATURES			BLS	3083

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
5	AS BUILT-INCORP DCN #7,#8 CC#1 CANCELED			SEE	COM	FILES	FOR SIGNATURES			REP	3083
4	AS BUILT-INCORP DCN #6			SEE	COM	FILES	FOR SIGNATURES			DVY	3083
3	AS BUILT-INCORP DCN #5			SEE	COM	FILES	FOR SIGNATURES			BLS	3083
2	AS BUILT-INCORP DCN #3			SEE	COM	FILES	FOR SIGNATURES			BLS	8881
1	AS BUILT-INCORP DCN #2 & #4			SEE	COM	FILES	FOR SIGNATURES			DVY	8744
0	ISSUED AS BUILT			SEE	COM	FILES	FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
FEEDWATER SYSTEM
SHEET 2

Southern California Edison

FWS

SHEET NO.
M

SCALE: NONE
____OF____SHTS.

07-15-86

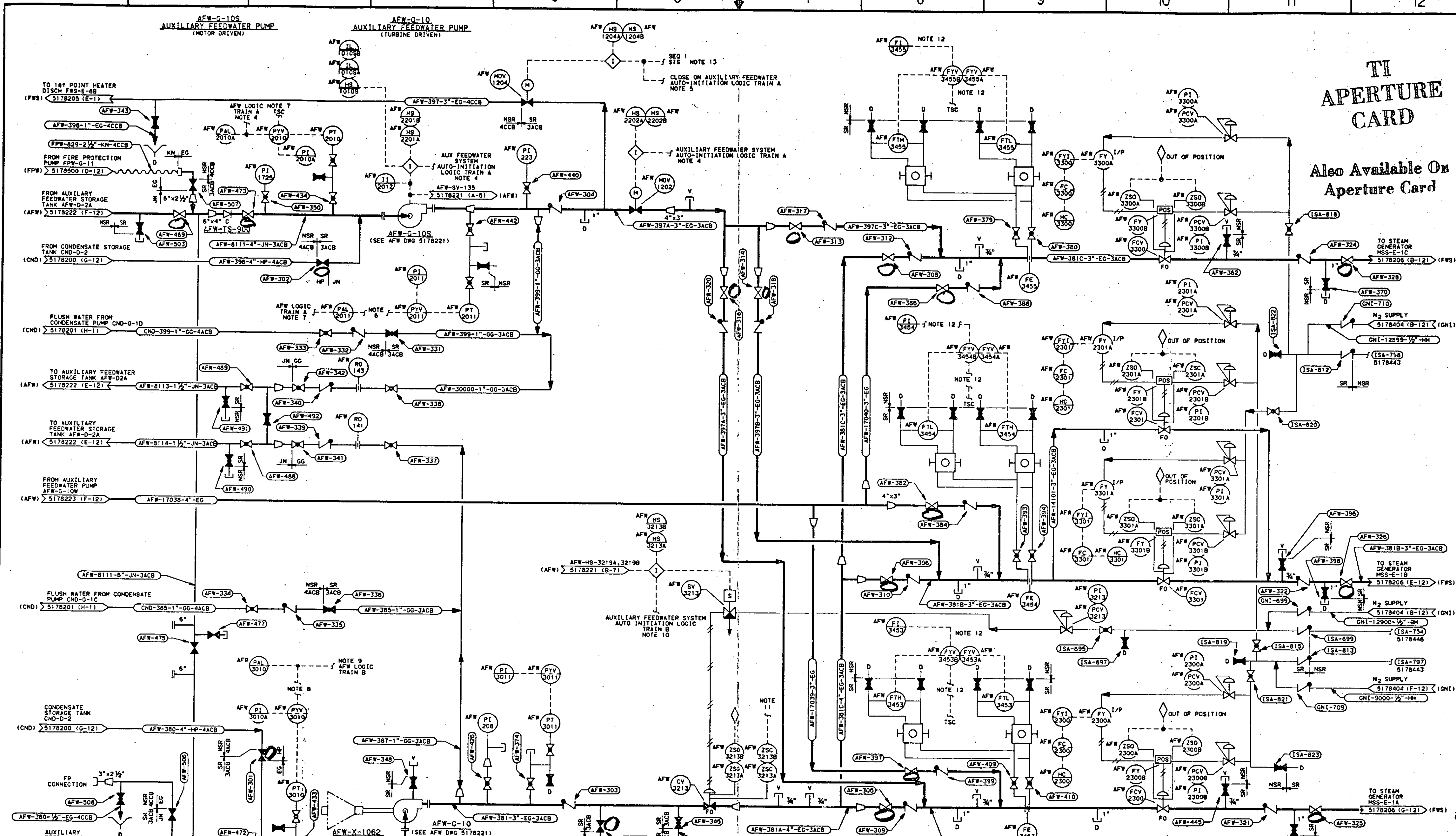
568779

8711100274-55

5178206-7

TI APERTURE CARD

Also Available On Aperture Card



NOTES:

1. ALL ALARMS ARE NSR.
2. SEE DWG 5178221 FOR SH 2
3. ISA SYSTEM IS NSR
4. SEE DWG 451772 FOR CONTROL DETAILS
5. SEE DWG 235865 FOR CONTROL DETAILS
6. SEE DWG 451666 FOR CONTROL DETAILS
7. SEE DWG 5180611 FOR CONTROL DETAILS
8. SEE DWG 451869 FOR CONTROL DETAILS
9. SEE DWG 5159794 FOR CONTROL DETAILS
10. SEE DWG 451868 FOR CONTROL DETAILS
11. SEE DWG 451665 FOR CONTROL DETAILS
12. SEE DWG 451876 FOR CONTROL DETAILS
13. SEE DWG 5149180 FOR CONTROL DETAILS
14. THIS DRAWING SUPERSEDES DRAWING 5159570 AND ALL CCN'S WHICH PERTAIN TO IT
15. SEE DWG 5178222 FOR SH 3
16. SEE DWG 5178223 FOR SH 4

SAFETY RELATED EXCEPT AS NOTED (SREAN)

WP 82-297

REFERENCE DRAWINGS	
5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
5159559	ELEM DIAGRAM - MOV 1204
5159841	ELEM DIAGRAM - MOV 1202

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
8	AS BUILT-INCORP DCN #18		4/5/87							GAC	3831
7	AS BUILT-INCORP DCN #10,11,12 & PART 13			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
—	DCN'S 8,14,15,16,17 & PART 13 ON DWG 5178223	—	—	—	—	—	—	—	—	—	—
6	AS BUILT-INCORP DCN #9									BLS	3083
5	AS BUILT-INCORP DCN #6			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
4	AS BUILT-INCORP DCN #7, & MINOR CHGS			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #5, & MINOR CHGS			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
2	AS BUILT-PARTIALLY INCORP DCN #3 & 4 ON			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
—	THIS DWG AND ON DWG 5178222	—	—	—	—	—	—	—	—	—	—
1	AS BUILT-INCORP DCN #2-DCN #1 CANCELED			SEE	CDM	FILES	FOR SIGNATURES			DVY	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
AUXILIARY FEEDWATER
SYSTEM SHEET 1

Southern California Edison

AFW

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

DWG. LIST M- ___ SH. ___
* REVISE ON CADD SYSTEM ONLY *

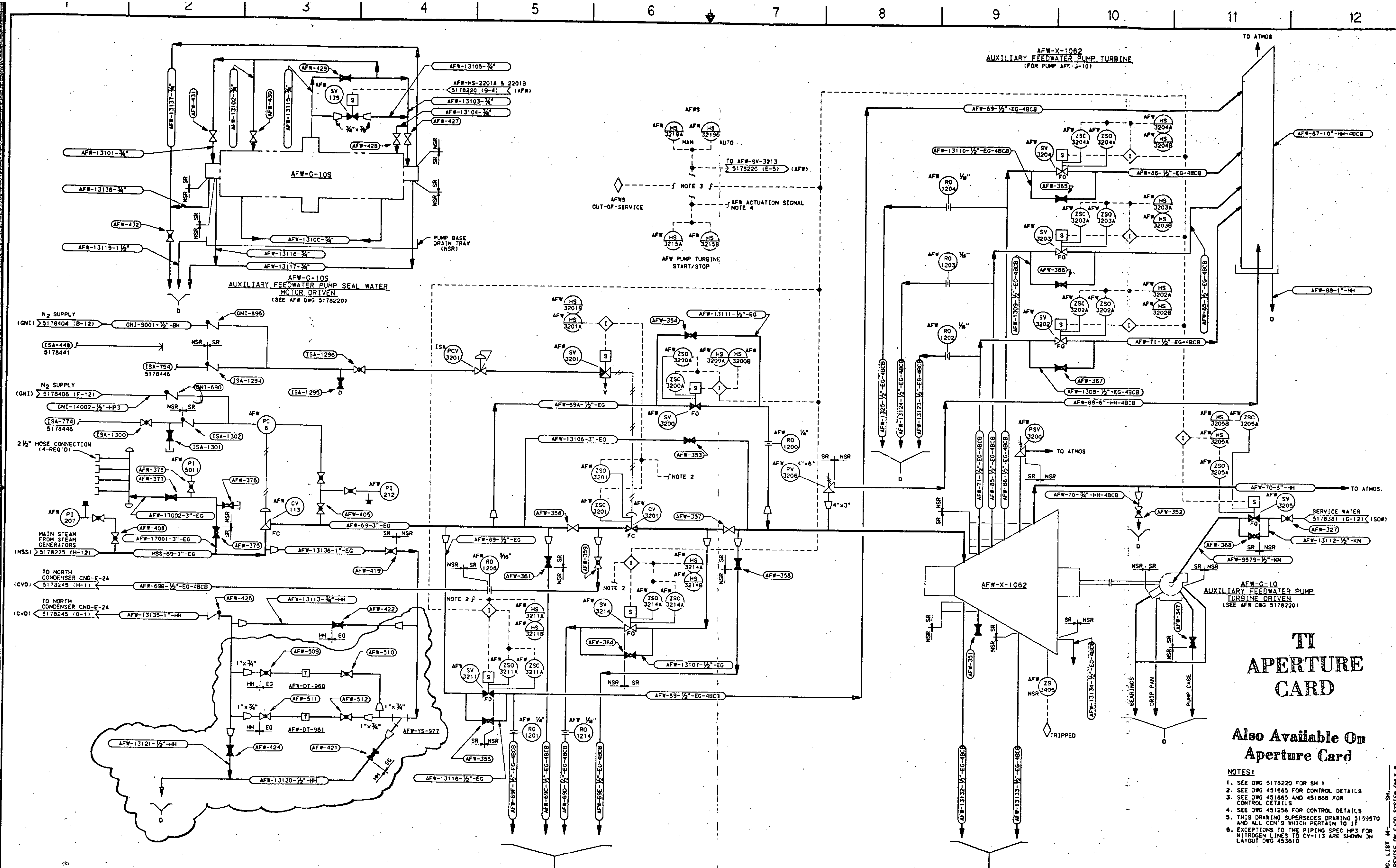
06-10-87 CASTRO

E4-832-CADD 03-85

5159570

8711100274-56

5178220-8



Also Available On
Aperture Card

NOTES:

1. SEE DWG 5178220 FOR SH 1
2. SEE DWG 451665 FOR CONTROL DETAILS
3. SEE DWG 451665 AND 451668 FOR CONTROL DETAILS
4. SEE DWG 451256 FOR CONTROL DETAILS
5. THIS DRAWING SUPERSEDES DRAWING 5159570 AND ALL CCN'S WHICH PERTAIN TO IT
6. EXCEPTIONS TO THE PIPING SPEC HP3 FOR NITROGEN LINES TO CV-113 ARE SHOWN ON LAYOUT DWG 453610

DWG. LIST M- ___ SH. ___
• REVISE ON CADD SYSTEM ONLY •

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-063

5178000	P&I DIAGRAM LEGEND SH 1
5178001	P&I DIAGRAM LEGEND SH 2
5178002	P&I DIAGRAM LEGEND SH 3
5159794	ELEM DIAGRAM - AFW SOLENOID VALVES
451256	LOGIC DIAGRAM - AFWS ACTUATION
REFERENCE DRAWINGS	

REFERENCE DRAWINGS

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
8	AS BUILT-INCORP DCN #16		7-7-87					ED	AR	GAC	3831
7	AS BUILT-INCORP DCN #15			SEE	CDM	FILES	FOR SIGNATURES			GAC	3831
6	AS BUILT-INCORP DCN #14			SEE	CDM	FILES	FOR SIGNATURES			GAC	3831
5	AS BUILT-INCORP DCN #13			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
4	AS BUILT-INCORP DCN #9, #10, #11, #12 &			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
	MINOR CHANGES	—	—	—	—	—	—	—	—	—	—
3	AS BUILT-INCORP DCN #8			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
2	AS BUILT-INCORP DCN #3, #6 & #7			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
	(DCN #4 & #5 NOT USED)	—	—	—	—	—	—	—	—	—	—
1	AS BUILT-INCORP DCN #2 CC #1 CANCELED			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
AUXILIARY FEEDWATER
SYSTEM SHEET 2

Southern California Edison

AFW

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

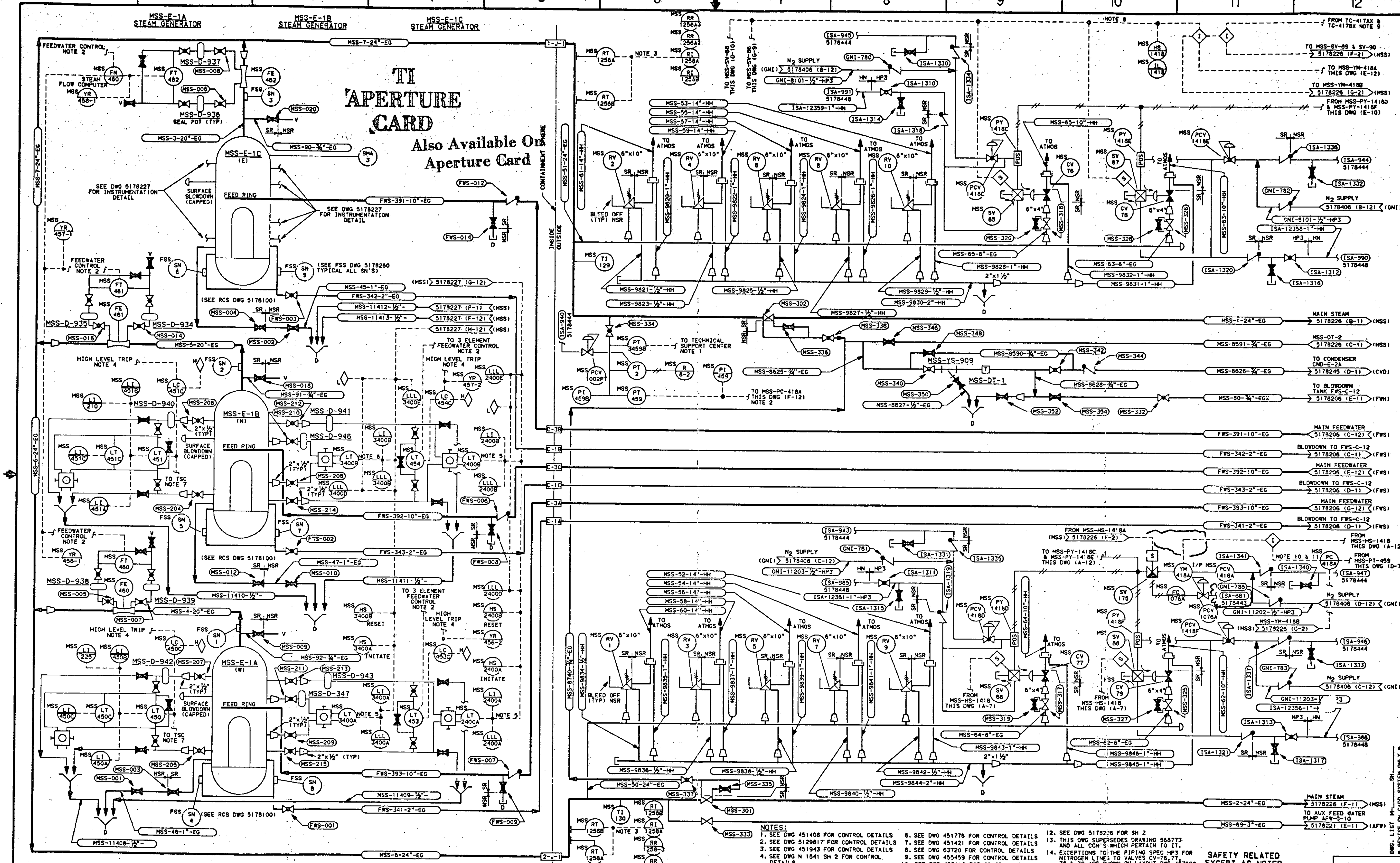
06-26-87 CASTRO

E4-652-CADD 03-85

5159570

8711100274-57

5178221-8



NOTES:
1. SEE DWG 451408 FOR CONTROL DETAILS
2. SEE DWG 5129817 FOR CONTROL DETAILS
3. SEE DWG 451943 FOR CONTROL DETAILS
4. SEE DWG N 1541 SH 2 FOR CONTROL DETAILS
5. SEE DWG 451775 FOR CONTROL DETAILS
6. SEE DWG 451776 FOR CONTROL DETAILS
7. SEE DWG 451421 FOR CONTROL DETAILS
8. SEE DWG 63720 FOR CONTROL DETAILS
9. SEE DWG 455459 FOR CONTROL DETAILS
10. SEE DWG 455116 FOR CONTROL DETAILS
11. SEE DWG 63714 FOR CONTROL DETAILS
12. SEE DWG 5178226 FOR SH 2
13. THIS DWG SUPERSEDES DRAWING 568773 AND ALL CCN'S WHICH PERTAIN TO IT.
14. EXCEPTIONS TO THE PIPING SPEC HP3 FOR NITROGEN LINES TO VALVES CV-76,77, 78 & 79 ARE SHOWN ON LAYOUT DWG 453520
15. SEE DWG 5178227 FOR SH 3

SAFETY RELATED EXCEPT AS NOTED (SREAN)

WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
451871	LOOP DIAG-PASS AREA-RAD MONITORING SYS
451887	LOOP DIAG-PASS AUXILIARY SYSTEM
451942	LOOP DIAG-STACK EFFLUENT MONITORING SYS
REFERENCE DRAWINGS	

REFERENCE DRAWINGS

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
6	AS BUILT-INCORP DCN #13									DVY	3083
5	AS BUILT-INCORP DCN #11 & #12			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
4	AS BUILT-INCORP DCN #10 & MINOR CHANGES			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #8 & #9 (#7 UNUSED)			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
2	AS BUILT-INCORP CC #1 & SH 3 OF DCN #4, DCN'S #5 & #6			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
1	AS BUILT-INCORP DCN #3-CC #2 CANCELED			SEE	CDM	FILES	FOR SIGNATURES			DVY	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
MAIN STEAM SYSTEM
SHEET 1

Southern California Edison

MSS

SHEET NO. M

SCALE: NONE

____ OF ____ SHTS.

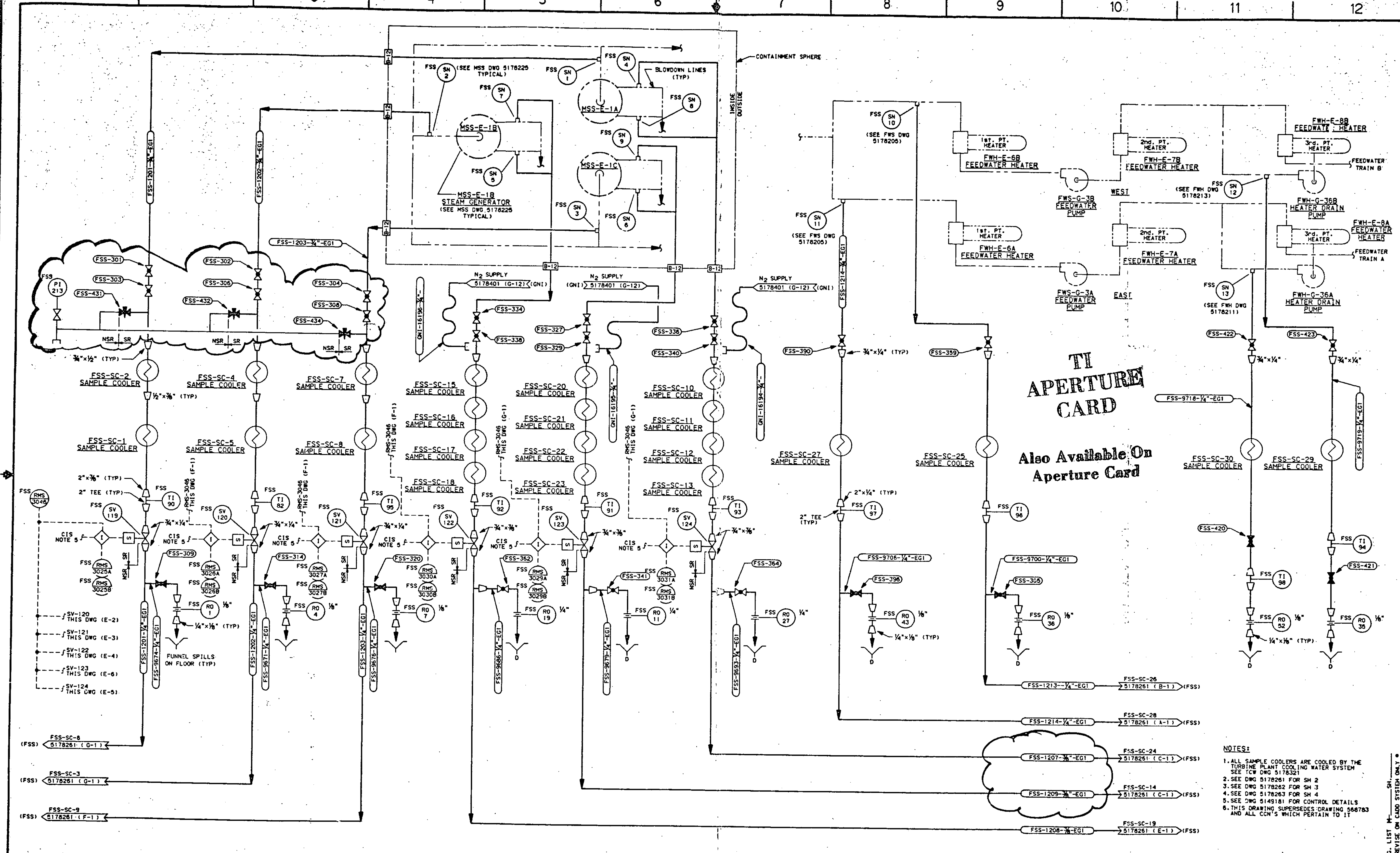
07-09-86

E4-662-CADD 03-88

8711100274-58

568773

5178225-6



NOTES:

1. ALL SAMPLE COOLERS ARE COOLED BY THE TURBINE PLANT COOLING WATER SYSTEM SEE TCW DWG 5178321
2. SEE DWG 5178261 FOR SH 2
3. SEE DWG 5178262 FOR SH 3
4. SEE DWG 5178263 FOR SH 4
5. SEE DWG 5149181 FOR CONTROL DETAILS
6. THIS DRAWING SUPERSEDES DRAWING 568783 AND ALL CCN'S WHICH PERTAIN TO IT

DWG. LIST M— SH.—
• REVISE ON CADD SYSTEM ONLY •

SAFETY RELATED
AS NOTED
(SRAN)

WP 82-297

FSS

5178000	P&I DIAGRAM LEGEND SH 1
5178001	P&I DIAGRAM LEGEND SH 2
5178002	P&I DIAGRAM LEGEND SH 3
5159717	CONTROL SWITCH - CONT. ISO. SYSTEM
5159701	WIRING DIAGRAM - CONT. ISO. SYSTEM

REFERENCE DRAWINGS | REFERENCE DRAWINGS

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
3	AS BUILT-INCORP DCN #4, #5 & #6		11-21-85					DH	LAM	DVY	3083
2	AS BUILT-INCORP DCN #3			SEE	COM	FILES	FOR SIGNATURES			DVY	3081
1	AS BUILT-INCORP DCN #1 & #2			SEE	COM	FILES	FOR SIGNATURES			DVY	3744
0	ISSUED AS BUILT			SEE	COM	FILES	FOR SIGNATURES			JB	6252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
FEEDWATER SAMPLING
SYSTEM SHEET 1

Southern California Edison

SHEET NO.
M

SCALE: NONE
——OF——SHTS.

11-25-85

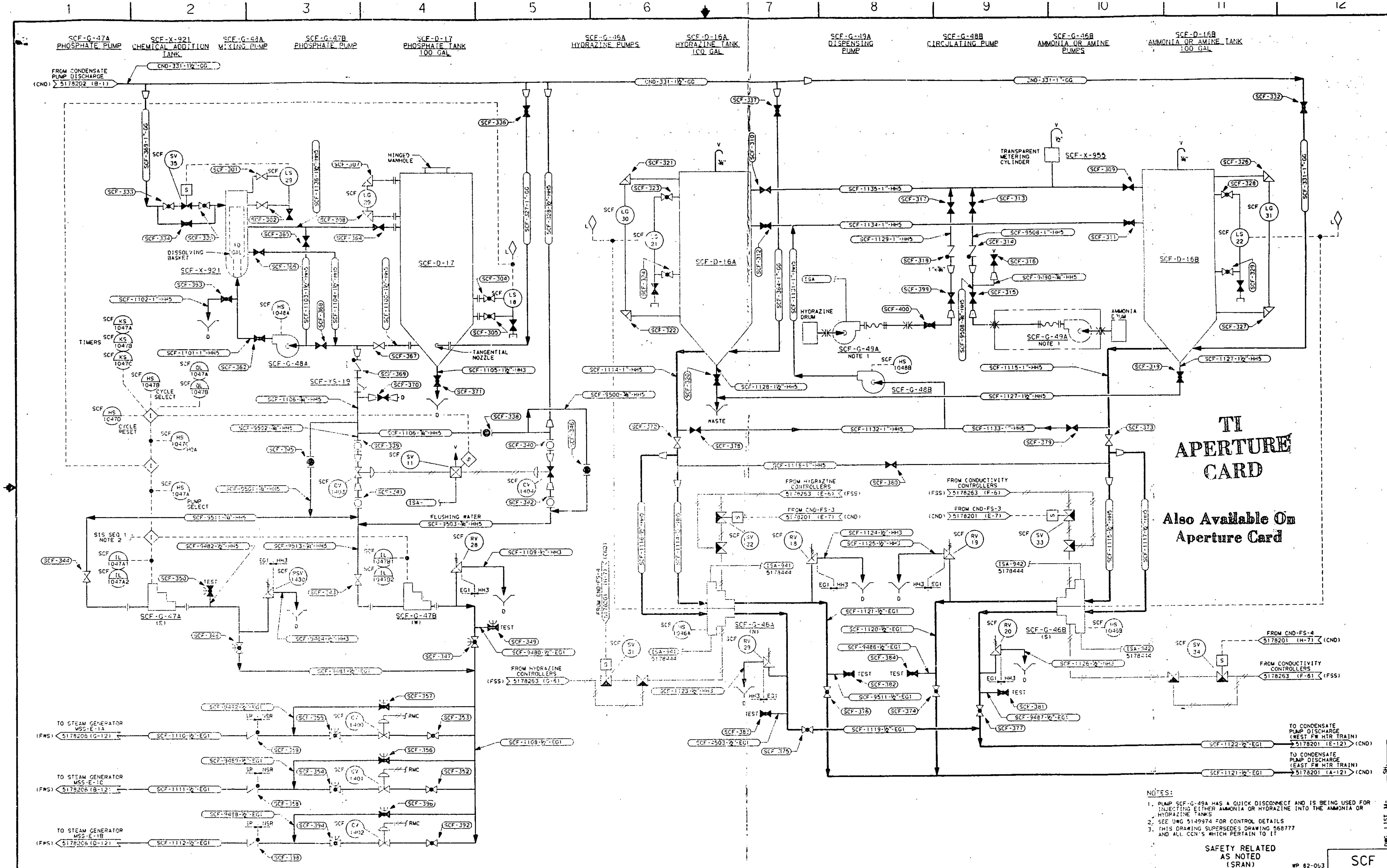
E4-662-CADD 03-85

568783

5178260-3

MICROFILMED FROM

8711100274-59



5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
452359	PHOSPHATE PUMPS G-47A & G-47B
5150346	ELEM DIAGRAM PHOSPHATE PUMPS
5150347	ELEM DIAGRAM HYDRAZINE & AMMONIA PUMPS
REFERENCE DRAWINGS	

NO.	REVISIONS	BY	DATE	P.E.	OAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
1	AS BUILT-INCORP DCN #1 & #2							DH	GJ	BLS	8744
0	ISSUED AS BUILT		SEE CDM FILES FOR SIGNATURES							DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
SECONDARY CHEMICAL
FEED SYSTEM

SCE EDISON
Rosemead California

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

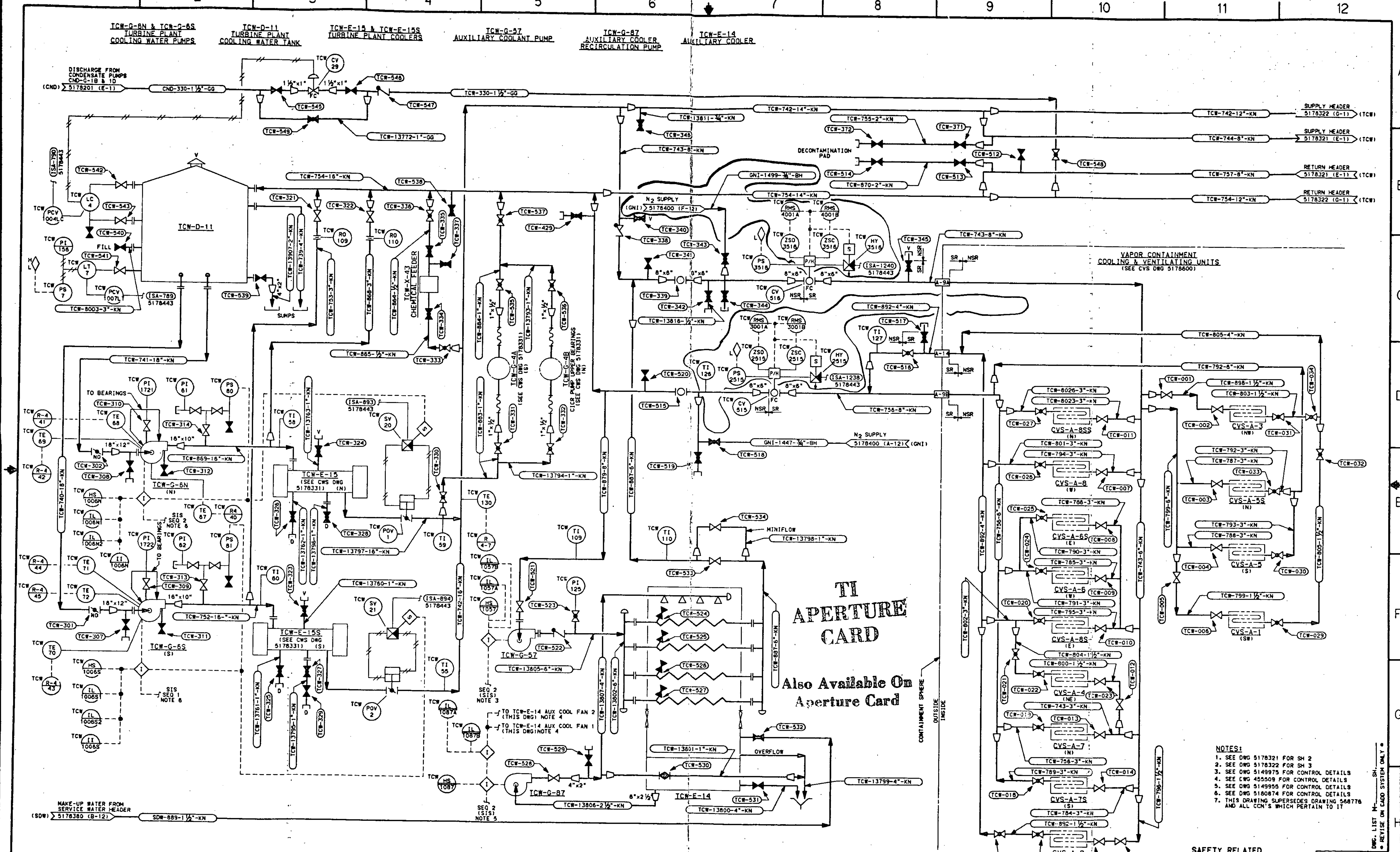
DWG. LIST M-___ SH.___ REVISE ON CADD SYSTEM ONLY

568777

5178270-1

MICROFILMED FROM

8711100274-6D



5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
5149920	ELEM DIAGRAM-TURB PLANT COOLING WATER PUMPS
64384	ELEM DIAGRAM CV-515
REFERENCE DRAWINGS	

64371	ELEM DIAGRAM CV-516
455436	ELEM-DIAGRAM AUX COOL PUMP G-57
455509	ELEM-DIAGRAM AUX COOL RECIRC PUMP
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
3	AS BUILT-INCORP DCN #6		3/30/8							BLS	3083
2	AS BUILT-INCORP DCN #4 & #5			SEE	CDM	FILES	FOR SIGNATURES			BLS	6881
1	AS BUILT-INCORP DCN #1, #2 & #3			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	6252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
TURBINE PLANT
COOLING WATER SH 1

Southern California Edison

TCW

SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

E4-852-C400 03-85

568776

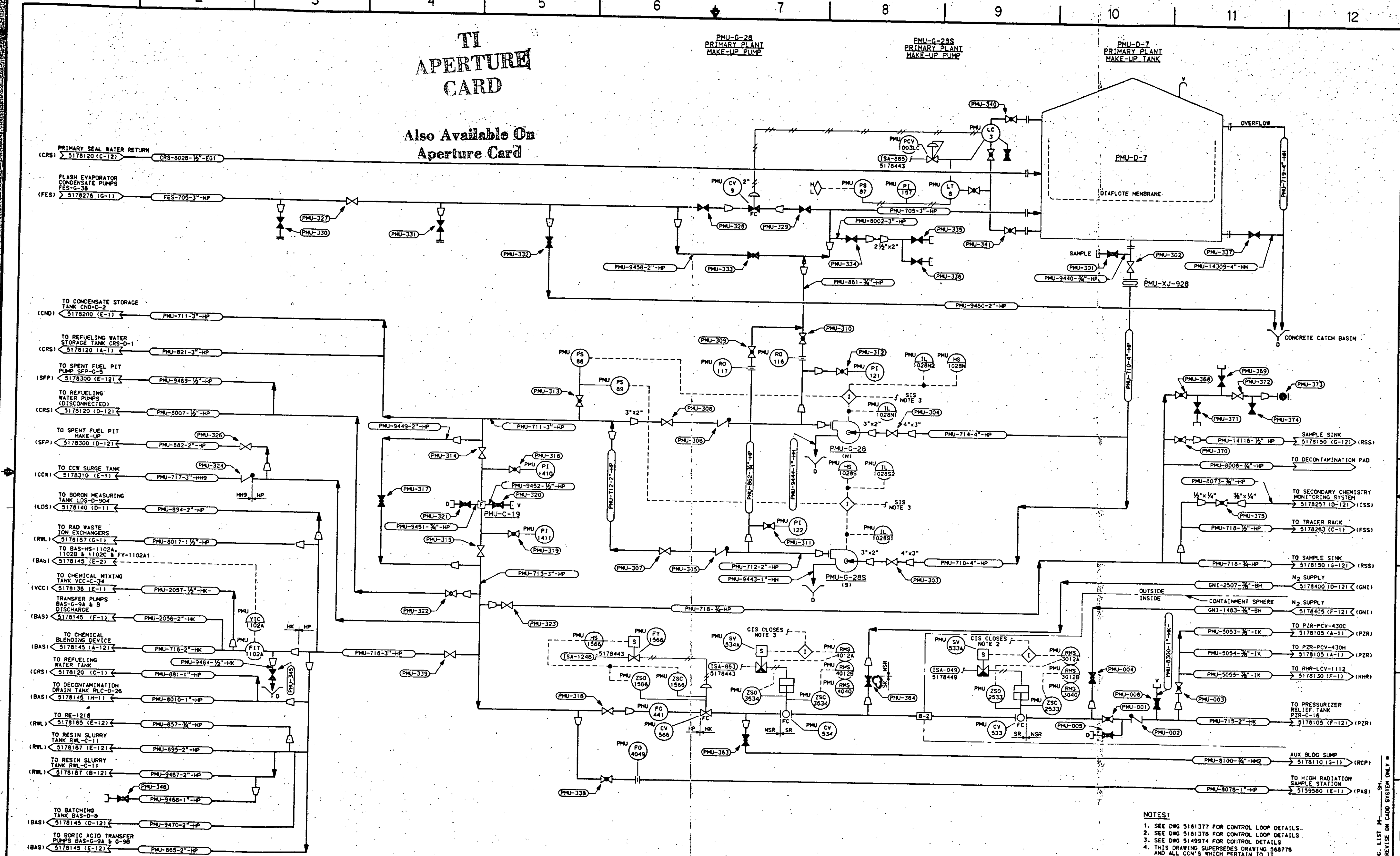
05-15-86

8711100274-41

5178320-3

TI
APERTURE
CARD

Also Available On
Aperture Card



NOTES:

1. SEE DWG 5161377 FOR CONTROL LOOP DETAILS.
2. SEE DWG 5161378 FOR CONTROL LOOP DETAILS.
3. SEE DWG 5149974 FOR CONTROL DETAILS.
4. THIS DRAWING SUPERSEDES DRAWING 568776 AND ALL CCN'S WHICH PERTAIN TO IT

SAFETY RELATED
AS NOTED
(SRAN)

WP 82-063

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
5150334	ELEM DIAGRAM-PUMPS G-26, G-28, G-28S, G-39
REFERENCE DRAWINGS	

NO.	REVISIONS						
3	AS BUILT-INCORP DCN #4				BLS	3831
2	AS BUILT-INCORP DCN #3	SEE CDM FILES FOR SIGNATURES			DYY	3083
1	AS BUILT-INCORP DCN #2-CC#1 CANCELED	SEE CDM FILES FOR SIGNATURES			BLS	6744
0	ISSUED AS BUILT	SEE CDM FILES FOR SIGNATURES			DYY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
PRIMARY PLANT
MAKE-UP WATER SYSTEM

Southern California Edison

PMU

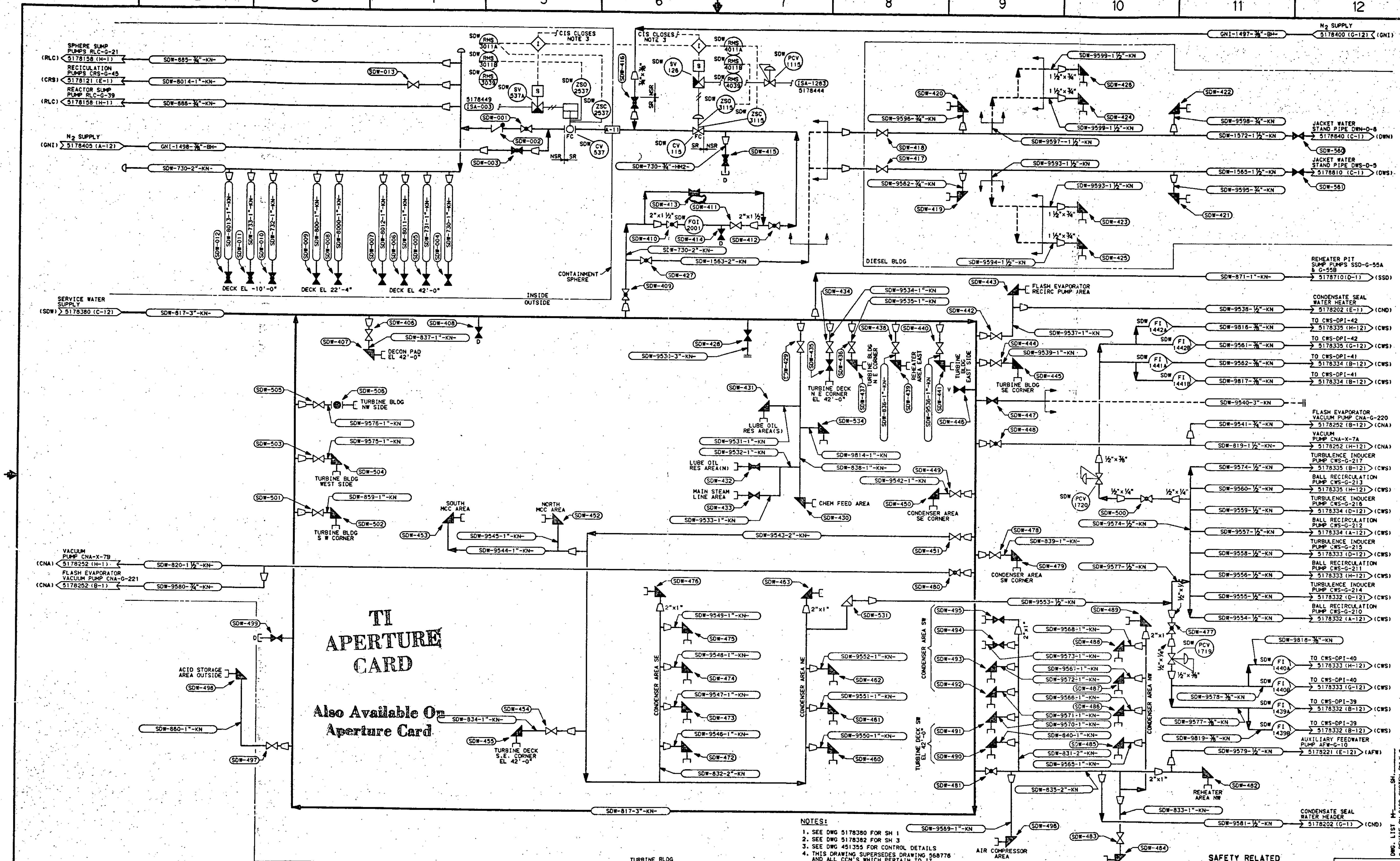
SHEET NO. M

SCALE: NONE

568776

8711100274-62

5178370-3



NOTES:

1. SEE DWG 5178380 FOR SH 1
2. SEE DWG 5178382 FOR SH 3
3. SEE DWG 451355 FOR CONTROL DETAILS
4. THIS DRAWING SUPERSEDES DRAWING 568776 AND ALL CCN'S WHICH PERTAIN TO IT

SAFETY RELATED AS NOTED (SRAN)

WP 82-063

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
64358	ELEM DIAGRAM-CV-537
64360	ELEM DIAGRAM-CV-115

REFERENCE DRAWINGS

NO.	REVISIONS					APPROVED				J.O.
5	AS BUILT-INCORP DCN #7								BLS	3831
4	AS BUILT-INCORP DCN #6		SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
3	AS BUILT-INCORP DCN #5		SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
2	AS BUILT-INCORP DCN #3 & #4		SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
1	AS BUILT-INCORP DCN #2-CC #1 CANCELED		SEE	CDM	FILES	FOR SIGNATURES			DVY	8744
0	ISSUED AS BUILT		SEE	CDM	FILES	FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
SERVICE AND DOMESTIC
WATER SYS (SERVICE) SH 2

Southern California Edison

SDW

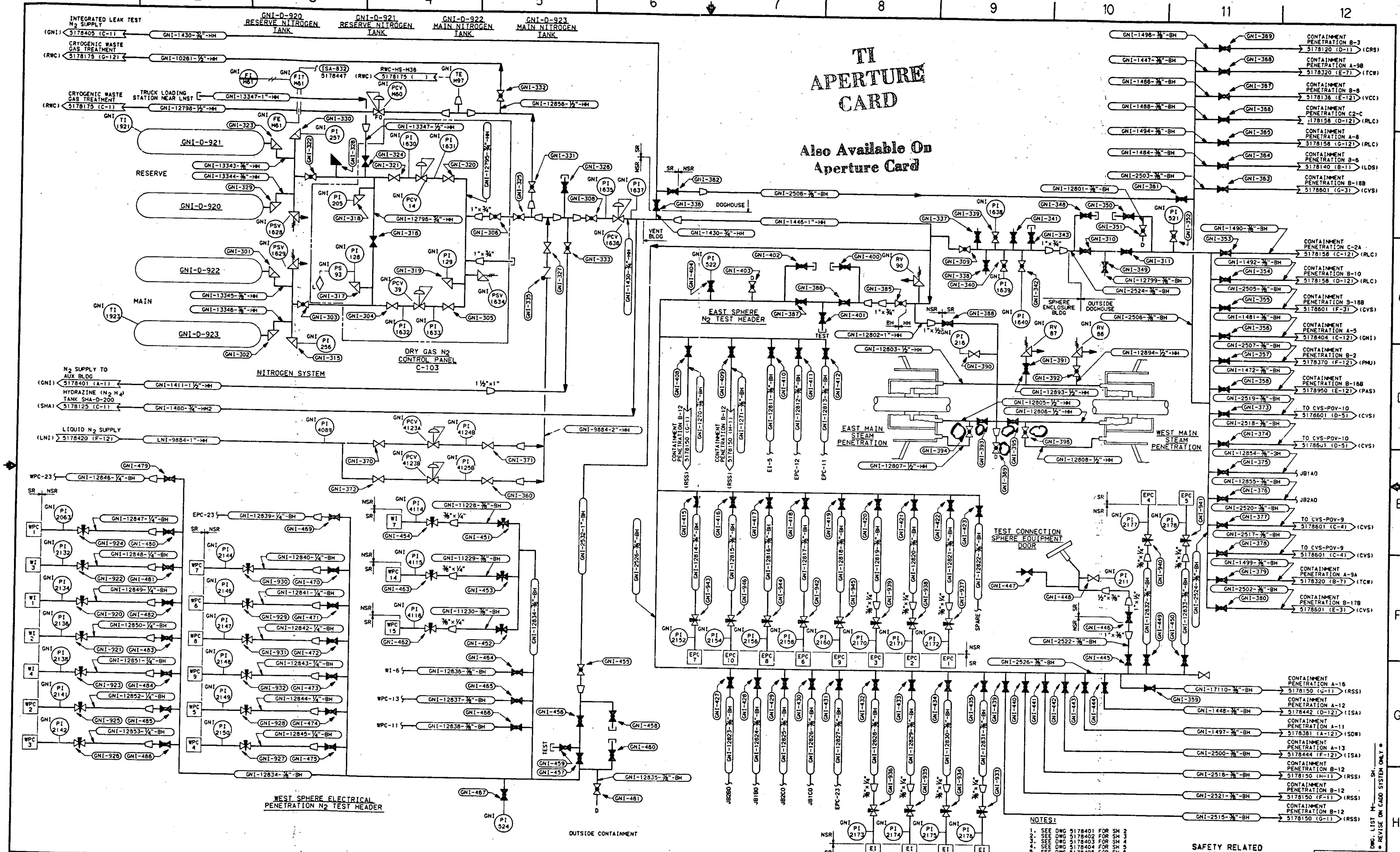
SHEET NO. M

SCALE: NONE

___ OF ___ SHTS.

8711100274-63

5178381-5



GNI

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
7	AS BUILT-INCORP DCN# 15		7/24/91					WW	AR	BLS	3831
6	AS BUILT-INCORP DCN# 14			SEE	COM FILES		FOR SIGNATURES			DVY	3083
5	AS BUILT-INCORP DCN #9,10,11,12 & 13			SEE	COM FILES		FOR SIGNATURES			DVY	3083
4	AS BUILT-INCORP DCN #5,6,7 & 8			SEE	COM FILES		FOR SIGNATURES			DVY	3083
3	AS BUILT-INCORP DCN #4 & MINOR CHANGES			SEE	COM FILES		FOR SIGNATURES			GK	3083
2	AS BUILT-INCORP DCN #3			SEE	COM FILES		FOR SIGNATURES			BLS	8881
1	AS BUILT-INCORP DCN #2-CC #1 CANCELED			SEE	COM FILES		FOR SIGNATURES			DVY	8744
0	ISSUED AS BUILT			SEE	COM FILES		FOR SIGNATURES			DVY	8252

E4-652-CADD 03-85

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
GASEOUS NITROGEN
SYSTEM SHEET 1

Southern California Edison

SHEET NO. M

SCALE: NONE

____ OF ____ SHTS.

DWG. LIST M-____ SH.____
* REVISE ON CADD SYSTEM ONLY *

05-21-87 SHOOL

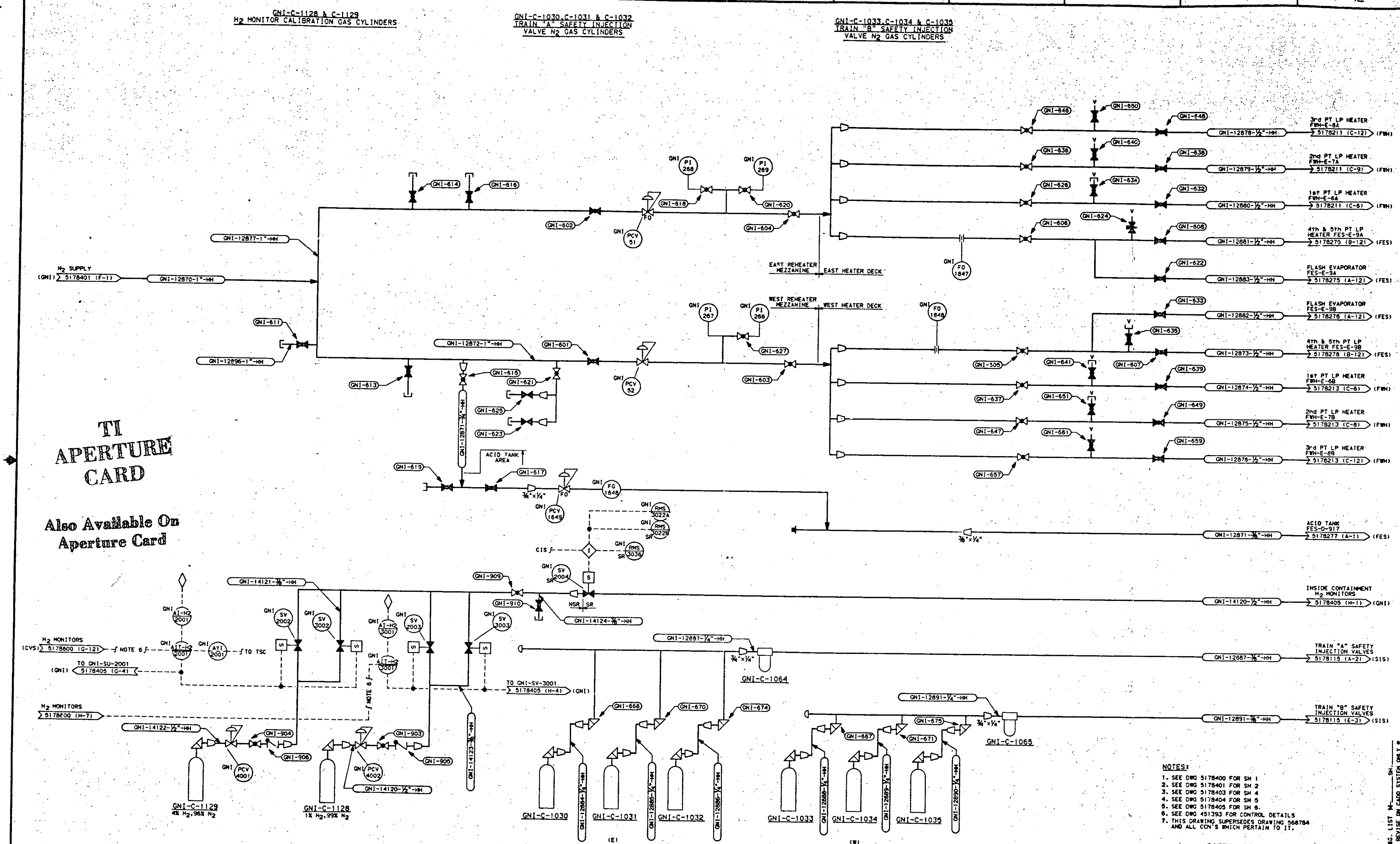
568784

8711100274-64

5178400-7

TI APERTURE CARD

Also Available On Aperture Card



NOTES:
1. SEE DWG 5178400 FOR SH 1
2. SEE DWG 5178401 FOR SH 2
3. SEE DWG 5178403 FOR SH 4
4. SEE DWG 5178404 FOR SH 5
5. SEE DWG 5178405 FOR SH 6
6. SEE DWG 451393 FOR CONTROL DETAILS
7. THIS DRAWING SUPERSEDES DRAWING 568784 AND ALL CCN'S WHICH PERTAIN TO IT.

SAFETY RELATED AS NOTED (SRAN)

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
514266	S I VALVE PNEUMATIC SYS RECHARGE
451356	LOGIC DIAGRAM-CONTAINMENT ISOLATION
451393	LOOP DIAGRAM-CONTAINMENT H_2 MONITORING
REFERENCE DRAWINGS	

NO.	REVISIONS			
2	AS BUILT-INCORP DCN #3	DVY	3083
1	AS BUILT-INCORP CC #1	SEE CDM FILES FOR SIGNATURES	BLS	8881
0	ISSUED AS BUILT	SEE CDM FILES FOR SIGNATURES	BLS	8262

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
GASEOUS NITROGEN
SYSTEM SHEET 3

Southern California Edison

GNI

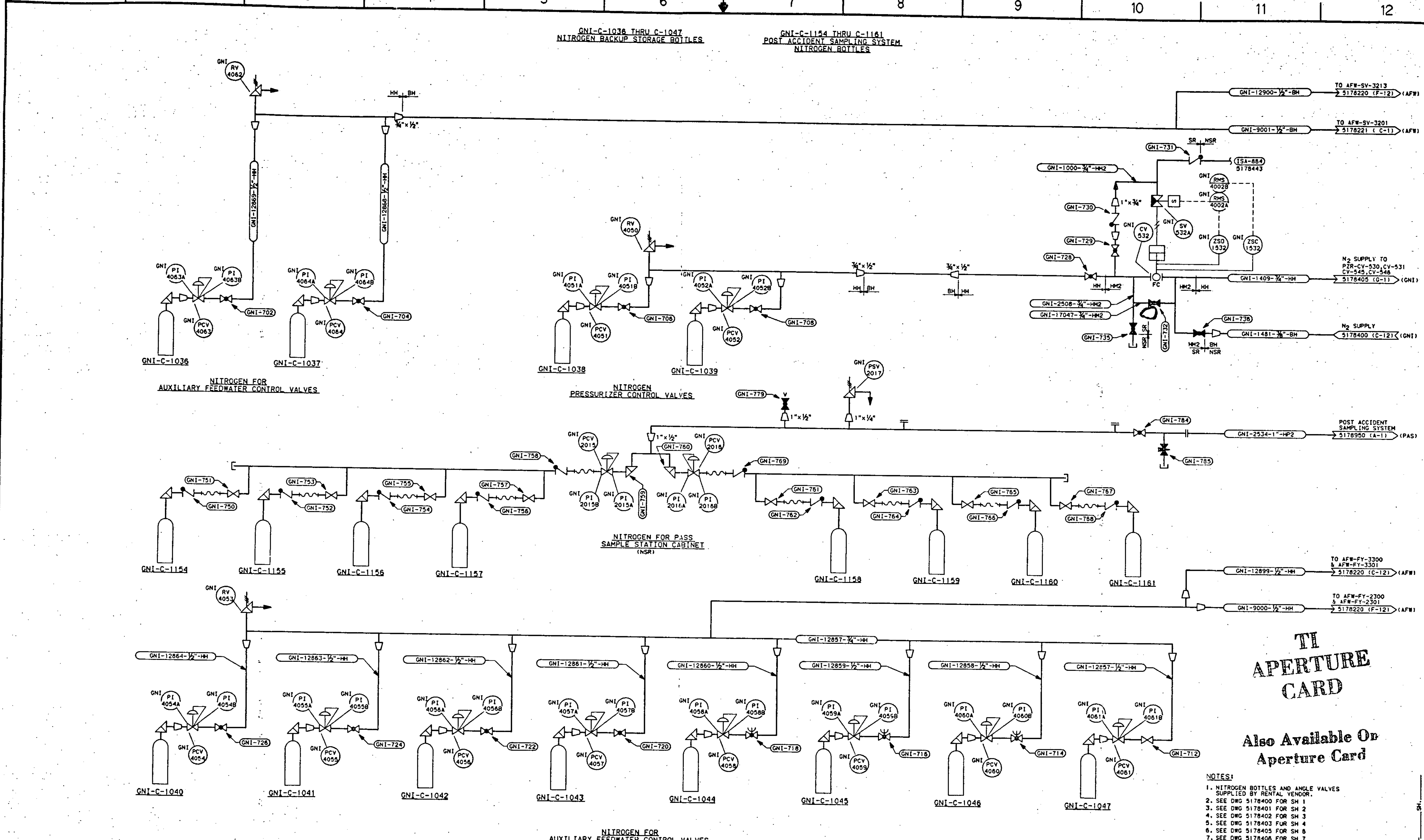
SHEET NO. M

SCALE: NONE

DWG. LIST M- SH. - REVISE ON CADD SYSTEM ONLY

8711100274-65

5178402-2



NOTES:

1. NITROGEN BOTTLES AND ANGLE VALVES SUPPLIED BY RENTAL VENDOR.
2. SEE DWG 5178400 FOR SH 1
3. SEE DWG 5178401 FOR SH 2
4. SEE DWG 5178402 FOR SH 3
5. SEE DWG 5178403 FOR SH 4
6. SEE DWG 5178405 FOR SH 6
7. SEE DWG 5178406 FOR SH 7
8. THIS DRAWING SUPERSEDES DRAWING 568784 AND ALL CCN'S WHICH PERTAIN TO IT

DWG. LIST M-____SH.____
• REVISE ON CADD SYSTEM ONLY •

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-063

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
7	AS BUILT-INCORP DCN #11		5-21-87						AR	BLS	3831
6	AS BUILT-INCORP DCN #10			SEE	COM	FILES	FOR SIGNATURES			GK	3083
5	AS BUILT-INCORP DCN #9-DCN #8 CANCELED			SEE	COM	FILES	FOR SIGNATURES			DVY	3083
4	AS BUILT-INCORP DCN #7			SEE	COM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #4 & #6 INCORP ON DWG# 5178408,DCN #5 UNUSED			SEE	COM	FILES	FOR SIGNATURES			DVY	3083
2	AS BUILT-INCORP DCN #3			SEE	COM	FILES	FOR SIGNATURES			DVY	8744
1	AS BUILT-INCORP DCN #2-CC#1 CANCELED			SEE	COM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	COM	FILES	FOR SIGNATURES			DVY	8252

GNI

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
GASEOUS NITROGEN
SYSTEM SHEET 5

SHEET NO. M

SCALE: NONE

____OF____SHTS.

Southern California Edison

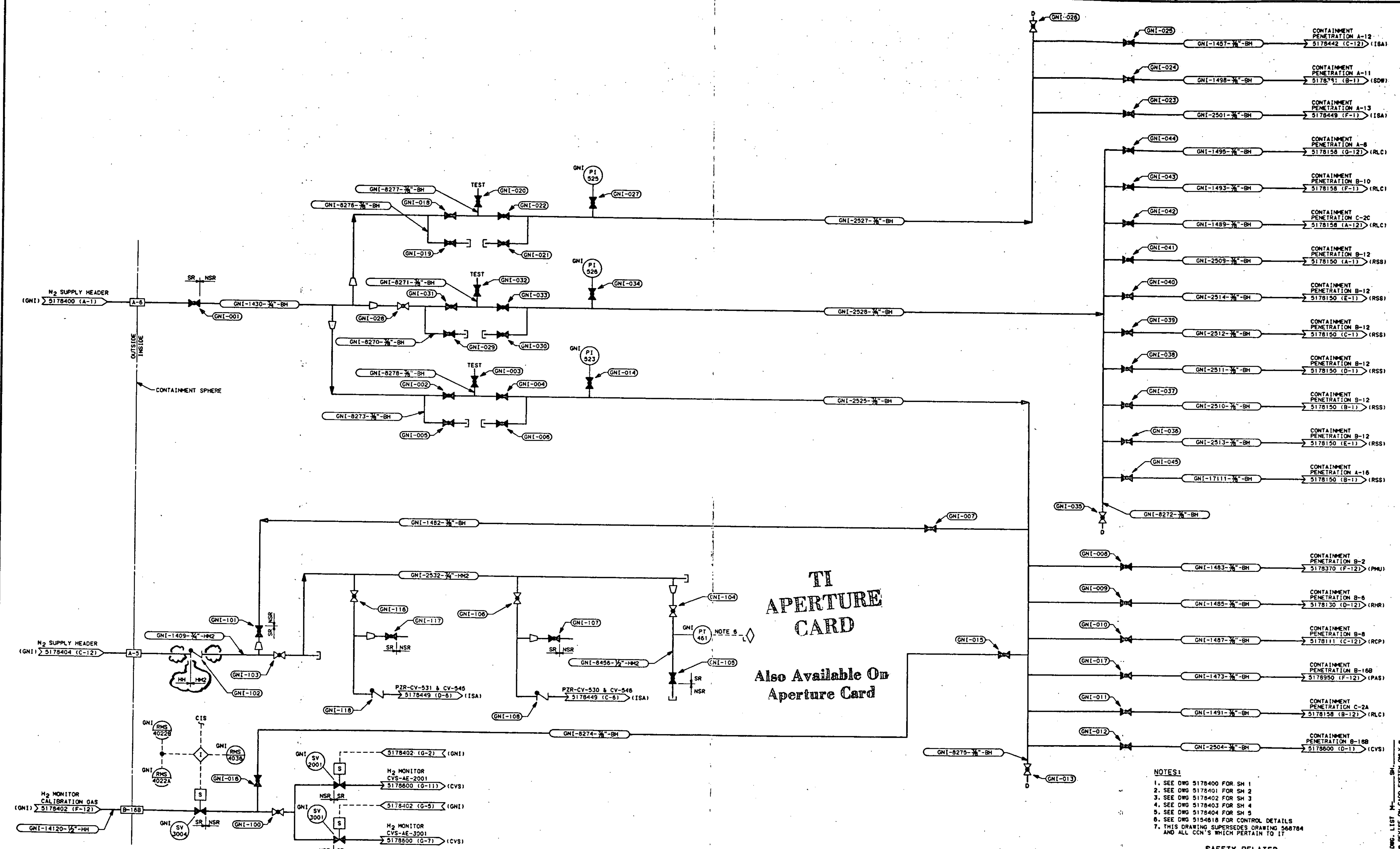
8711100274-66

568784

5178404-7

SCE E4-682-CADD 03-85

05-20-87 SHOOL



NOTES:

1. SEE DWG 5178400 FOR SH 1
2. SEE DWG 5178401 FOR SH 2
3. SEE DWG 5178402 FOR SH 3
4. SEE DWG 5178403 FOR SH 4
5. SEE DWG 5178404 FOR SH 5
6. SEE DWG 5154618 FOR CONTROL DETAILS
7. THIS DRAWING SUPERSEDES DRAWING 568784 AND ALL CCN'S WHICH PERTAIN TO IT

SAFETY RELATED
AS NOTED
(SRAN)

WP 82-297

GNI

5178000	P & I DIAGRAM LEGEND SH 1	
5178001	P & I DIAGRAM LEGEND SH 2	
5178002	P & I DIAGRAM LEGEND SH 3	
REFERENCE DRAWINGS		REFERENCE DRAWINGS

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
4	AS BUILT-INCORP DCN #7		10/31/86						AAR	GAC	3024
3	AS BUILT-INCORP DCN #6 & MINOR CHG			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
2	AS BUILT-INCORP CC #1 & DCN #5			SEE	CDM	FILES	FOR SIGNATURES			BLS	8881
1	AS BUILT-INCORP DCN #3 & #4-CC#2 CANCELED			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
GASEOUS NITROGEN
SYSTEM SHEET 6

Southern California Edison

568784

SHEET NO. M

SCALE: NONE

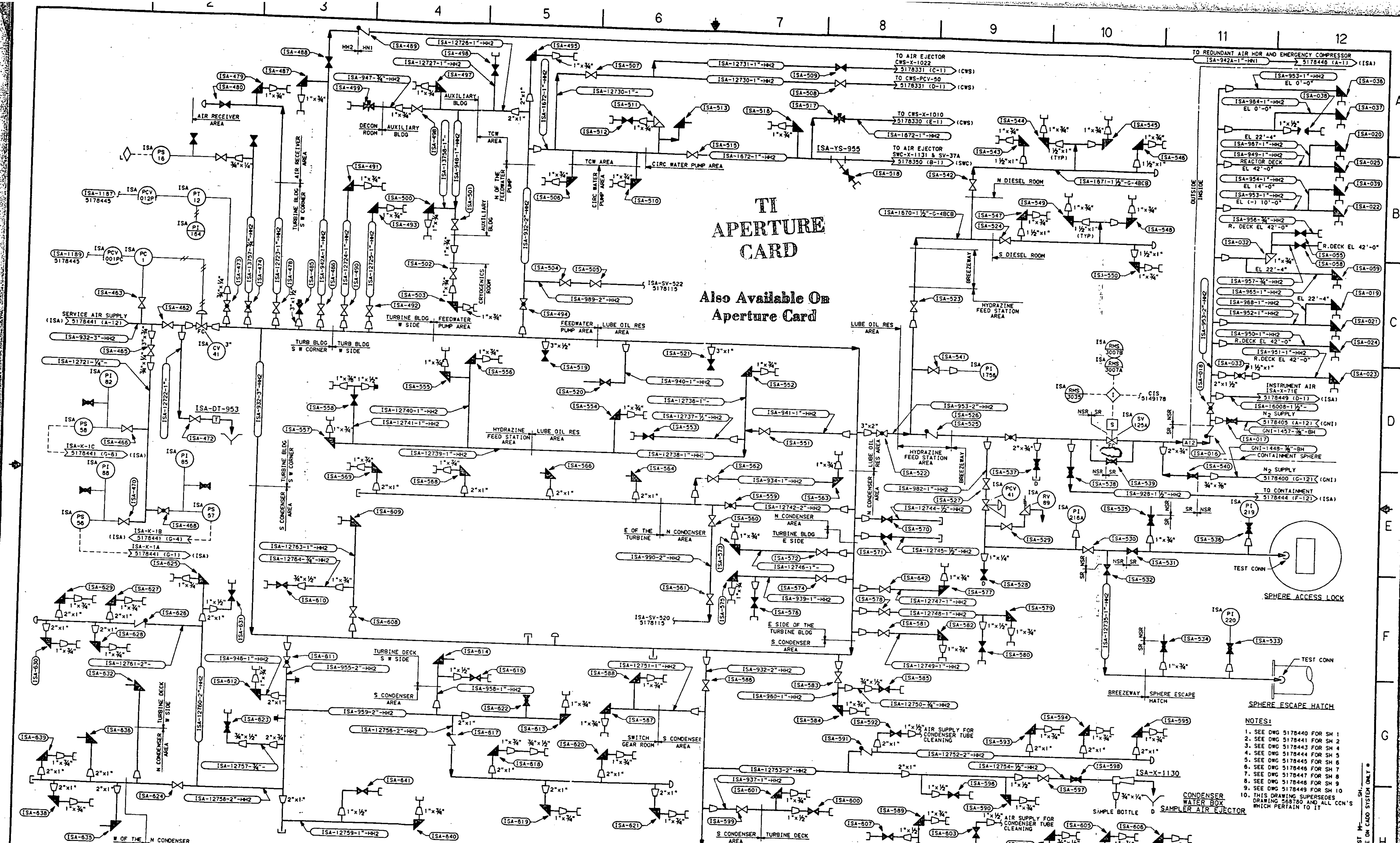
___ OF ___ SHTS.

10-24-86

DWG. LIST M— SH. —
* REVISE ON CADD SYSTEM ONLY *

5178405-4

8711100274-67



REFERENCE DRAWINGS	
5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3

NO.	REVISIONS	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
5	AS BUILT-INCORP DCN #5	4/1/97							BLS	3831
4	AS BUILT-INCORP DCN #4		SEE	COM FILES	FOR SIGNATURES				BLS	9134
3	AS BUILT-INCORP DCN #3		SEE	COM FILES	FOR SIGNATURES				BLS	3083
2	AS BUILT-INCORP DCN #2		SEE	COM FILES	FOR SIGNATURES				DVY	3087
1	AS BUILT-INCORP DCN #1		SEE	COM FILES	FOR SIGNATURES				BLS	8744
0	ISSUED AS BUILT		SEE	COM FILES	FOR SIGNATURES				DVY	8252

WP 82-063

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
INSTRUMENT AND SERVICE
AIR SYSTEM SHEET 3

Southern California Edison

ISA

SHEET NO. M

SCALE: NONE

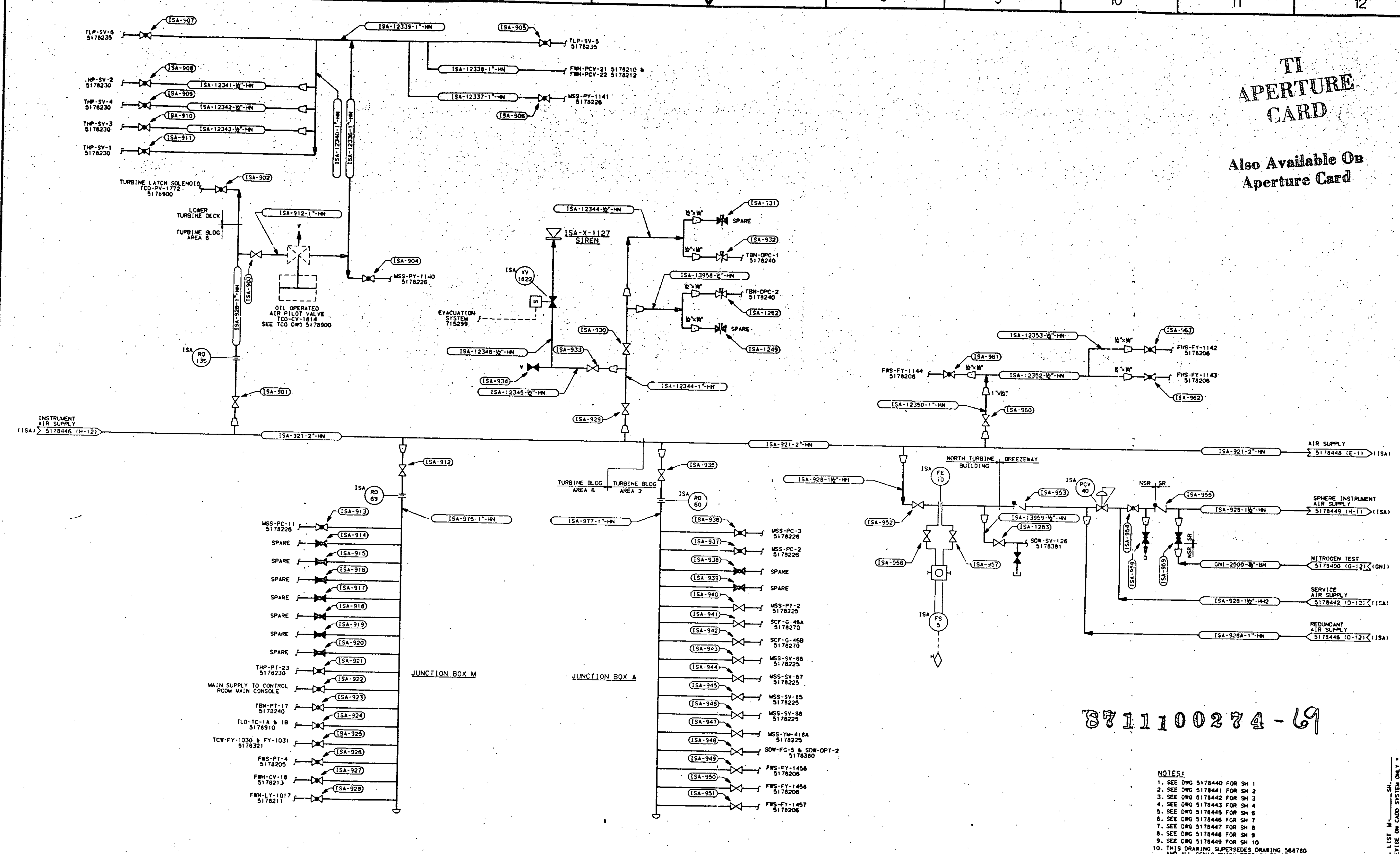
___OF___SHTS.

DWG. LIST SH. • REVISE ON CADD SYSTEM ONLY •

8711100274-62

568780

5178442-5



TI APERTURE CARD

Also Available On Aperture Card

8711100274-69

NOTES:
1. SEE DWG 5178440 FOR SH 1
2. SEE DWG 5178441 FOR SH 2
3. SEE DWG 5178442 FOR SH 3
4. SEE DWG 5178443 FOR SH 4
5. SEE DWG 5178445 FOR SH 6
6. SEE DWG 5178446 FOR SH 7
7. SEE DWG 5178447 FOR SH 8
8. SEE DWG 5178448 FOR SH 9
9. SEE DWG 5178449 FOR SH 10
10. THIS DRAWING SUPERSEDES DRAWING 568780 AND ALL CCN'S WHICH PERTAIN TO IT

SAFETY RELATED AS NOTED (SRAN)

WP 82-063

ISA

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3

REFERENCE DRAWINGS

NO.	REVISIONS		
1	AS BUILT-INCORP DCN #1		DVY 8744
0	ISSUED AS BUILT	SEE CDM FILES FOR SIGNATURES	DVY 8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
INSTRUMENT & SERVICE
AIR SYSTEM SHEET 5

SCE EDISON
Rosemead California

SHEET NO. M

SCALE: NONE

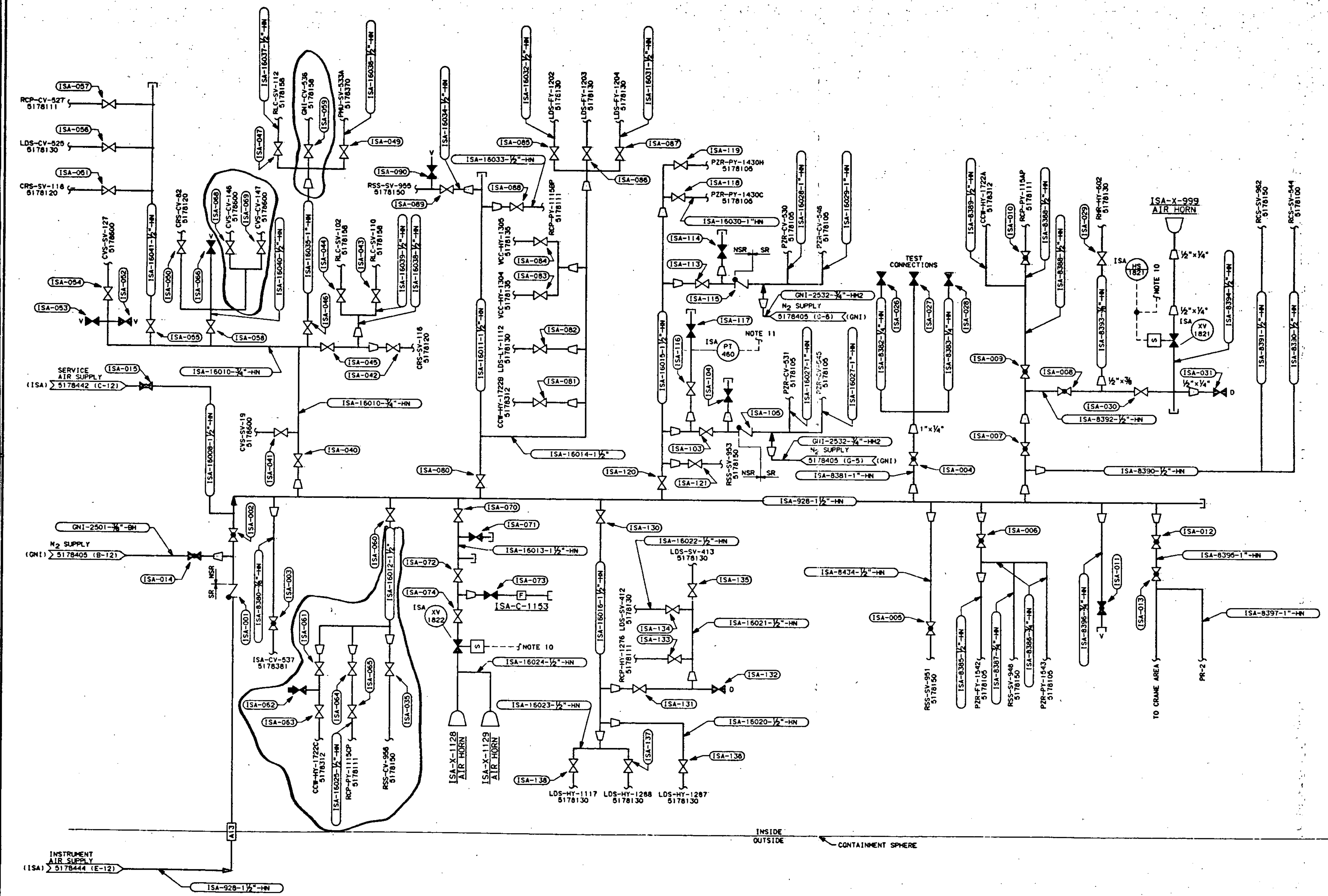
___ OF ___ SHTS.

568780
8/17/84

5178444-1

TI
APERTURE
CARD

Also Available On
Aperture Card



87111 00274-70

NOTES:

1. SEE DWG 5178440 FOR SH 1
2. SEE DWG 5178441 FOR SH 2
3. SEE DWG 5178442 FOR SH 3
4. SEE DWG 5178443 FOR SH 4
5. SEE DWG 5178444 FOR SH 5
6. SEE DWG 5178445 FOR SH 6
7. SEE DWG 5178446 FOR SH 7
8. SEE DWG 5178447 FOR SH 8
9. SEE DWG 5178448 FOR SH 9
10. SEE DWG 456377 FOR CONTROL DETAILS
11. SEE DWG 5154618 FOR CONTROL DETAILS
12. THIS DRAWING SUPERSEDES DRAWING 568780 AND ALL CCN'S WHICH PERTAIN TO IT.

SAFETY RELATED
AS NOTED
(SRAN)

WP 82-297

ISA

DWG. LIST M— SH—
● REVISE ON CADD SYSTEM ONLY ●

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
5	AS BUILT-INCORP DCN #8 & MINOR CHANGES									BLS	3083
4	AS BUILT-INCORP DCN #7		SEE	CDM	FILES	FOR SIGNATURES				BLS	3083
3	AS BUILT-INCORP DCN #6		SEE	CDM	FILES	FOR SIGNATURES				BLS	3083
2	AS BUILT-INCORP DCN #5,DCN#4 CANCELLED		SEE	CDM	FILES	FOR SIGNATURES				DVY	6881
1	AS BUILT-INCORP DCN #2 & #3-CC #1 CANCELED		SEE	CDM	FILES	FOR SIGNATURES				DVY	8744
0	ISSUED AS BUILT		SEE	CDM	FILES	FOR SIGNATURES				DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
INSTRUMENT & SERVICE
AIR SYSTEM SHEET 10

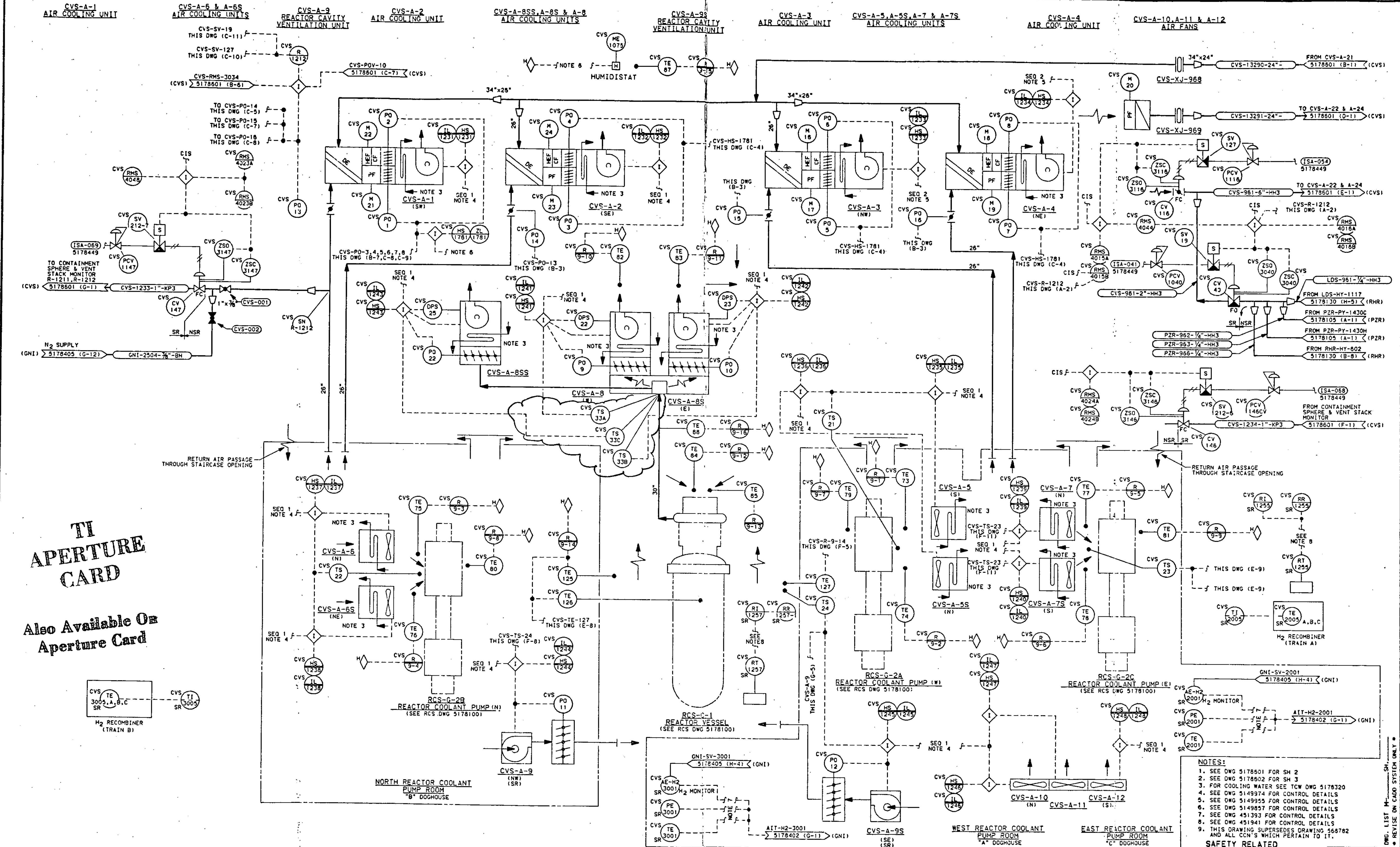
Southern California Edison

SHEET NO.
M

SCALE: NONE
___ OF ___ SHTS.

568780

5178449-5



NOTES:
1. SEE DWG 5178501 FOR SH 2
2. SEE DWG 5178502 FOR SH 3
3. FOR COOLING WATER SEE TCW DWG 5178320
4. SEE DWG 5149974 FOR CONTROL DETAILS
5. SEE DWG 5149955 FOR CONTROL DETAILS
6. SEE DWG 5149857 FOR CONTROL DETAILS
7. SEE DWG 451393 FOR CONTROL DETAILS
8. SEE DWG 451941 FOR CONTROL DETAILS
9. THIS DRAWING SUPERSEDES DRAWING 568782 AND ALL CCN'S WHICH PERTAIN TO IT.

SAFETY RELATED AS NOTED (SRAN)

WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
568656	HVAC EQUIPMENT SCHEDULE
REFERENCE DRAWINGS	

NO.	REVISIONS		DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
6	AS BUILT-INCORP DCN #9									BLS	3083

NO.	REVISIONS		DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
5	AS BUILT-INCORP DCN #8 & MINOR CHANGES		SEE	COM	FILES		FOR SIGNATURES			DV	3083
4	AS BUILT-INCORP DCN #7		SEE	COM	FILES		FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #6		SEE	COM	FILES		FOR SIGNATURES			BLS	3083
2	AS BUILT-INCORP CC #5		SEE	COM	FILES		FOR SIGNATURES			BLS	3125
1	AS BUILT-INCORP DCN #2-CC #1, #2 & 4 CANCELED		SEE	COM	FILES		FOR SIGNATURES			BLS	6744
0	ISSUED AS BUILT		SEE	COM	FILES		FOR SIGNATURES			BLS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
CONTAINMENT VENTILATION
SYSTEM SHEET 1

Southern California Edison

CVS

SHEET NO. M

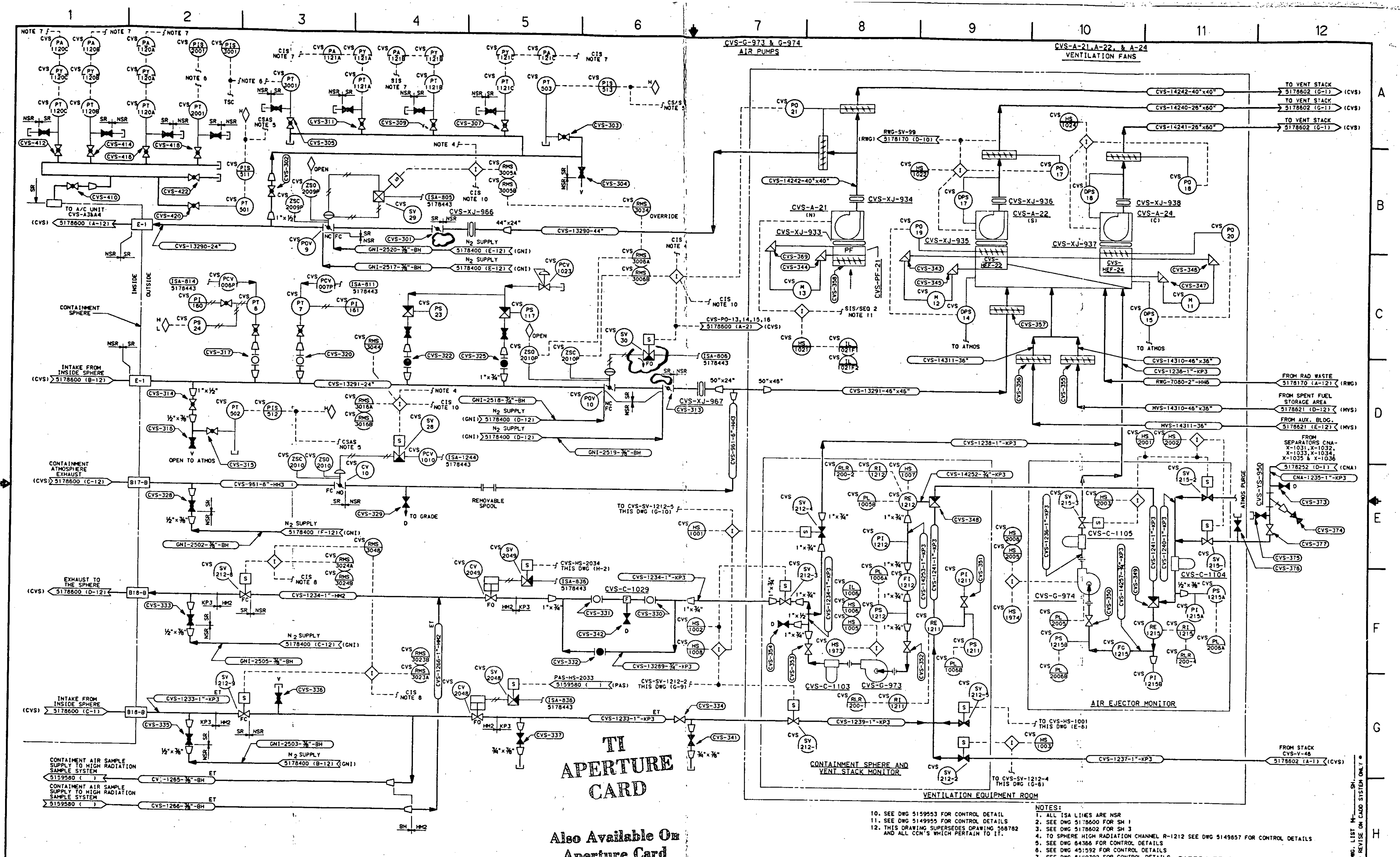
SCALE: NONE

___OF___SHTS.

DWG. LIST M-___ SH.___ • REVISE ON CADD SYSTEM ONLY •

8711100274-71

5178600-6



10. SEE DWG 5159553 FOR CONTROL DETAIL
11. SEE DWG 5149955 FOR CONTROL DETAILS
12. THIS DRAWING SUPERSEDES DRAWING 568782 AND ALL CCN'S WHICH PERTAIN TO IT.

NOTES:
1. ALL ISA LINES ARE NSR
2. SEE DWG 5178600 FOR SH 1
3. SEE DWG 5178602 FOR SH 3
4. TO SPHERE HIGH RADIATION CHANNEL R-1212 SEE DWG 5149657 FOR CONTROL DETAILS
5. SEE DWG 64366 FOR CONTROL DETAILS
6. SEE DWG 451592 FOR CONTROL DETAILS
7. SEE DWG 5149702 FOR CONTROL DETAILS
8. SEE DWG 5159551 FOR CONTROL DETAILS
9. ALL ANNUNCIATORS ARE NSR

SAFETY RELATED AS NOTED (SRAN)

WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1	5419857	ELEM DIAGRAM PRESS EQUAL, INSTR AIR, DAMPERS
5178001	P & I DIAGRAM LEGEND SH 2		
5178002	P & I DIAGRAM LEGEND SH 3	455488	ELEM DIAGRAM-PURGE FAN A-21
5149890	ELEM DIAGRAM SPHERE ISOL VALVES	568596	HVAC LAYOUT-FUEL BLDG PLAN
5159888	ELEM DIAGRAM CV-2048,2049,2033,2034	568597	HVAC LAYOUT-FUEL BLDG SECTIONS
5150628	ELEM DIAGRAM FANS A-22,A-24	568888	HVAC EQUIPMENT SCHEDULE
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
4	AS BUILT-INCORP DCN #9 & MINOR CHANGE								AR	GAC	3831
3	AS BUILT-INCORP DCN #8		SEE	CDM	FILES	FOR SIGNATURES				ELS	3083
2	AS BUILT-INCORP DCN #4,#5#6 & #7		SEE	CDM	FILES	FOR SIGNATURES				ELS	8681
1	AS BUILT-INCORP DCN #2 & #3-CC #1 CANCELED		SEE	CDM	FILES	FOR SIGNATURES				DVY	8744
0	ISSUED AS BUILT		SEE	CDM	FILES	FOR SIGNATURES				DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
CONTAINMENT VENTILATION
SYSTEM SHEET 2

Southern California Edison

CVS

SHEET NO.
M

SCALE: NONE

___ OF ___ SHTS.

DWG. LIST M- ___ SH ___
• REVISE ON CADD SYSTEM ONLY •

03-26-87

8711100274-72

568782

5178601-4

FIGURE 2: CIS PANEL
(LEFT SECTION)

(1) CONT CLG OUT CV-516 OPEN	(5) CONT CLG OUT CV-515 CLOSE	(9) PRE AIR TO SF POV-9 OPEN	(13) PRE AIR TO SF POV-9 CLOSE	(17) SPN SUMP DIS CV-103 OPEN	(21) SPN SUMP DIS CV-108 CLOSE	(25) RCS DR TK D13 CV-105 OPEN	(29) RCS DR TK D15 CV-105 CLOSE	(33) RCS DR TK VNT CV-107 OPEN	(37) RCS DR TK VNT CV-107 CLOSE	(41) N2 to DR TK CV-536 OPEN	(45) N2 TO DR TK CV-536 CLOSE	(49) SG A STM SPL SV-119 OPEN	(53) SG A STM SPL SV-119 CLOSE	(57) SG A BLD SPL SV-123 OPEN	(61) SG A BLD SPL SV-123 CLOSE
(2)	(6)	(10) PRG AIR FR SP POV-10 OPEN	(14) PRG AIR FR SP POV-10 CLOSE	(18)	(22)	(26)	(30)	(34)	(38)	(42) H2 CALIB GAS SV-2004 OPEN	(46) H2 CALIB GAS SV-2004 CLOSE	(50) SG B STM SPL SV-120 OPEN	(54) SG B STM SPL SV-120 CLOSE	(58) SG B BLD SPL SV-122 OPEN	(62) SG B BLD SPL SV-122 CLOSE
(3) LETDOWN CV-525 OPEN	(7) LETDOWN CV-525 OPEN	(11) SPH SVC AIR SV-125 OPEN	(15) SPH SVC AIR SV-125 CLOSE	(19) SPH SVC WTR CV-537 OPEN	(23) SPH SVC WTR CV-537 CLOSE	(27)	(31)	(35) SI LP CVNT SV-702B OPEN	(39) SI LP CVNT SV-702B OPEN	(43) ORMS SPL SUP SV-1212-9 OPEN	(47) ORMS SPL SUP SV-1212-9 CLOSE	(51) SG C STM SPL SV-121 OPEN	(55) SG C STM SPL SV-121 CLOSE	(59) SG C BLD SPL SV-124 OPEN	(63) SG C BLD SPL SV-124 CLOSE
(4) SEAL WTR RET CV-527 OPEN	(8) SEAL WTR RET CV-527 CLOSE	(12)	(16)	(20) PRI MAKE UP CV-533 OPEN	(24) PRI MAKE UP CV-533 CLOSE	(28) SPHERE VENT CV-10 OPEN	(32) SPHERE VENT CV-10 CLOSE	(36) SI LP B VHF SV-702D OPEN	(40) SI LP B VHF SV-702D CLOSE	(44) ORMS SPG RET SV-1212B OPEN	(48) ORMS SPG RET SV-1212B CLOSE	(52)	(56)	(60)	(64)

LEGEND

| White Mounting Barriers (Outside Containment)

* Asterisk Mounting Barriers (Inside Containment)

CONTIANMENT ISOLATION
SYSTEM
SUB PANEL C13A

(1) CONT CLG IN CV-516 OPEN	(5) CONT CLG IN CV-516 CLOSE	(9) PRT GAS SPL CV-949 OPEN	(13) PRT GAS SPL CV-949 OPEN	(17) SPH SUMP DIS CV-102 OPEN	(21) SPH SUMP DIS CV-102 CLOSE	(25) RCS DR TK DIS CV-104 OPEN	(29) RCS DR TK DIS CV-104 CLOSE	(33) RCS DR TK VNT CV-106 OPEN	(37) RCS DR TK VNT CV-106 CLOSE	(41) N2 TO DR TK CV-535 OPEN	(45) N2 TO DR TK CV-535 CLOSE	(49)	(53)	(57)	(61)
(2) CONT N2 SUMP CV-532 OPEN	(6) CONT N2 SUMP CV-532 OPEN	(10) AUX CLG SPL CV-102 OPEN	(14) AUX CLG SPL CV-102 CLOSE	(18)	(22)	(26) RC LOOP SPL SV-3302 OPEN	(30) RC LOOP SPL SV-3302 CLOSE	(34) RC RET LINE SV-3302 OPEN	(38) RC RET LINE SV-3302 CLOSE	(42) H2 CALIB GAS SV-3004 OPEN	(46) H2 CALIB GAS SV-3004 CLOSE	(50)	(54)	(58)	(62)
(3) LETDOWN CV-526 OPEN	(7) LETDOWN CV-526 CLOSE	(11) PZR SAMPLE CV-992 OPEN	(15) PZR SAMPLE CV-992 CLOSE	(19) SPH SVC WTR CV-115 OPEN	(23) SPH SVC WTR CV-115 CLOSE	(27) SPH EQL VLV CV-116 OPEN	(31) SPH EQL VLV CV-116 CLOSE	(35) SI LP C VNT SV-702A OPEN	(39) SI LP C VNT SV-702A CLOSE	(43) ORMS SVC SUP CV-147 OPEN	(47) ORMS SVC SUP CV-147 CLOSE	(51)	(55)	(59)	(63)
(4) SEAL WTR RET CV-528 OPEN	(8) SEAL WTR RET CV-538 CLOSE	(12) CHARG LN SPL CV-2145 OPEN	(16) CHARG LN SPL CV-2145 CLOSE	(20) PRI MAKE UP CV-534 OPEN	(24) PRI MAKE UP CV-534 CLOSE	(28) INST HDR VNT CV-40 OPEN	(32) INST HDR VNT CV-40 CLOSE	(36) SILP B VNT SV-702C OPEN	(40) SILP B VNT SV-702C CLOSE	(44) ORMS SPL RET CV-146 OPEN	(48) ORMS SPL RET CV-146 CLOSE	(52)	(56)	(60)	(64)

TI
APERTURE
CARD

CONTIANMENT ISOLATION
SYSTEM
SUB PANEL C13B

Also Available On
Aperture Card

8711100274-73

TABLE 1

CI Line/Valve Information

SYS - LINE NO.	PENT NO.	* PENT TYPE / GRP.	SERVICE	INSIDE SPHERE VALVE NO	INSIDE SPHERE VALVE TYPE	INSIDE SPHERE ACT. TYPE	INSIDE SPHERE ACT. METHOD	INSIDE SPHERE NORM POS	INSIDE SPHERE FAIL POS	OUTSIDE SPHERE VALVE NO.	OUTSIDE SPHERE VALVE TYPE	OUTSIDE SPHERE ACT. TYPE	OUTSIDE SPHERE ACT. METHOD	OUTSIDE SPHERE NORM POS.	OUTSIDE SPHERE FAIL POS.	DRAWING NO.
				THE FOLLOWING LINES ISOLATE AUTOMATICALLY ON CIS												
CVS-24" SUPPLY	E-1	E / D	SPHERE PURGE SUPPLY							POV-9	BUTTER-FLY	AOV	CIS HI ROD R.M.	C	FAI	5178601
CVS-24" EXHAUST	E-1	E / D	SPHERE PURGE EXHAUST							POV-10	BUTTER-FLY	AOV	CIS HI ROD R.M.	C	FAI	5178601
CVS-961-2"-HH3	B-17B	B / B	SPHERE ATMOSPHERIC EXHAUST	CV40 CV116	GLOBE BUTTER-FLY	AOV AOV	CIS HI ROD R.M.	C	FC	CV-10	BUTTER-FLY	AOV	CIS HI ROD R.M.	C	FC	5178600 5178601
CVS-1233-1"-KP3	B-18B	B / B	SPHERE VAPOR SAMPLE SUPPLY	CV-147	GLOBE	AOV	CIS R.M.	NA	FC	SV-1212-9	GLOBE	SV	CIS HI ROD R.M.	NA	FC	5178600 5178601
CVS-1234-1"-KP3	B-18B	B / B	SPHERE SAMPLE RETURN	CV-146	GLOBE	AOV	CIS R.M.	NA	FC	SV-1212-8	GLOBE	SV	CIS HI ROD R.M.	NA	FC	5178600 5178601
SDW-730-2"-KN	A-11	A / NOTE 1	SERVICE WATER	CV-537	BALL	CONTROL MATIC	CIS R.M.	O	FC	CV-115	GLOBE	AOV	CIS R.M.	O	FC	5178381
RLC-7073-2"-HP2	C-2B	B / A	RCDT VENT	CV-106	GLOBE	AOV	CIS R.M.	C	FC	CV-107	GLOBE	AOV	CIS R.M.	C	FC	5178158
RLC-7076-2"-HP2	B-10	B / A	RCDT DISCHARGE	CV-104	GLOBE	AOV	CIS R.M.	C	FC	CV-105	GLOBE	AOV	CIS R.M.	C	FC	5178158
RLC-7078-1-1 1/2"-HP2	A-8	B / A	SPHERE SUMP DISCHARGE	CV-102	GLOBE	AOV	CIS R.M.	C	FC	CV-103	GLOBE	AOV	CIS R.M.	C	FC	5178158
PMU-715-3"-HP	B-2	B / NOTE 1	MAKE-UP TO PRT	CV-533	BALL	CONTROL MATIC	CIS R.M.	C	FC	CV-534	BALL	CONTROL MATIC	CIS R.M.	C	FC	5178370
SIS-6107-3/4"- CL	E-15	B / A	SIS LOOP 'C' VENT	SV-702B	GLOBE	SV	CIS R.M.	C	FC	SV-702A	GLOBE	SV	CIS R.M.	C	FC	5178115
SIS-6108-3/4" - CL	E-15	B / A	SIS LOOP 'B' VENT	SV-702D	GLOBE	SV	CIS R.M.	C	FC	SV-702C	GLOBE	SV	CIS R.M.	C	FC	5178115
GNI-1410-1"-HH	C-2A	A / NOTE 1	N_2 TO RCDT	CV-536	BALL	CONTROL MATIC	CIS R.M.	C	FC	CV-535	BALL	CONTROL MATIC	CIS R.M.	C	FC	5178158
GNI-14120-1/2" -HH	B-16B	A / B	H_2 CALIBRATION GAS	SV-3004	GLOBE	SV	CIS R.M.	C	FC	SV-2004	GLOBE	SV	CIS R.M.	C	FC	5178402 5178405
ISA-953-2"-HH2	A-12	A / D	SERVICE AIR							SV-125	GLOBE	SV	CIS R.M.	O	FC	5178442
FSS-1201-3/4"-EG1	B-12	C / C	STEAM SAMPLE FROM 'A' SG							SV-119	GLOBE	SV	CIS R.M.	C	FC	5178260
FSS-1202-3/4 "-EG1	B-12	C / C	STEAM SAMPLE FROM 'B' SG							SV-120	GLOBE	SV	CIS R.M.	C	FC	5178260

TABLE 1

CI Line/Valve Information
(Continued)

				INSIDE SPHERE						OUTSIDE SPHERE						
SYS - LINE NO.	PENT NO.	* PENT TYPE GRP.	SERVICE	VALVE NO	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS	FAIL POS	VALVE NO.	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS.	FAIL POS.	DRAWING NO.
FSS-1203-3/4"-EG1	B-12	C / C	STEAM SAMPLE FROM 'C' SG							SV-121	GLOBE	SV	CIS R.M.	C	FC	5178260
FSS-1207-3/4"-EG1	B-12	C / C	BLOWDOWN SAMPLE FROM 'C' SG							SV-124	GLOBE	SV	CIS R.M.	0	FC	5178260
FSS-1208-3/4"-EG1	B-12	C / C	BLOWDOWN SAMPLE FROM 'B' SG							SV-122	GLOBE	SV	CIS R.M.	0	FC	5178260
FSS-1209-3/4"-EG1	B-12	C / C	BLOWDOWN SAMPLE FROM 'A' SG							SV-123	GLOBE	SV	CIS R.M.	0	FC	5178260
PZR-5029-3/4"-BH2 PZR-5032-3/4"-BH2	B-12	B / A	PZR SAMPLE, LIQUID STEAM	CV-951 CV-953	GLOBE	AOV	R.M.	C	FC	CV-992	GLOBE	AOV	CIS R.M.	C	FC	5178150
PZR-5052-3/4"-HH9	B-12	B / A	PRT GAS SAMPLE	CV-948	GLOBE	AOV	R.M.	C	FC	CV-949	GLOBE	AOV	CIS R.M.	C	FC	5178158
RCS-5004-3/4"-BH2 PZR-5032-3/4"-BH2	B-12	B / A	RCS LOOP B & C SAMPLE	CV-955 CV-956 SV-3302	GLOBE	AOV SV	R.M. CIS RM	C C	FC FC	SV-3303	GLOBE	SV	CIS R.M.	C	FC	5178150
RHR-3008- "-BH2	B-12	B / A	RHR SAMPLE	CV-962	GLOBE	AOV	R.M.	C	FC	CV-957	GLOBE	AOV	CIS R.M.	C	FC	5178150

				INSIDE SPHERE						OUTSIDE SPHERE						
SYS - LINE NO.	PENT NO.	* PENT TYPE GRP.	SERVICE	VALVE NO	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS	FAIL POS	VALVE NO.	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS.	FAIL POS.	DRAWING NO.
THE FOLLOWING LINES ARE MANUAL ISOLATIONS WITH VALVES INDICATED ON THE CIS PANEL																
TCW-743-8"-KN	A-9A	A / NOTE 1	COOLING WATER TO AIR HANDLING UNITS							CV-516	BALL	P.M. P/H	R.M.	0	FC	5178320
TCW-756-8"-KN TCW-892-4"-KN	A-9B A-14	A / NOTE 1	COOLING WATER FROM AIR HANDLING UNITS							CV-515	BALL	P.M. P/H	R.M.	0	FC	5178320
LDS-3006-2"-601	B-6	B / A	LETDOWN TO CVCS	CV-525	BALL					CV-526	BALL	P.M. P/H	R.M.	0	FC	5178130 5178140
RCP-2014-3"-HK	B-8	B / A	RCP SEAL WATER RETURN	CV-527	BALL					CV-528	BALL	P.M. P/H	R.M.	0	FC	5178111 5178136
VCC 2024-3/4"-BH3	NA	NA	CHARGINE LINE SAMPLE							CV-2145	GLOBE	SV	R.M.	C	FC	5178150
GNI- 1409-3/4"-HH	A-5	B / NOTE 1	N 2 TO CONTAINMENT							CV-532	BALL	CONTROL MATIC	R.M.	C	FC	5178405 5178406

3217i

TI APERTURE CARD

Also Available On Aperture Card

8711100274-75

TABLE 1

CI Line/Valve Information
(Continued)

		*		INSIDE SPHERE						OUTSIDE SPHERE						
SYS - LINE NO.	PENT NO.	PENT TYPE GRP.	SERVICE	VALVE NO	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS	FAIL POS	VALVE NO.	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS.	FAIL POS.	DRAWING NO.
THE FOLLOWING LINES ARE ALSO CONSIDERED AS REQUIREMENTS FOR CONTAINMENT ISOLATION IN THE FSA																
VCC-2002-2"-BH3 VCC-2080-2"-BH2 VCC-2081-2"-BH2	B-5	B/A	CHARGING AUX SPRAY TO PZR							FCV-1112	GLOBE	AOV	FC1112 R.M.	0	FO NOTE 4	5178135
RCP-2006-2"-BH3	B-7C	B/A	SEAL WATER TO 'A' RCP							FCV-1115A	GLOBE	AOV	FC1115 R.M.	0	FO NOTE 4	5178110
RCP-2009-2"-BH3	B-7B	B/A	SEAL WATER TO 'B' RCP							FCV-1115B	GLOBE	AOV	FC-1115B R.M.	0	FO NOTE 4	5178110
RCP-2012-2"-BH3	B-7A	B/A	SEAL WATER TO 'C' RCP							FCV-1115C	GLOBE	AOV	FC-1115C R.M.	0	FO NOTE 4	5178110
CCW-3064-8"-HH9	A-1D	A/NOTE 1	CCW TO RHR HX 'A'													5178312
CCW-3033-8"-HH9	A-1C	C/NOTE 1	CCW FROM RHR HX 'A'													5178312
CCW-3090-8"-HH9	A-1B	A/NOTE 1	CCW TO RHR HX 'B'													5178312
CCW-3029-8"-HH9	A-1A	C/NOTE 1	CCW FROM RHR HX 'B'													5178312
CCW-3069-3"-HH9	A-4B	a/NOTE 1	CCW TO RCP 'A'													5178312
CCW-3073-3"-HH9	A-4A	A/NOTE 1	CCW FROM RCP 'A'													5178312
CCW-3068-3"-HH9	A-4F	A/NOTE 1	CCW TO RCP 'B'													5178312
CCW-3078-3"-HH9	A-4E	A/NOTE 1	CCW FROM RCP 'B'													5178312
CCW-3067-3"-HH9	A-4D	A/NOTE 1	CCW TO RCP 'C'													5178312
CCW-3083-3"-HH9	A-4C	A/NOTE 1	CCW FROM RCP 'C'													5178312

8711100274-76

TABLE 1

CI Line/Valve Information
(Continued)

SYS - LINE NO.	PENT NO.	* PENT TYPE GRP.	SERVICE	INSIDE SPHERE VALVE NO	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS	FAIL POS	OUTSIDE SPHERE VALVE NO.	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS.	FAIL POS.	DRAWING NO.
CCW-3094-2 1/2"-HH	A-2A	A / NOTE 1	CCW TO SHIELD COOLING COILS													5178312
CCW-3095-2 1/2"-HH	A-2B	A / NOTE 1	CCW FROM SHIELD COOLING COILS													5178312
CCW-3066-3"-HH9	A-3A	A / NOTE 1	CCW TO EXESS Ltd. HX													5178312
CCW-3085-3"-HH9	A-3B	C / NOTE 1	CCW FROM EXCESS Ltd. HX													5178312
SIS-6008-6"-BH2 SIS-6006-6"-BH2 SIS-6007-6"-BH2	B-1C	B / NOTE 2	SIS TO LOOP 'A' 'B' 'C'							HV-851A HV-851B	GATE	P/H	R.M.	0	FAI	5178115
SIS-6009-2"-CL	B-17A	B / NOTE 2	SI RECIRC. TO RWST							385	GLOBE	MAN.	MAN.	0	NA	5179115
MSS-7-24"-EG	1-J-1	D / C	STEAM HEADER WEST							TURBINE STOP		AOV	TURB TRIP	0	FC / NOTE 5	5178225 5178226
MSS-6-24"-EG	2-J-1	D / C	STEAM HEADER WEST							TURBINE STOP		AOV	TURB TRIP	0	FC / NOTE 5	5178225 5178226
ISA-928-1 1/2"-HN	A-13	A / NOTE 1	INSTRUMENT AIR							PCV-40	GLOBE	AOV	SELF	0	FC	5178444 5178449
FWS-393-10"-EG	C-3A	C / C	FEEDWATER TO 'A' SG							FCV-456	GLOBE	AOV	SIS R.M.	0	FO NOTE 6	5178206 5178225
FWS-392-10"-EG	C-3C	C / C	FEEDWATER TO 'B' SG							FCV-457	GLOBE	AOV	SIS R.M.	0	FO NOTE 6	5178206 5178225
FWS-391-10"-EG	C-3B	C / C	FEEDWATER TO 'C' SG							FCV-458	GLOBE	AOV	SIS R.M.	0	FO NOTE 6	5178206 5178225
FWS-341-2"-EG FWS-343-2"-EG FWS-634-2"-EG	C-1A	C / C	BLOWDOWN FROM 'A' SG 'B' SG 'C' SG							CV-100 to blowdown tank / CV-100 A/B to outfall	CV-100 Angle CV-100AAngle CV-100BGlobe	AOV	HI ROD	CV-100C / CV-100A CV-100B 0	FC	5178206 5178225

TI APERTURE CARD

Also Available On Aperture Card

8711100274-77

TABLE 1

CI Line/Valve Information
(Continued)

SYS - LINE NO.	PENT NO.	* PENT TYPE GRP.	SERVICE	INSIDE SPHERE VALVE NO	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS	FAIL POS	OUTSIDE SPHERE VALVE NO.	VALVE TYPE	ACT. TYPE	ACT. METHOD	NORM POS.	FAIL POS.	DRAWING NO.
CRS-734-6"-HP	B-18A	C NOTE 2	REFUELING WATER TO CS	CV-92 CV-119 CV-82	BUTTER-FLY											5178120
CRS-728-8"-HP CRS-729-8"-HP CRS-737-8"-HP	B-11	C NOTE 8	SUMP RECIRC. RETURN AND REACTOR CAVITY DEWATERING													5178121

Note 1 - Lines which enter and leave the containment sphere but are not open to the containment sphere free volume or the outside atmosphere are not required to have isolation valves. These lines are either part of separate, closes systems or are not subject to damage as a result of a reactor system rupture.

Note 2 - Safety injection lines must remain open in the event of an accident.

Note 3 - The seal water return header is a closed loop connected to the charging system.

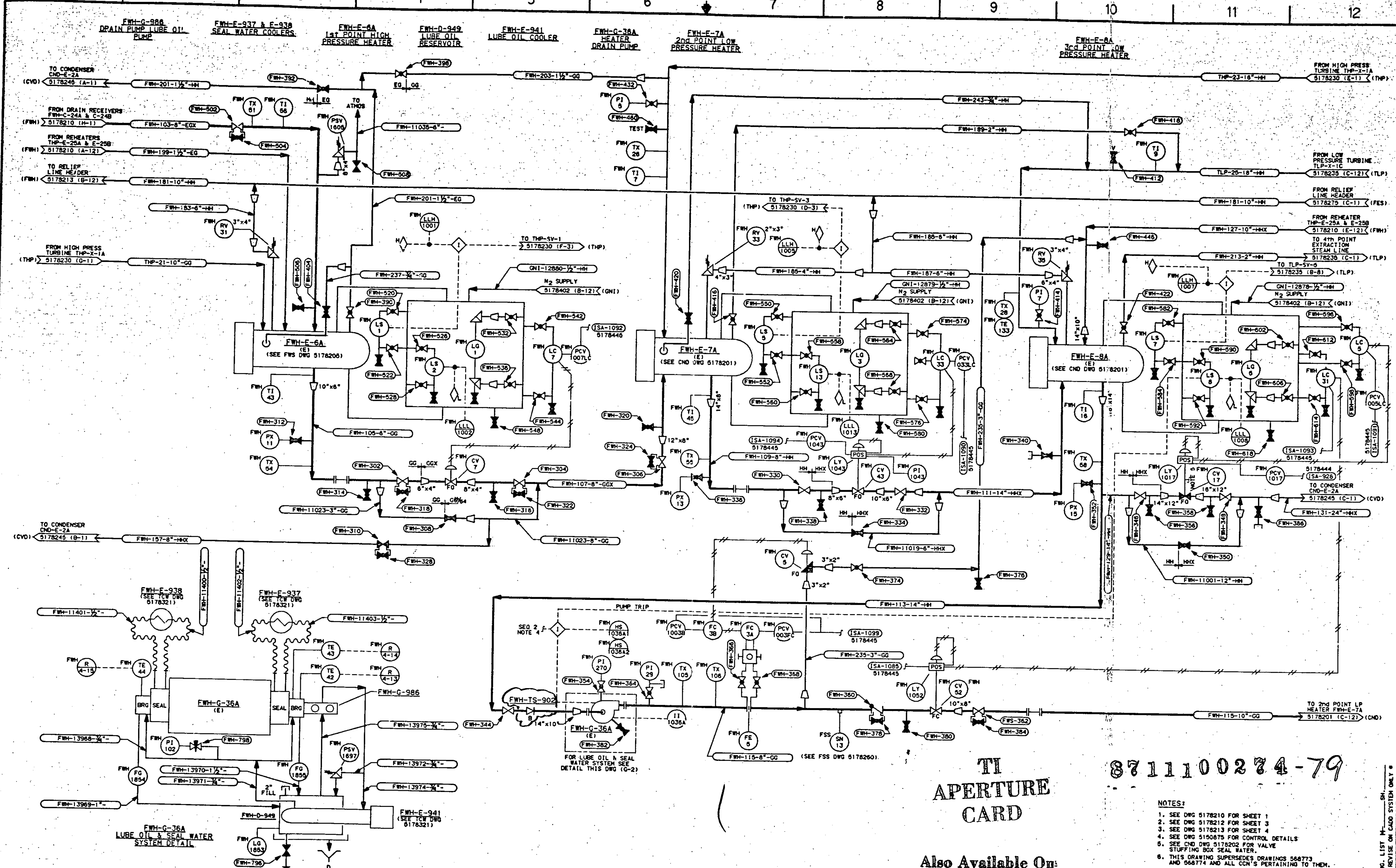
Note 4 - The seal water supply lines are designed as an alternate path for safety injection recirculation, requiring that isolation valves fail open.

Note 5 - The turbine stop valves fail as is, electrically, but will be closed by turbine overspeed trip.

Note 6 - The feed water regulating valves fail open due to heat sink requirements associated with reactor trips. However, check valves are provided to prevent reverse flow and remotely - controlled, motor-operated valves at the feed water pumps are a second means of isolation.

Note 7 - Penetration type is defined in System Description S01-630 Containment/Containment Isolation.

Note 8 - These lines are considered an extension of containment.



TI APERTURE CARD

8711100274-79

Also Available On Aperture Card

NOTES:

1. SEE DWG 5178210 FOR SHEET 1
2. SEE DWG 5178212 FOR SHEET 3
3. SEE DWG 5178213 FOR SHEET 4
4. SEE DWG 5150875 FOR CONTROL DETAILS
5. SEE CND DWG 5178202 FOR VALVE STUFFING BOX SEAL WATER.
6. THIS DRAWING SUPERSEDES DRAWINGS 568773 AND 568774 AND ALL CCN'S PERTAINING TO THEM.

DWG. LIST M-____ SH.____
• REVISE ON CADD SYSTEM ONLY •

NON-SAFETY RELATED (NSR)

WP 82-063

FWH

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
5149918	ELEM DIAGRAM HEATER DRAIN PUMP G-36A
	& G-36B
REFERENCE DRAWINGS	

N1541	ELEM DIAGRAM REHEATER DRAIN
	ANNUNCIATOR, SH 21
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
2	AS BUILT-INCORP DCN #2 & MINOR CHG.									ELS	3083
1	AS BUILT-INCORP DCN #1			SEE	CDM	FILES	FOR SIGNATURES			ELS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			ELS	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
1st, 2nd, 3rd POINT
FEEDWATER HEATERS SH 2

Southern California Edison

SHEET NO. M

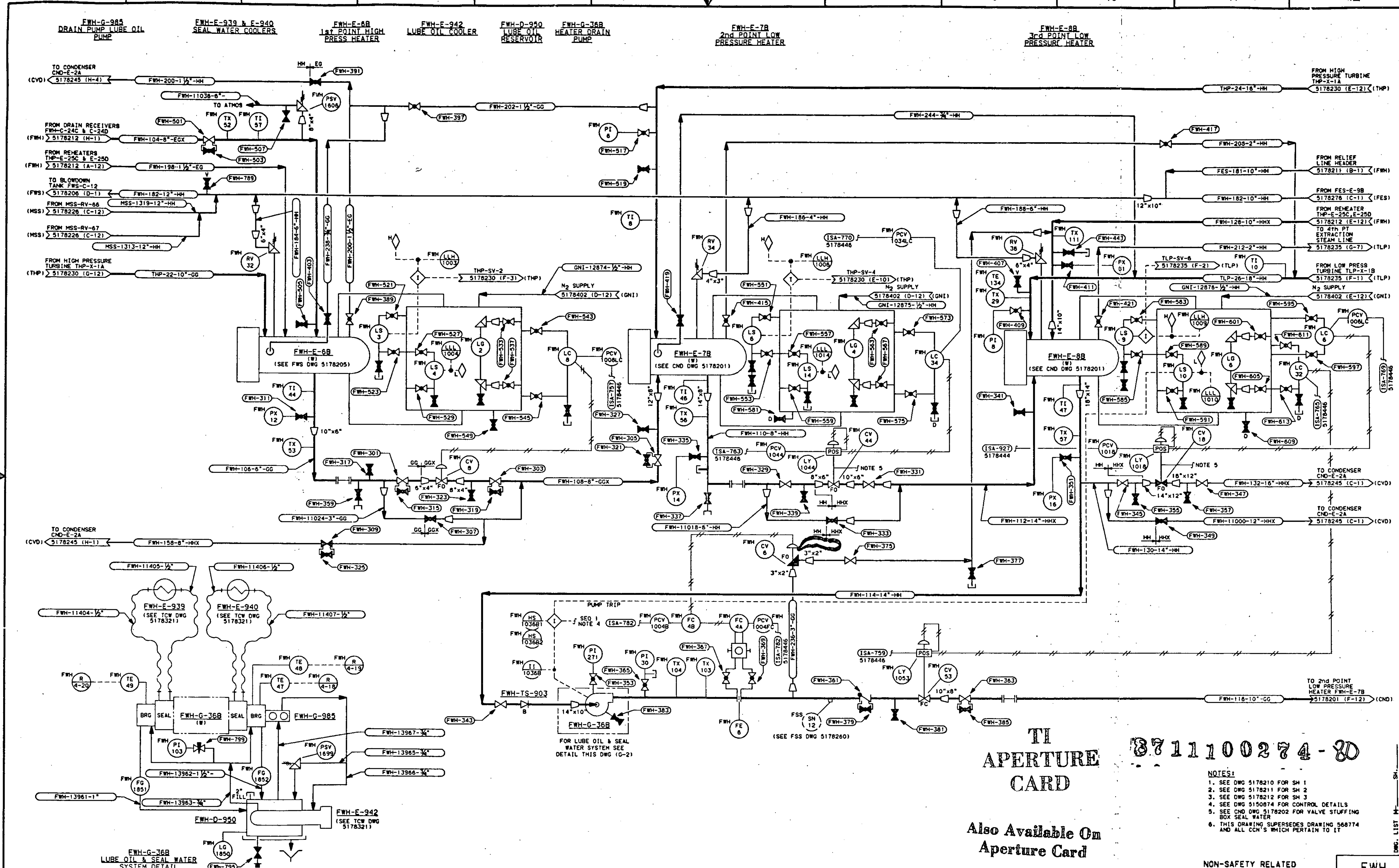
SCALE: NONE

____ OF ____ SHTS.

01-10-86

568774
568773

5178211-2



TI APERTURE CARD

8711100274-80

Also Available On Aperture Card

NOTES:
1. SEE DWG 5178210 FOR SH 1
2. SEE DWG 5178211 FOR SH 2
3. SEE DWG 5178212 FOR SH 3
4. SEE DWG 5150874 FOR CONTROL DETAILS
5. SEE CND DWG 5178202 FOR VALVE STUFFING BOX SEAL WATER
6. THIS DRAWING SUPERSEDES DRAWING 568774 AND ALL CCN'S WHICH PERTAIN TO IT

NON-SAFETY RELATED (NSR) WP 82-297

FWH

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
5149918	ELEM DIAGRAM-PUMPS G-36A & G-36B
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
5	AS BUILT-INCORP DCN #6									GAC	3831
4	AS BUILT-INCORP DCN #5 & MINOR CHANGES			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP DCN #4			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
2	AS BUILT-INCORP DCN #3			SEE	CDM	FILES	FOR SIGNATURES			BLS	8681
1	AS BUILT-INCORP DCN #1 & #2			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUE AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	6252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
1st, 2nd, 3rd POINT
FEEDWATER HEATERS SH 4

Southern California Edison

SHEET NO. M

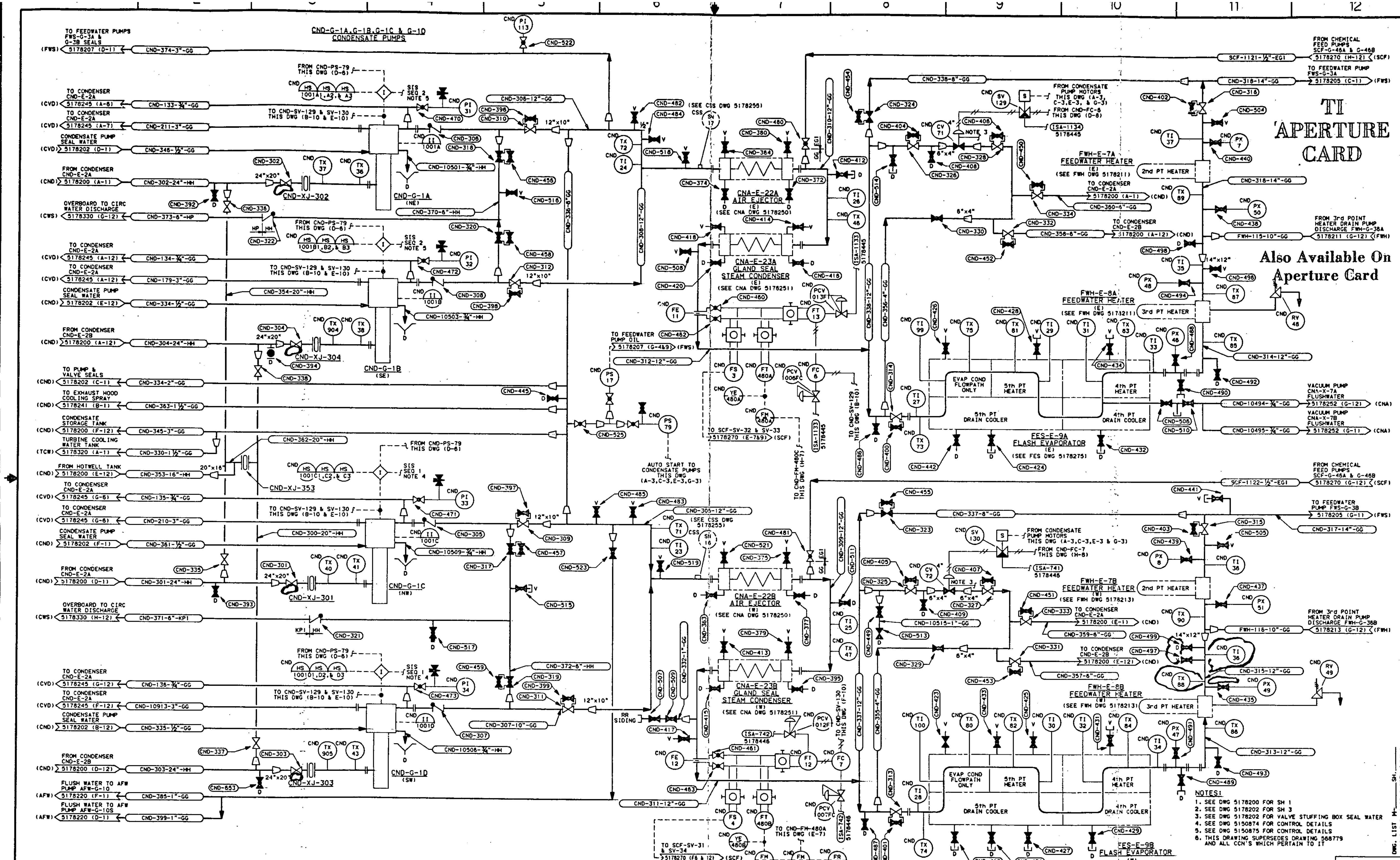
SCALE: NONE

____ OF ____ SHTS.

12-03-86

568774

5178213-5



NOTES:
1. SEE DWG 5178200 FOR SH 1
2. SEE DWG 5178202 FOR SH 3
3. SEE DWG 5178202 FOR VALVE STUFFING BOX SEAL WATER
4. SEE DWG 5150874 FOR CONTROL DETAILS
5. SEE DWG 5150875 FOR CONTROL DETAILS
6. THIS DRAWING SUPERSEDES DRAWING 568779 AND ALL CCN'S WHICH PERTAIN TO IT

DWG. LIST M-____ SH. ____
* REVISE ON CADD SYSTEM ONLY *

NON-SAFETY RELATED
(NSR)

WP 82-297

CND

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
5149970	ELEM DIAGRAM-COND PUMPS, SV-129 & SV-130
5149178	SEQUENCE LOAD SCHEDULE No 1
5149182	SEQUENCE LOAD SCHEDULE No 2
REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
4	AS BUILT-INCORP DCN #6 & MINOR CHANGES		11/13/86						AAR	GAC	3024
3	AS BUILT-INCORP DCN #4 & #5			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
2	AS BUILT-INCORP DCN #3			SEE	CDM	FILES	FOR SIGNATURES			BLS	8881
1	AS BUILT-INCORP DCN #2-DCN #1 CANCELED			SEE	CDM	FILES	FOR SIGNATURES			BLS	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
CONDENSATE SYSTEM
SHEET 2

Southern California Edison

SHEET NO.
M

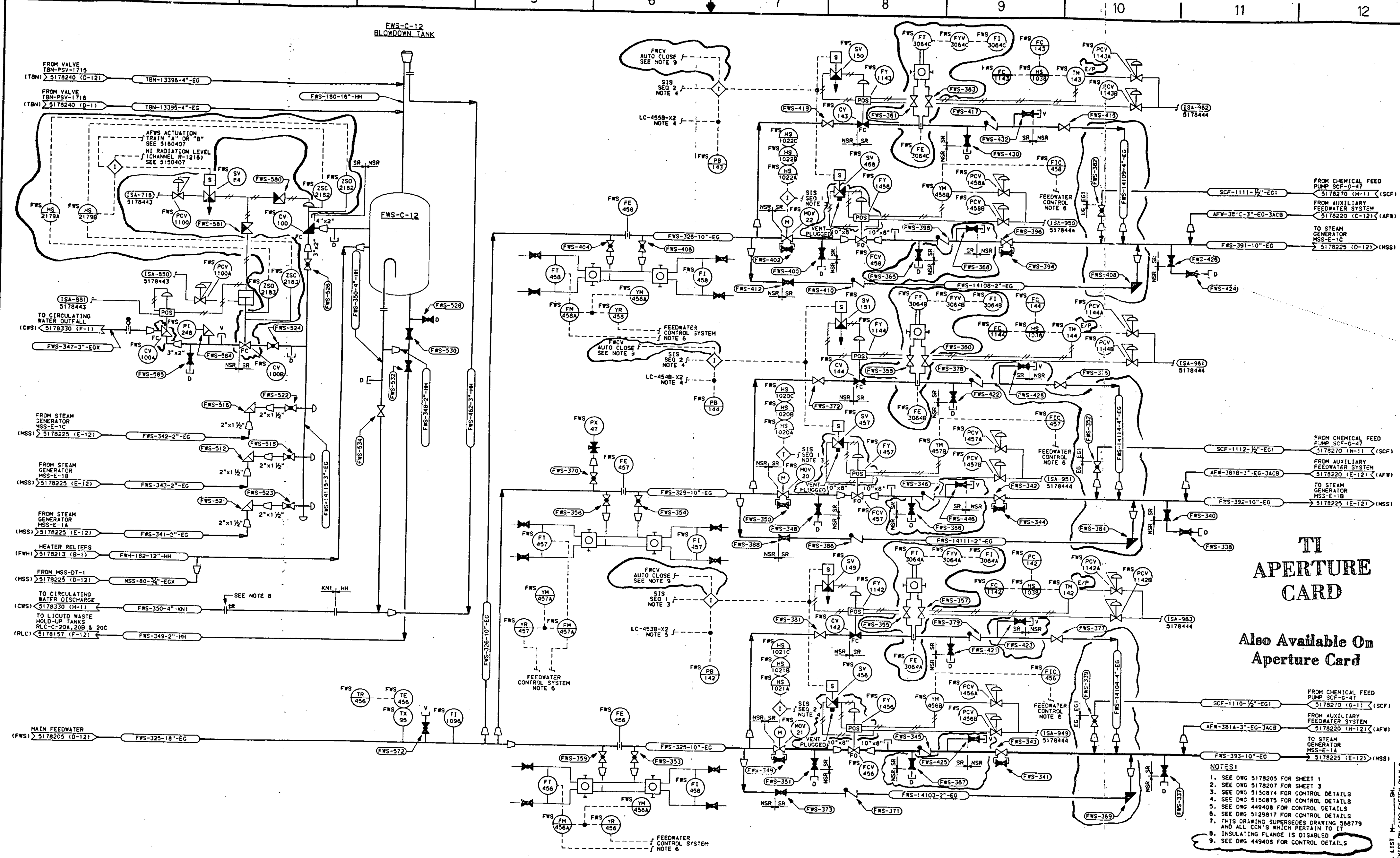
SCALE: NONE
____ OF ____ SHTS.

11-04-86

E4-652-CADD 03-85

568779

8711100274-81 5178201-4



NOTES:

1. SEE DWG 5178205 FOR SHEET 1
2. SEE DWG 5178207 FOR SHEET 3
3. SEE DWG 5150874 FOR CONTROL DETAILS
4. SEE DWG 5150875 FOR CONTROL DETAILS
5. SEE DWG 449408 FOR CONTROL DETAILS
6. SEE DWG 5129817 FOR CONTROL DETAILS
7. THIS DRAWING SUPERSEDES DRAWING 568779 AND ALL CCN'S WHICH PERTAIN TO IT
8. INSULATING FLANGE IS DISABLED
9. SEE DWG 449408 FOR CONTROL DETAILS

DWG. LIST M-____ SH.____
* REVISE ON CADD SYSTEM ONLY *

SAFETY RELATED EXCEPT AS NOTED (SREAN)

WP 82-297

5178000	P & I DIAGRAM LEGEND SH 1
5178001	P & I DIAGRAM LEGEND SH 2
5178002	P & I DIAGRAM LEGEND SH 3
455379	ELEM DIAGRAM MOV'S 20,21 & 22
N1543	ELEM DIAGRAM-CV-100,SH 18
REFERENCE DRAWINGS	

REFERENCE DRAWINGS

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
7	AS BUILT-INCORP DCN #11,12,13,14,15 & 16		7/21/86							BLS	3083
6	AS BUILT-INCORP DCN #9,10 & MINOR CHG'S			SEE	CDM FILES		FOR SIGNATURES			BLS	3083
5	AS BUILT-INCORP DCN #7,#8 CC#1 CANCELED			SEE	CDM FILES		FOR SIGNATURES			REP	3083
4	AS BUILT-INCORP DCN #6			SEE	CDM FILES		FOR SIGNATURES			DVY	3083
3	AS BUILT-INCORP DCN #5			SEE	CDM FILES		FOR SIGNATURES			BLS	3083
2	AS BUILT-INCORP DCN #3			SEE	CDM FILES		FOR SIGNATURES			BLS	8881
1	AS BUILT-INCORP DCN #2 & #4			SEE	CDM FILES		FOR SIGNATURES			DVY	8744
0	ISSUED AS BUILT			SEE	CDM FILES		FOR SIGNATURES			DVY	8252

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
FEEDWATER SYSTEM
SHEET 2

Southern California Edison

FWS

SHEET NO. M

SCALE: NONE

____ OF ____ SHTS.

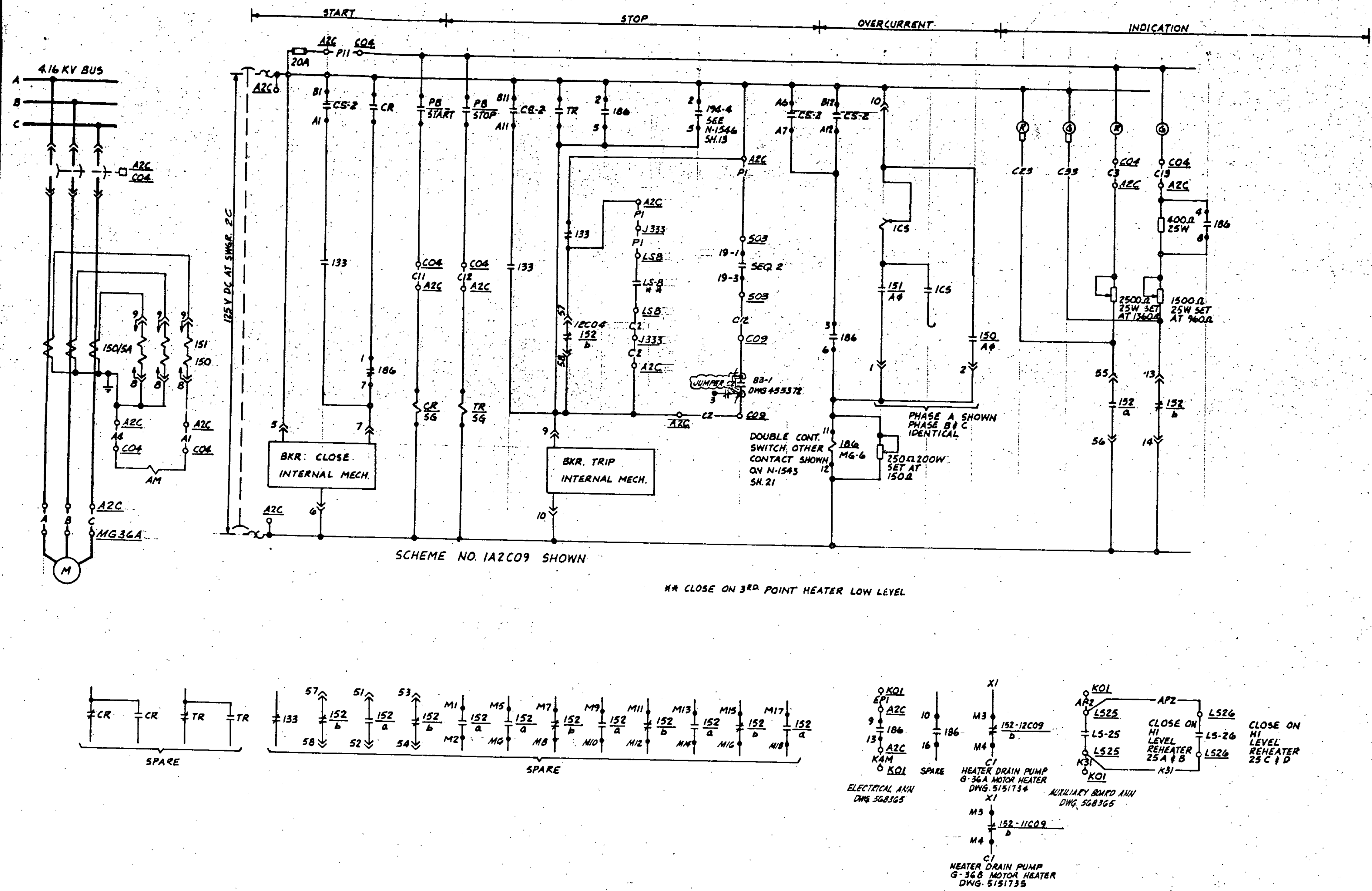
07-15-86

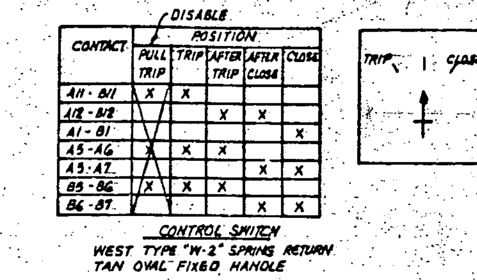
E4-652-CADD 03-85

568779

8711100274-22

5178206-7





TI APERTURE CARD

Also Available On Aperture Card

8711100274-83

EQUIPMENT	SCHEME NO.	BREAKER NO.	LS	152 b	J.B.	LOCATION		WIRE NO.	INTLK	INTLK	SEQUENCER NO.	T.B. STUD NO.		TIME	DWG NO.
HTR. DRAIN PUMP G-36A (EAST)	1A2C09	152-12C09	LS-8	12C04	J-333	M636A	A2C	K4M	1944	HV-853A	2	19	1, 3	0 SEC.	5150875
HTR. DRAIN PUMP G-36B (WEST)	1A1C09	152-11C09	LS-10	11C04	J-332	M635B	A1C	K4N	194	HV-853B	1	18	10, 12	0 SEC.	5150874

"ONLY THE CIRCLED, CLASSIFIED PORTIONS OF THIS DRAWING HAVE BEEN VERIFIED FOR THEIR SAFETY CLASSIFICATION."

NON-SAFETY RELATED
SONGS 1
FEEDWATER & CONDENSATE

REDRAWN FROM N-1543 SH. 4

Reference Drawings		Reference Drawings		Reference Drawings	
		5149957	OPERATING CONDITIONS TRAIN 1		
		5149958	OPERATING CONDITIONS TRAIN 2	5102167	1-LINE-MCC-2
455372	ELEM. DIAG. HV-853 A & B	5149974	SIS/LOP LOCKOUT RELAYS	5102165	1-LINE-MCC-1
63715	SAFETY INJECTION SYSTEM	5149679	DEVICE FUNCTION NO'S/SYMBOLS	5149955	SIS/LOP LOCKOUT RELAYS
		5149964	EQUIP. LOCATION INDEX.	5146828	MAIN-1 LINE DIAG.

No.	Revisions	Date	Approved	O.K.	O.K.	Ch'd.	Made	I.O. No.
4	AS BUILT INCORP CCN 4,5 ADD Q CL & NOTE	3/31/85					EACO	3083
3	INCORP CCN 3 EFF. DATE IMMEDIATELY	3-21-77						0736
2	INCORP CCN 2 EFFECT DATE IMMED							0736
1	INCORP CCN 1 EFFECT DATE 10-1-76	10-4-76						0736
0	ISSUED FOR CONST. ADDED SEQ. 2, REV. LOCKOUT RLY. CALLOUTS	3-24-76						0736

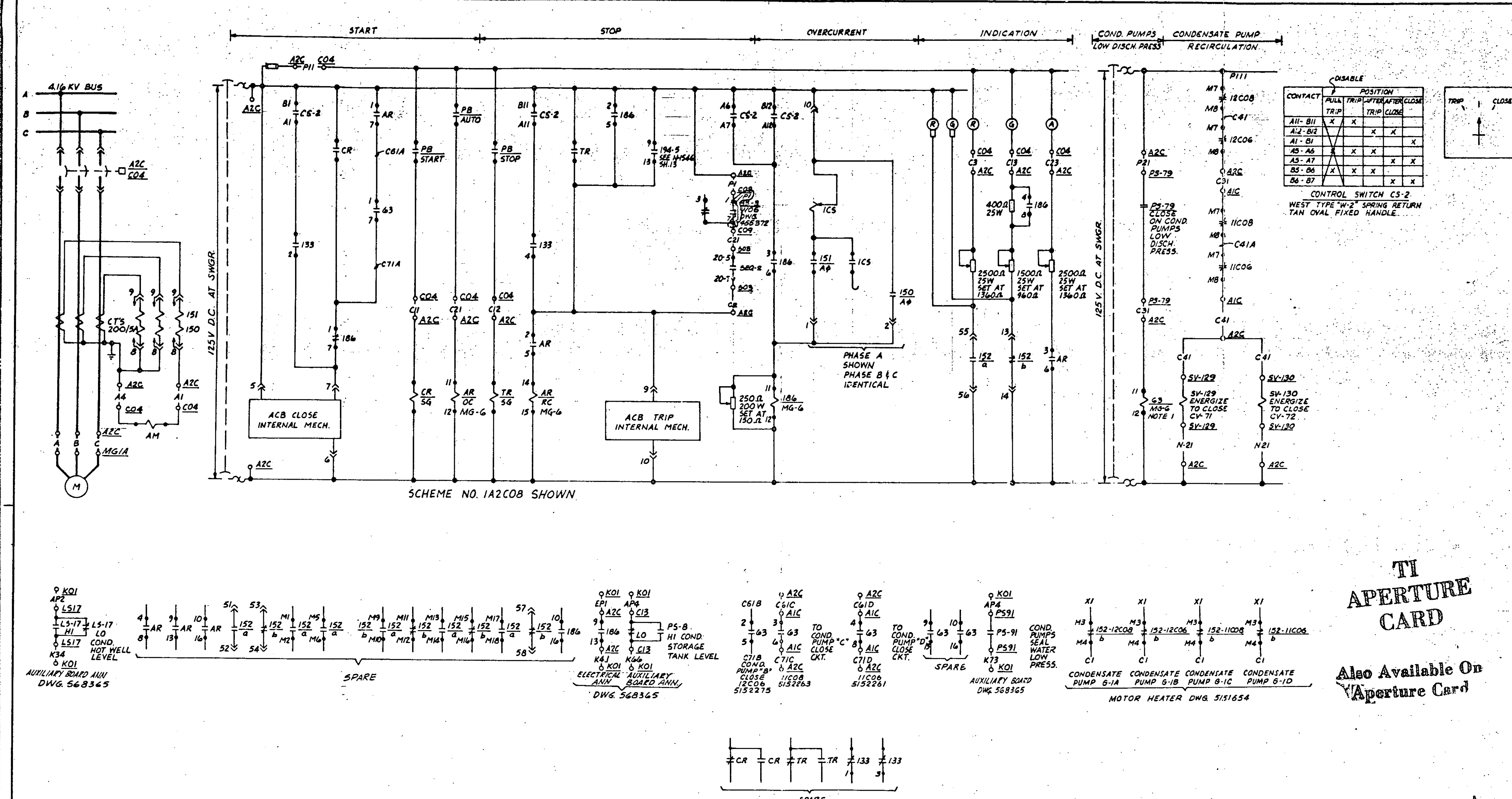
Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
HEATER DRAIN PUMP
G36A & B

Southern California Edison Company

5149918-4



TI APERTURE CARD

Also Available On Aperture Card

8711100274-84

EQUIPMENT	BREAKER NO.	SCHEME NO.	LOCATION		WIRE	INTLK.	INTLK.	SEQUENCE NO.	T.B.	STUD	TIME	DWG. NO.	INTLK–RLY–TERM'S
CONDENSATE PUMP G-1A (N.E.)	152-12C08	1A2C08	A2C	MG1A	K4J	194-5	HV-853A	2	20	5-7	0 SEC.	5150875	83-3 – W06 – 1 & 7
CONDENSATE PUMP G-1B (S.E.)	152-12C06	1A2C06	A2C	MG1B	K4L	194-5	HV-853A	2	20	9-11	0 SEC.		83-3 – W06 – 8 & 2
CONDENSATE PUMP G-1C (N.W.)	152-11C08	1A1C08	A1C	MG1C	K4O	194-1	HV-853B	1	19	6-8	0 SEC.	5150874	83-3 – W09 – 1 & 7
CONDENSATE PUMP G-1D (S.W.)	152-11C06	1A1C06	A1C	MG1D	K4Q	194-1	HV-853B	1	19	9-11	0 SEC.		83-3 – W09 – 8 & 2

"ONLY THE CIRCLED, CLASSIFIED PORTION OF THIS DRAWING HAVE BEEN VERIFIED FOR THEIR SAFETY CLASSIFICATION."

NON-SAFETY RELATED
SONGS 1
FEEDWATER & CONDENSATE

REDRAWN FROM N-1543 SH.3 & N-1543 SH.3A

Reference Drawings	
5102170	1-LINE-MCC 3
5146828	MAIN 1-LINE DIAGRAM

No.	Revisions	Date	J.O. No.
4	AS BUILT, ADD CCN 4, 5 ADD Q CLASS & NOTE		
3	INCORP CCN 3 EFF IMMEDIATELY	3/2/77	0736
2	INCORP CCN 2 EFF DATE: IMMEDIATELY	2/3/77	0736
1	INCORP CCN 1 EFFECT DATE 10-1-76	10-4-76	0736
0	ISSUED FOR CONST.; REV'D A1 & B1 CONTACTS, ADDED SEQ. CONTACTS; 83-3 & 86-M3-1 CONTACTS & CONDENSATE PUMP RECIRCULATION CIRCUIT.	3-24-76	0736

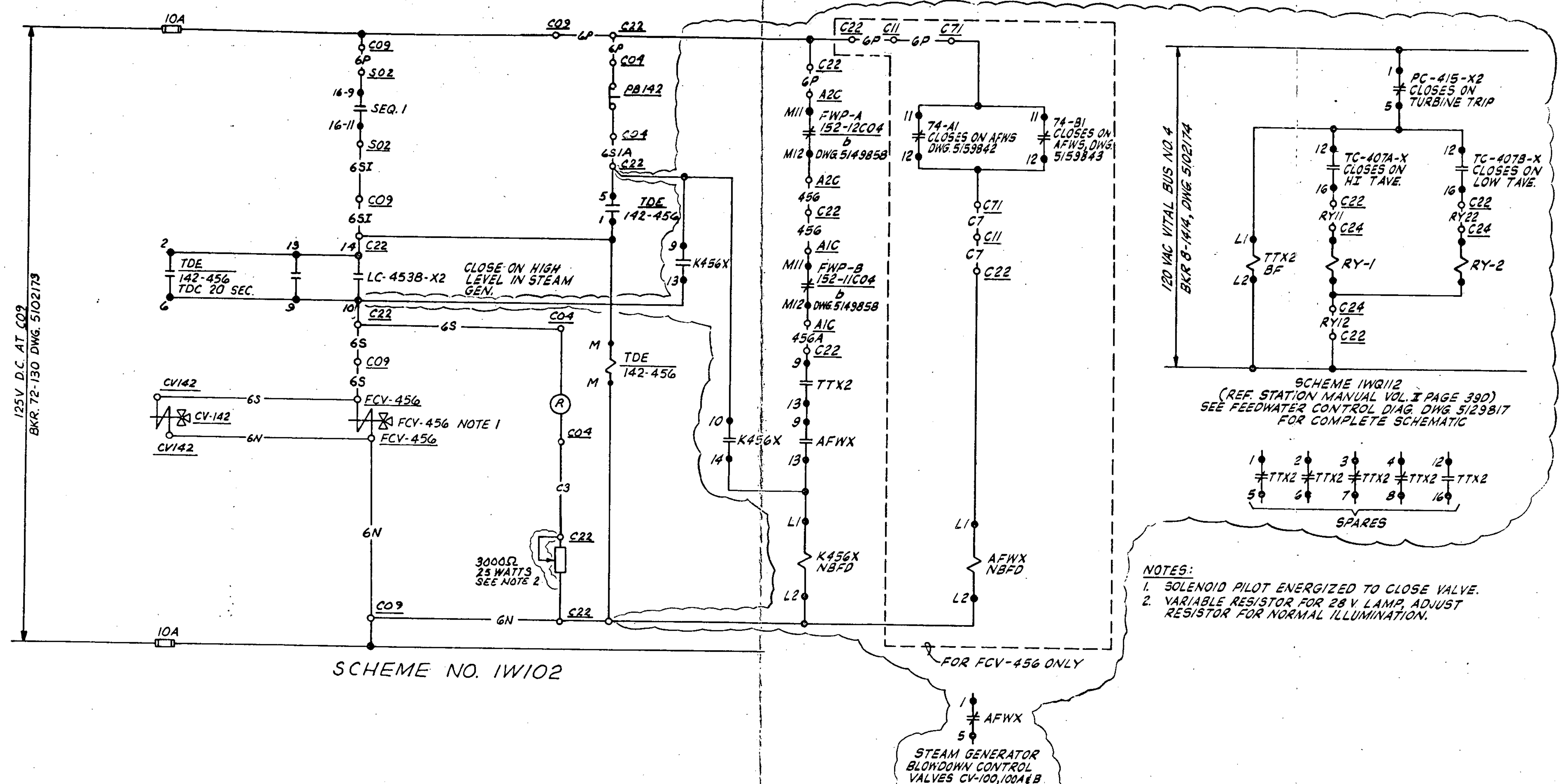
Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
CONDENSATE PUMPS
G-1A, G-1B, G-1C & G-1D

Southern California Edison Company SCE

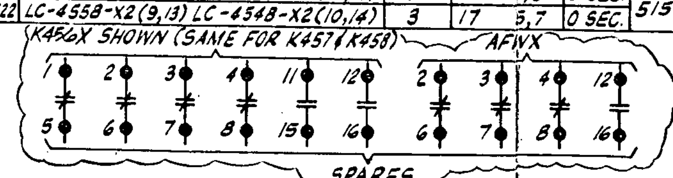
5149970-4



SCHEME NO. 1W102

NOTES:
1. SOLENOID PILOT ENERGIZED TO CLOSE VALVE.
2. VARIABLE RESISTOR FOR 28 V. LAMP, ADJUST RESISTOR FOR NORMAL ILLUMINATION.

BYPASS VALVE	MAIN	SCHEME NO	FUNCTION	LOCATION						INTERLOCKS REQ. & CONTACT NO'S.	SEQUENCER						CONTROL RELAY		SWGR		AFWS		TURBINE		WIRE NO'S.								
											NO.	T.B.	STUD	TIME	DWG. NO.		RELAY NO.	CONT. NO.	FWPA	FWPB	RELAY NO.	CONT. NO.	RELAY NO.	CONTACT NO.									
142	FCV-456	1W102	FEEDWATER CONTROL & BYPASS	A2C	A1C	C11	C71	C09	C22	LC-453B-X2(9,13) LC-453B-X2(10,14)	1	16	9,11	0 SEC.	5150874		K456X	(9,13),(10,14)	12C04(M11,M12)	11C04(M11, M12)	AFWX	(9,13)	TTX2	(9,13)	6P	456	456A	C7	C3	6S	6SIA	6SI	6N
144	FCV-457	1W102	FEEDWATER CONTROL & BYPASS	A2C	A1C	—	—	C09	C22	LC-454B-X2(9,13) LC-454B-X2(10,14)	2	17	1,3	0 SEC.	5150875		K457	(9,13),(10,14)	12C04(M15,M16)	11C04(M15,M16)	—	(10,14)		(10,14)	7P	457	457A	—	C3	7S	7SIA	7SI	7N
143	FCV-458	1W102	FEEDWATER CONTROL & BYPASS	A2C	A1C	—	—	C09	C22	LC-455B-X2(9,13) LC-454B-X2(10,14)	3	17	5,7	0 SEC.			K458	(9,13),(10,14)	12C04(M21,M22)	11C04(M21,M22)	—	(11,15)		(11,15)	8P	458	458A	—	C3	8S	8SIA	8SI	8N



SONGS I
SAFETY RELATED

TMI II W.P. 2.1.1

BECHTEL 3241-BSO-W-J2-121

SUPERSEDE WESTINGHOUSE ED. SK. 323139-8-SH. 14

Reference Drawings		No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	J.O. No.
5112416	S.D. AUX. RELAY RACK R12 SH. 1									
5112417	S.D. AUX. RELAY RACK R12 SH. 2									
5149629	DEVICE FUNCTION NO'S. & SYMBOLS	8	AS BUILT-INCORP DCN 11,12	7/29/86					EACo	3400
5149964	EQUIP. LOCATION INDEX	7	AS BUILT INCORP CC#10 CANC T.B.C.9 T.Q.#16 20-6/4						RCK	7764

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	J.O. No.
6	REC. REV. - REVISED TITLE CCN #6	11-10-77					EACo	6500
5	INCORP CCN 5 EFF DATE IMMED	6-16-77						0736
4	INCORP. CCN 4 EFF. DATE: IMMEDIATELY	1-13-77						0736
3	INCORP CCN 2 EFF DATE 10-1-76	10-4-76						0736
2	INCORP CCN 1-EFF DATE 6-14-76 - REDRAWN	8/27/76						0736

Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
SOL. VALVES FCV-456, 457 & 458
FEEDWATER CONTROL & BY-PASS

Southern California Edison Company SCE

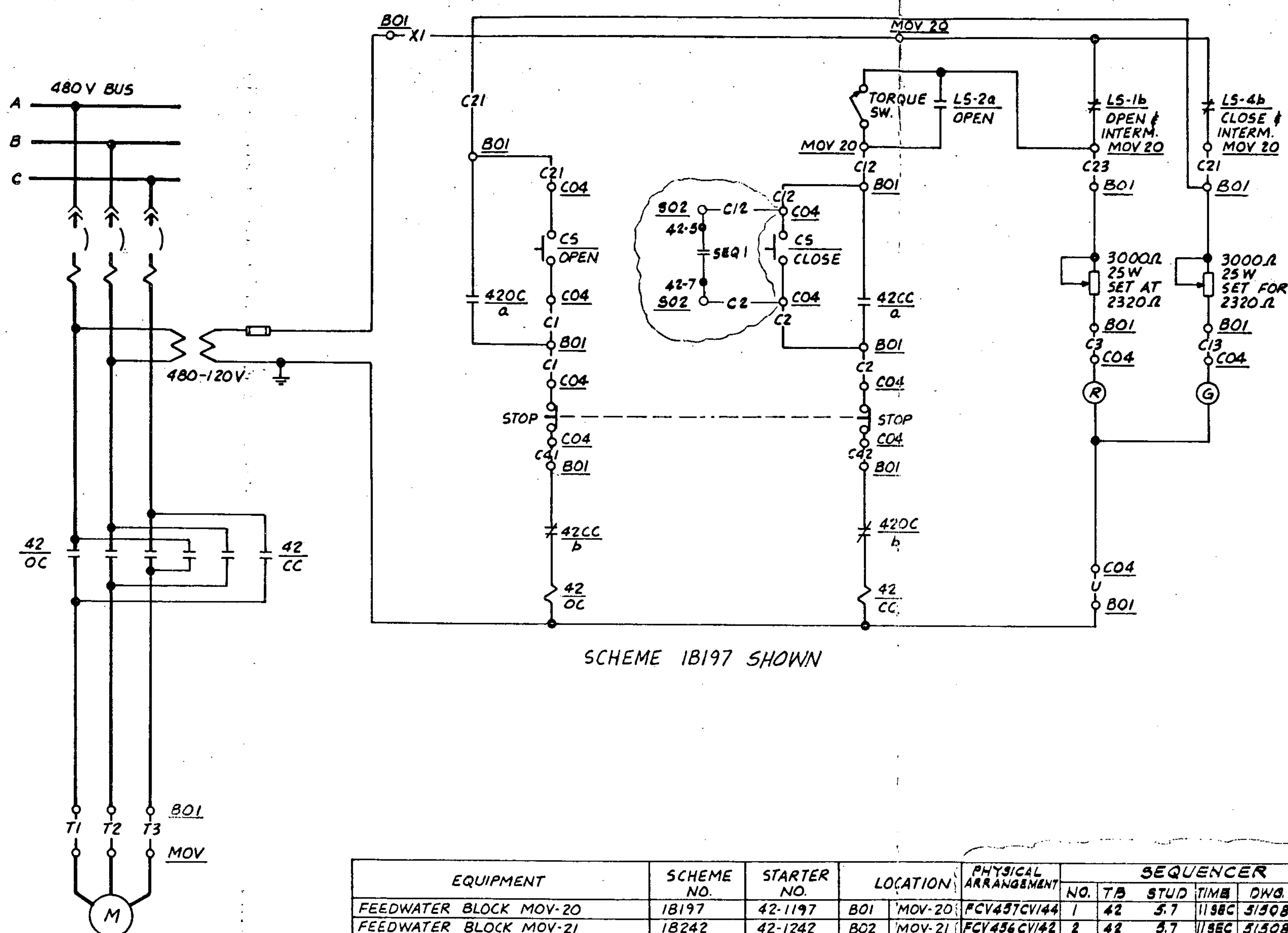
8711100274-85

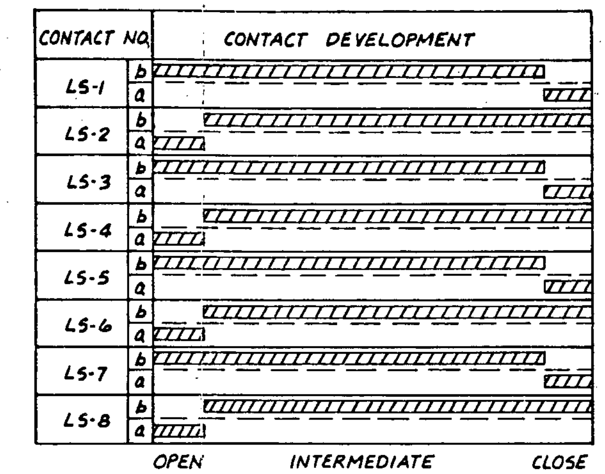
449408-8

DWG. LIST M-

TI APERTURE CARD

Also Available On Aperture Card





VALVE POSITION

▨ CONTACT CLOSED
a — N.O.- NORMALLY OPEN CONTACT
b — N.C.- NORMALLY CLOSED CONTACT

LIMIT SWITCH ARRANGEMENT FOR
MOV-20
MOV-21
MOV-22

EQUIPMENT	SCHEME NO.	STARTER NO.	LOCATION		PHYSICAL ARRANGEMENT	SEQUENCER NO.	TB	STUD	TIME	DWG. NO.	CONT. DWG.	EQUAL SCHEME* FOR TMI
FEEDWATER BLOCK MOV-20	1B197	42-1197	B01	MOV-20	FCV457CV144	1	42	5.7	11 SEC	5150874	5149179	1FB0197
FEEDWATER BLOCK MOV-21	1B242	42-1242	B02	MOV-21	FCV456CV142	2	42	5.7	11 SEC	5150875	5149182	1GB0242
FEEDWATER BLOCK MOV-22	1B387	42-1387	B03	MOV-22	FCV458CV143	1	58	1.3	11 SEC	5150874	5149179	1HB0387

TI APERTURE CARD

Also Available On Aperture Card

SONGS 1
SAFETY RELATED
FEEDWATER & CONDENSATE
REDRAWN FROM N-1543 SH.20

Reference Drawings	
5149629	DEVICE FUNC. NO'S & SYMBOLS
5149964	EQUIPMENT LOCATION INDEX
5102170	1-LINE - MCC#3
5102167	1-LINE - MCC#2
5102165	1-LINE - MCC#1

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	J.O. No.
3	INCORP. CC#3 & OTSC #3 "AS CONSTR." PER TMI APRIL '80 OUTAGE	6-11-81					EJF	7764
2	REC. REV.- REVISED TITLE	11-10-77					EACo	6500
1	INCORP CCN 1-EFFECT DATE 6-14-76	8/27/76						0736
0	ADDED SEQUENCER INTLK.	1-9-76		DLP				0736

Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
FEEDWATER MOV-20, 21 & 22
FEEDWATER BLOCK VALVES

Southern California Edison Company SCE

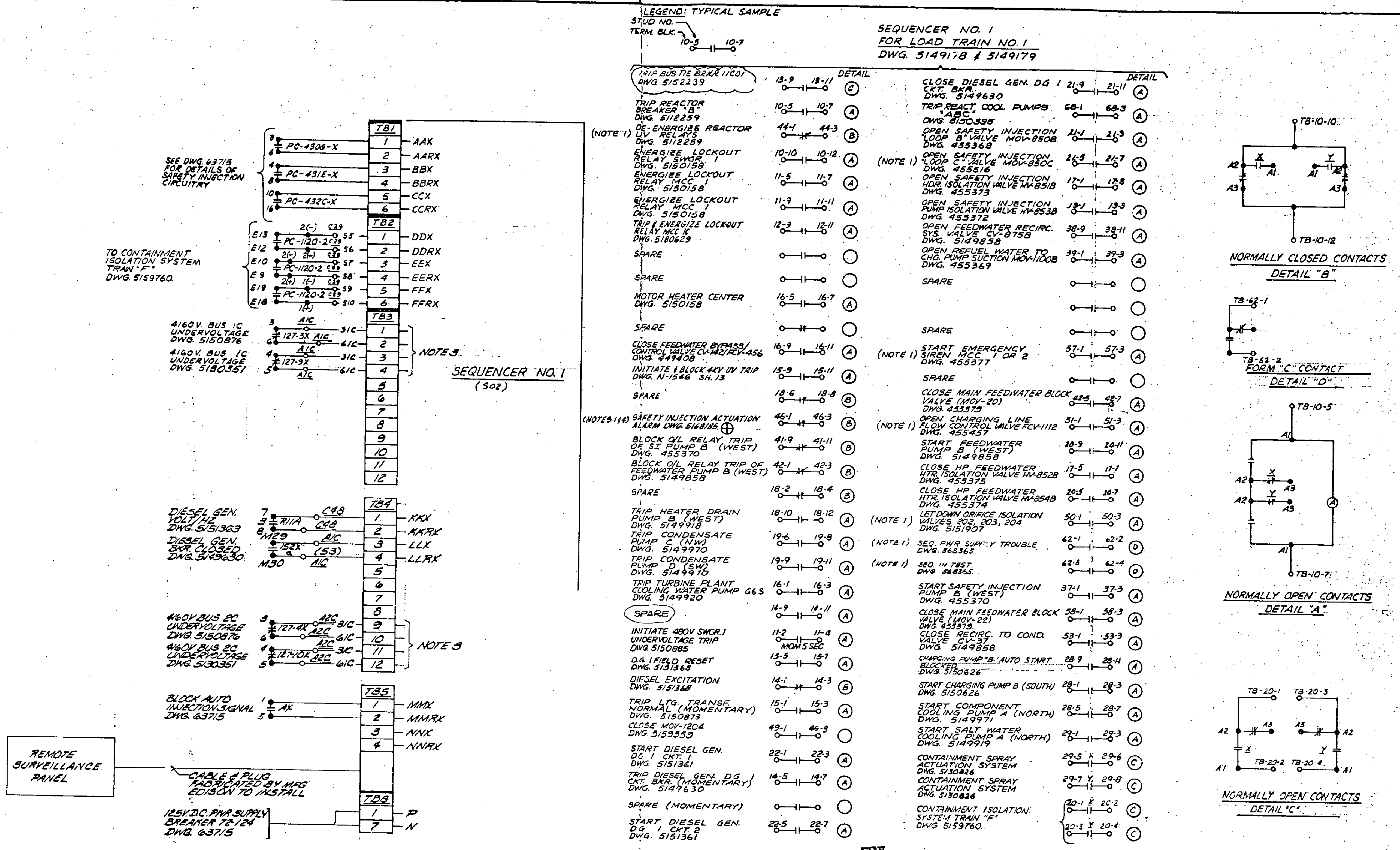
E

455379-3

44C

MICROFILMED FROM

8711100274-86



NOTE:
1. BOTH SEQUENCERS OPERATING THE SAME LOAD.
2. FOR SPARE CONTACTS SEE DWGS. 5149178 & 5149179.
3. CHANGES IN INTERNAL WIRING SHALL BE DONE BY SEQUENCER SUPPLIER CONSOLIDATED CONTROL CO. TO ACCOMODATE ADDITIONAL UNDERVOLTAGE SIGNAL INPUT FROM 4160V BUS 1C & 2C.
4. CONTACTS FOR NON-SAFETY RELATED OUTPUTS ARE ISOLATED WITH INDIVIDUAL ISOLATION BOX.

TI APERTURE CARD

Also Available On Aperture Card

12-1-80

SONGS 1
SAFETY RELATED
EXCEPT AS NOTED ⊕
TMI-II WP 2.2.2b
AAS WP 8060.2
J.O 14000-234

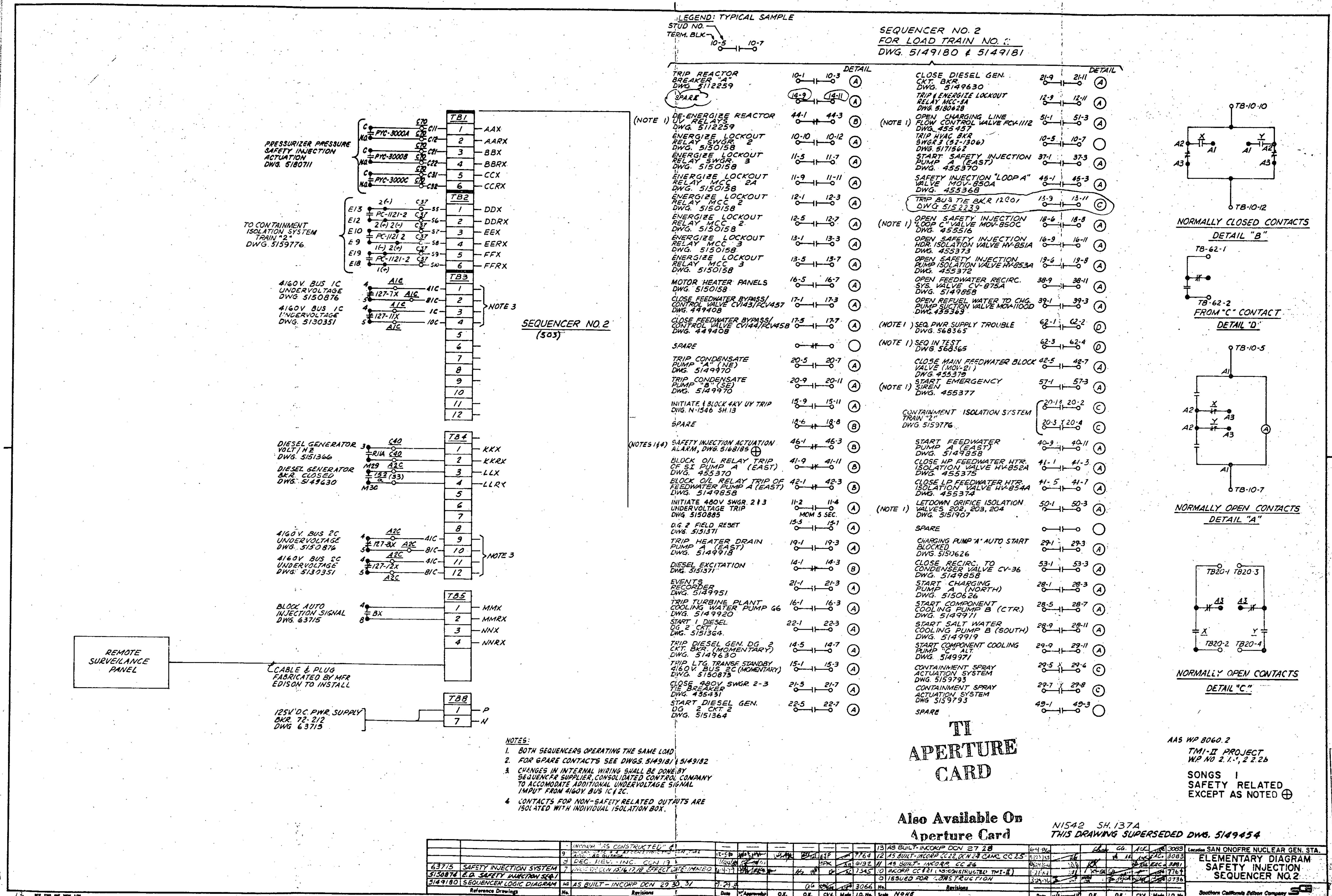
N1542 SH.137
THIS DRAWING SUPERSEDED DWG. 5149454

Reference Drawings	
63715	SAFETY INJECTION SYSTEM
5150873	E.D. SAFETY INJECTION SEQ. 2
5149180	SEQUENCER LOGIC DIAGRAM

SAN ONOFRE NUCLEAR GEN. STA.
ELEMENTARY DIAGRAM
SAFETY INJECTION
SEQUENCER NO. 1
Southern California Edison Company

8711100274-87

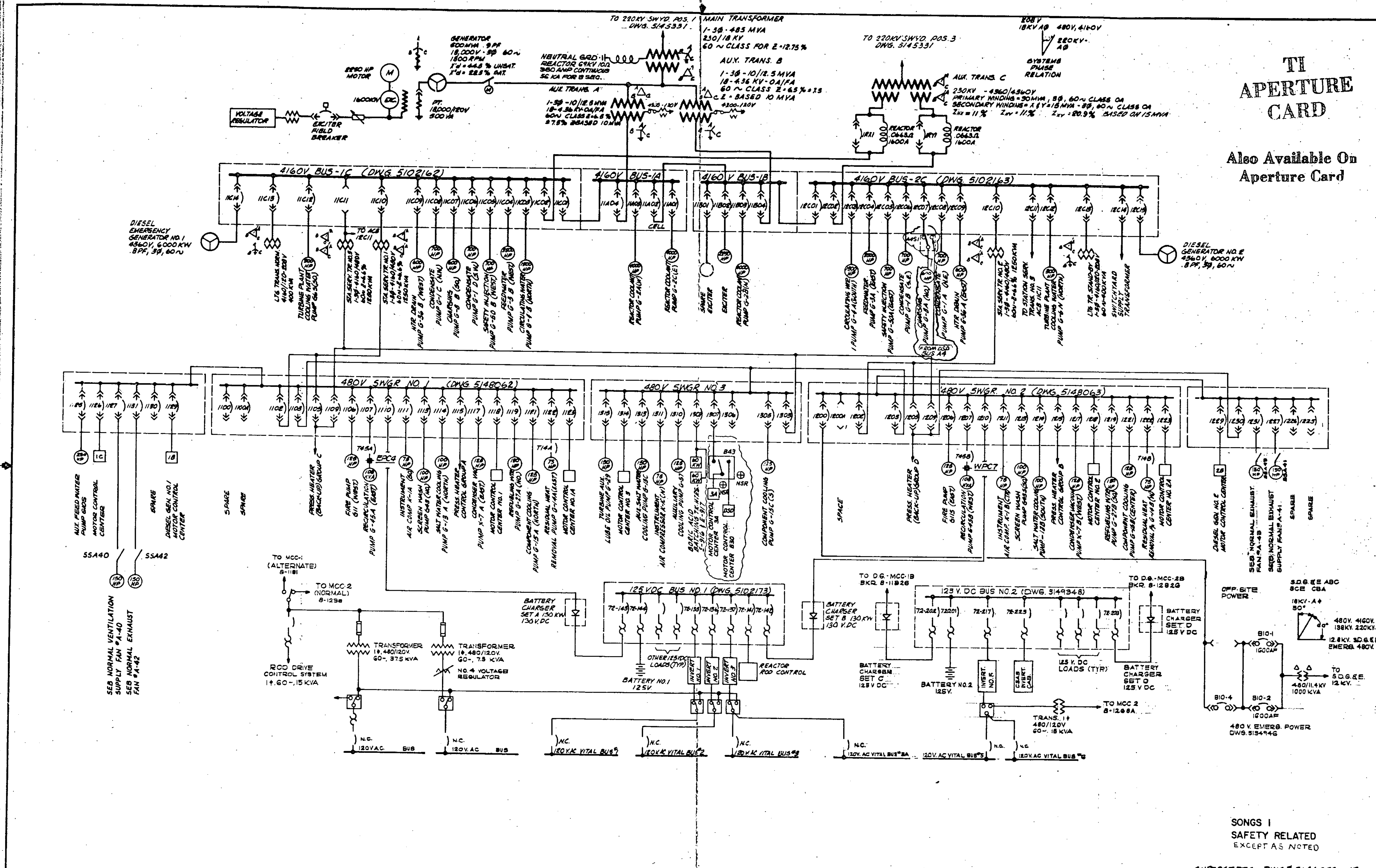
5150874-14



LEGEND: TYPICAL SAMPLE
STUD NO.
TERM. BLK.
SEQUENCER NO. 2
FOR LOAD TRAIN NO. 2
DWG. 5149180 & 5149181
PRESSURIZER PRESSURE SAFETY INJECTION ACTUATION DWG. 5180711
TO CONTAINMENT ISOLATION SYSTEM TRAIN "2" DWG. 5159776.
4160V. BUS 1C UNDERVOLTAGE DWG. 5150876
4160V BUS 1C UNDERVOLTAGE DWG. 5130351
SEQUENCER NO. 2 (503)
DIESEL GENERATOR VOLT/HZ DWG. 5151366
DIESEL GENERATOR BKR. CLOSED DWG. 5149630
4160V. BUS 2C UNDERVOLTAGE DWG. 5150876
4160V BUS 2C UNDERVOLTAGE DWG. 5130351
BLOCK AUTO INJECTION SIGNAL DWG. 63715
REMOTE SURVEILANCE PANEL
CABLE & PLUG FABRICATED BY MFR EDISON TO INSTALL
125V D.C. PWR. SUPPLY BKR. 72-212 DWG 63715
TB1 TB2 TB3 TB4 TB5 TB8
NOTE 3
TRIP REACTOR BREAKER "A" DWG. 5112259
SPARE
DE-ENERGIZE REACTOR UV RELAYS DWG. 5112259
ENERGIZE LOCKOUT RELAY SWGR. 2 DWG. 5150158
ENERGIZE LOCKOUT RELAY SWGR. 3 DWG. 5150158
ENERGIZE LOCKOUT RELAY MCC 2A DWG. 5150158
ENERGIZE LOCKOUT RELAY MCC 2 DWG. 5150158
ENERGIZE LOCKOUT RELAY MCC 2 DWG. 5150158
ENERGIZE LOCKOUT RELAY MCC 3 DWG. 5150158
ENERGIZE LOCKOUT RELAY MCC 3 DWG. 5150158
MOTOR HEATER PANELS DWG. 5150158
CLOSE FEEDWATER BYPASS/CONTROL VALVE CV143/FCV457 DWG. 449408
CLOSE FEEDWATER BYPASS/CONTROL VALVE CV144/FCV458 DWG. 449408
SPARE
TRIP CONDENSATE PUMP "A" (NE) DWG. 5149970
TRIP CONDENSATE PUMP "B" (SE) DWG. 5149970
INITIATE & BLOCK 4KV UV TRIP DWG. N-1546 SH.13
SPARE
SAFETY INJECTION ACTUATION ALARM, DWG. 5168185
BLOCK O/L RELAY TRIP OF SI PUMP A (EAST) DWG. 455370
BLOCK O/L RELAY TRIP OF FEEDWATER PUMP A (EAST) DWG. 5149858
INITIATE 480V SWGR. 2 & 3 UNDERVOLTAGE TRIP DWG. 5150885
MOM 5 SEC.
D.G. 2 FIELD RESET DWG. 5151371
TRIP HEATER DRAIN PUMP A (EAST) DWG. 5149918
DIESEL EXCITATION DWG. 5151371
EVENTS RECORDER DWG. 5149951
TRIP TURBINE PLANT COOLING WATER PUMP G6 DWG. 5149920
START 1 DIESEL DG 2 CKT 1 DWG. 5151364
TRIP DIESEL GEN. DG 2 CKT. BKR. (MOMENTARY) DWG. 5149630
TRIP LTG. TRANSF STANDBY 4160V. BUS 2C (MOMENTARY) DWG. 5150875
CLOSE 480V SWGR. 2-3 TIE BREAKER DWG. 455451
START DIESEL GEN. DG 2 CKT 2 DWG. 5151364
CLOSE DIESEL GEN. CKT. BKR. DWG. 5149630
TRIP & ENERGIZE LOCKOUT RELAY MCC-8A DWG. 5180628
OPEN CHARGING LINE FLOW CONTROL VALVE FCV-1112 DWG. 455457
TRIP HVAC BKR SWGR 3 (52-1306) DWG. 5171562
START SAFETY INJECTION PUMP A (EAST) DWG. 455370
SAFETY INJECTION "LOOP A" VALVE MOV-850A DWG. 455368
TRIP BUS TIE BKR 12C01 DWG 5152239
OPEN SAFETY INJECTION "LOOP C" VALVE MOV-850C DWG. 455516
OPEN SAFETY INJECTION HDR. ISOLATION VALVE HV-851A DWG. 455373
OPEN SAFETY INJECTION PUMP ISOLATION VALVE HV-853A DWG. 455372
OPEN FEEDWATER RECIRC. SYS. VALVE CV-875A DWG. 5149858
OPEN REFUEL WATER TO CHG. PUMP SUCTION VALVE MOV-1100D DWG. 455363
SEQ. PWR SUPPLY TROUBLE DWG. 568365
SEQ IN TEST DWG. 568365
CLOSE MAIN FEEDWATER BLOCK VALVE (MOV-21) DWG. 455379
START EMERGENCY SIREN DWG. 455377
CONTAINMENT ISOLATION SYSTEM TRAIN "2" DWG 5159776
START FEEDWATER PUMP A (EAST) DWG. 5149858
CLOSE HP FEEDWATER HTR. ISOLATION VALVE HV-852A DWG. 455375
CLOSE LP FEEDWATER HTR. ISOLATION VALVE HV-854A DWG. 455374
LETDOWN ORIFICE ISOLATION VALVES 202, 203, 204 DWG. 5151907
SPARE
CHARGING PUMP "A" AUTO START BLOCKED DWG. 5150626
CLOSE RECIRC. TO CONDENSER VALVE CV-36 DWG. 5149858
START CHARGING PUMP A (NORTH) DWG. 5150626
START COMPONENT COOLING PUMP B (CTR.) DWG. 5149971
START SALT WATER COOLING PUMP B (SOUTH) DWG. 5149919
START COMPONENT COOLING PUMP "C" ALT DWG. 5149971
CONTAINMENT SPRAY ACTUATION SYSTEM DWG. 5159793
CONTAINMENT SPRAY ACTUATION SYSTEM DWG 5159793
SPARE
DETAIL
(NOTE 1)
(NOTES 1&4)
NORMALLY CLOSED CONTACTS DETAIL "B"
FROM "C" CONTACT DETAIL "D"
NORMALLY OPEN CONTACTS DETAIL "A"
NORMALLY OPEN CONTACTS DETAIL "C"
NOTES:
1. BOTH SEQUENCERS OPERATING THE SAME LOAD
2. FOR SPARE CONTACTS SEE DWGS. 5149181 & 5149182
3. CHANGES IN INTERNAL WIRING SHALL BE DONE BY SEQUENCER SUPPLIER, CONSOLIDATED CONTROL COMPANY TO ACCOMODATE ADDITIONAL UNDERVOLTAGE SIGNAL INPUT FROM 4160V BUS 1C & 2C.
4. CONTACTS FOR NON-SAFETY RELATED OUTPUTS ARE ISOLATED WITH INDIVIDUAL ISOLATION BOX.
TI APERTURE CARD
Also Available On Aperture Card
AAS WP 8060.2
TMI-II PROJECT WP NO 2.1.-, 2.2.2b
SONGS 1 SAFETY RELATED EXCEPT AS NOTED
N1542 SH. 137A
THIS DRAWING SUPERSEDED DWG. 5149454
63715 SAFETY INJECTION SYSTEM
5150876 E.D. SAFETY INJECTION SEQ. 1
5149180 SEQUENCER LOGIC DIAGRAM
Reference Drawings
14 AS BUILT - INCORP DCN 29 30 31
13 AS BUILT-INCORP DCN 27 28
12 AS BUILT-INCORP CC 22, DCN 24 CANC. CC 25
11 AS BUILT-INCORP CC 26
10 INCORP CC21 "AS CONSTRUCTED" TMI-II
0 ISSUED FOR CONSTRUCTION
Revisions
Scale NONE
SAN ONOFRE NUCLEAR GEN. STA.
ELEMENTARY DIAGRAM SAFETY INJECTION SEQUENCER NO. 2
Southern California Edison Company
8711100274-88
5150875-14
12-1-80

TI
APERTURE
CARD

Also Available On
Aperture Card



SONGS I
SAFETY RELATED
EXCEPT AS NOTED

SUPERSEDES DWG.# 5146828-13

No.	Revisions	Date	Approved
24	AS BUILT - INCORP. DCN 32,33		
23	AS BUILT - INCORP. DCN 30,31		
22	AS BUILT - INCORP. DCN 29		
21	[illegible]		
20	INCORP. DCN 17, REVISED & REDRAWN		

Drawing List Sheet
Reference Drawings

SAN ONOFRE NUCLEAR GEN. STA.
MAIN
ONE LINE DIAGRAM
Southern California Edison Company

8711100274-89

5146828-24

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APERTURE
CARD

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Aperture Card

EAST HEATER VENTS AND DRAINS

1ST. 2ND. AND 3RD POINT

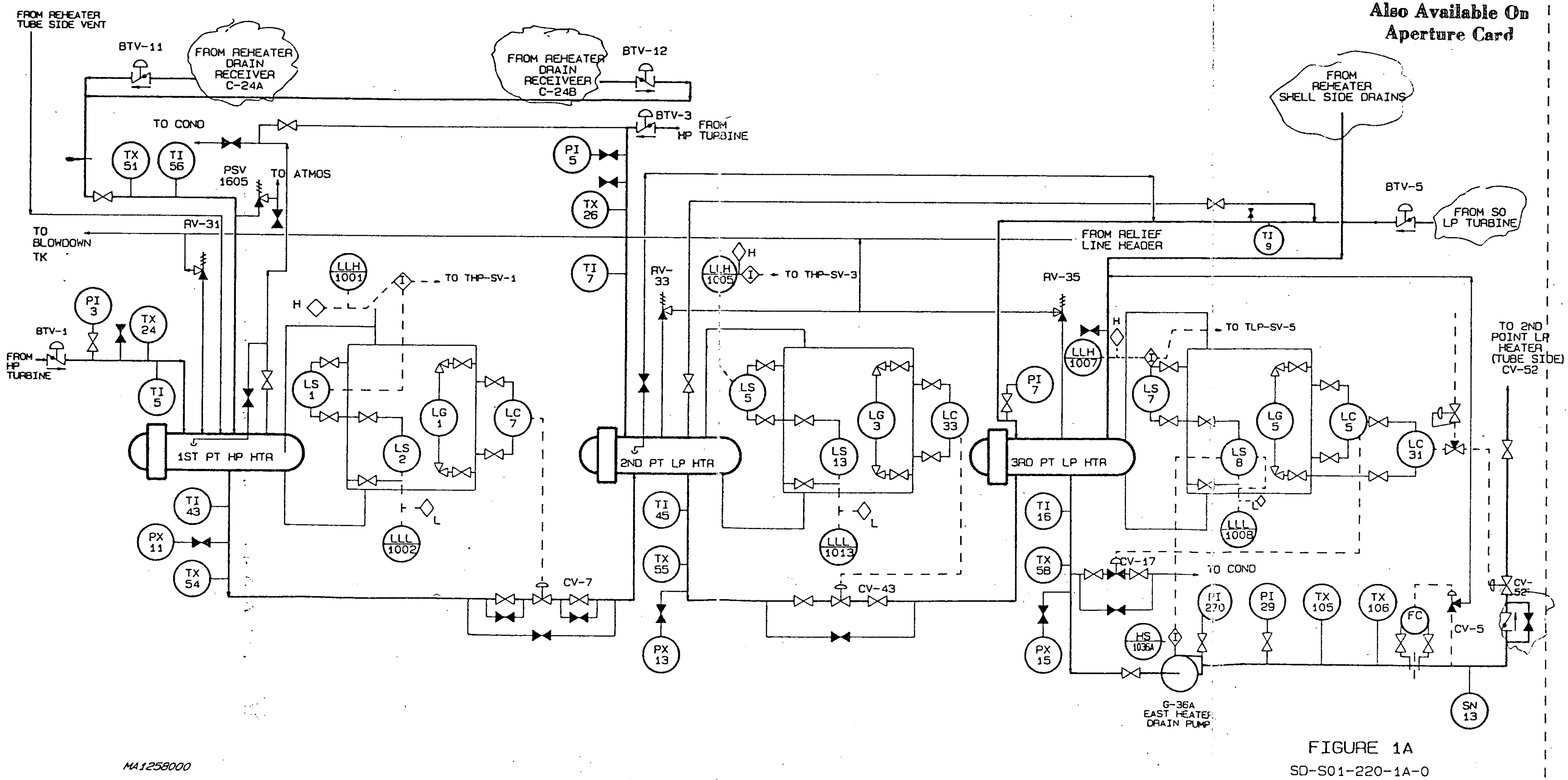


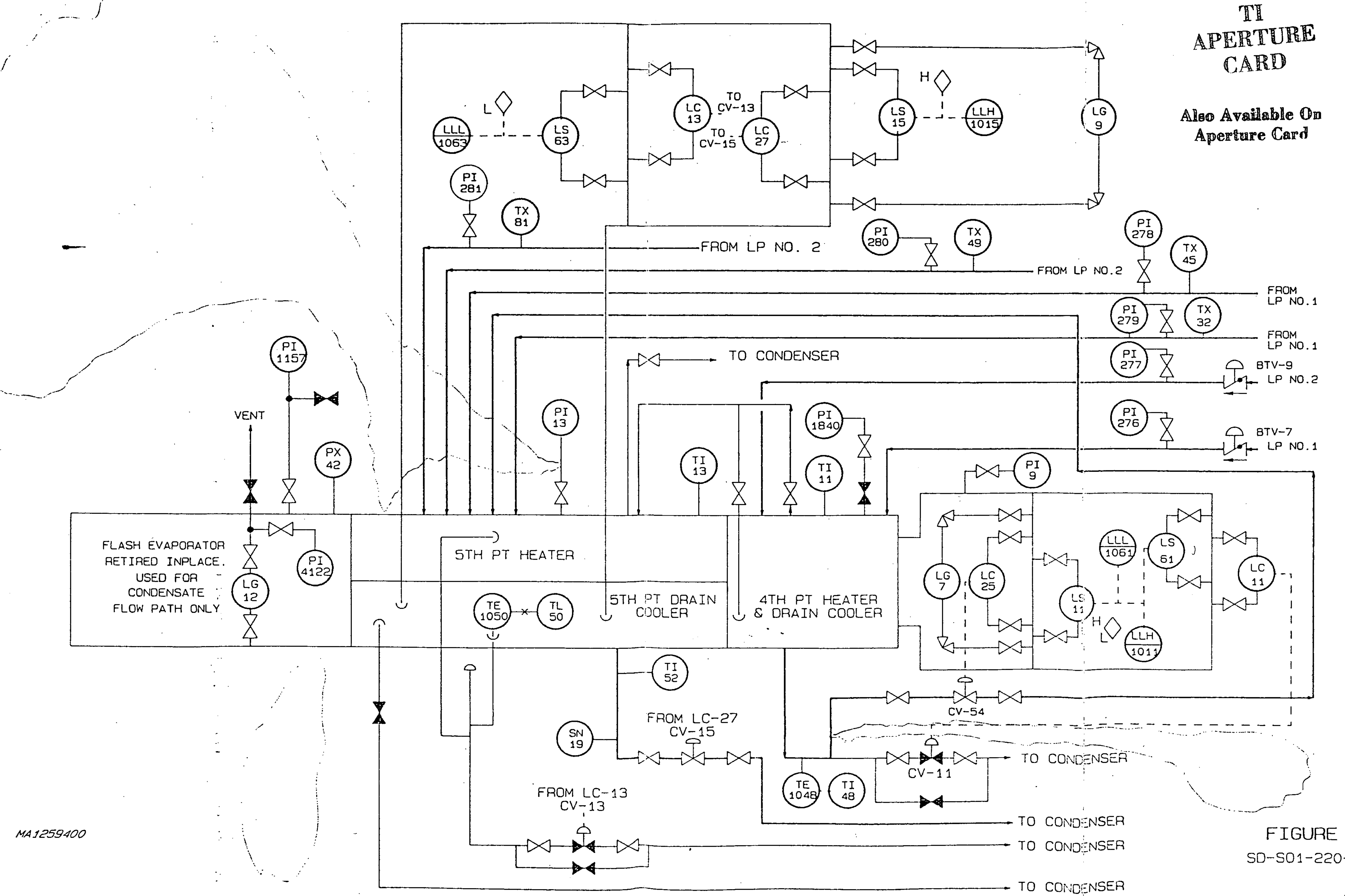
FIGURE 1A
SD-S01-220-1A-0

R
R
R

871100274 -90

EAST HEATER VENTS & DRAINS

4TH & 5TH POINT



TI APERTURE CARD

Also Available On Aperture Card

FIGURE 1B
SD-S01-220-1B-1

8711100274-91

EAST HEATER DRAIN PUMP

LUBE OIL & SEAL WATER DETAIL

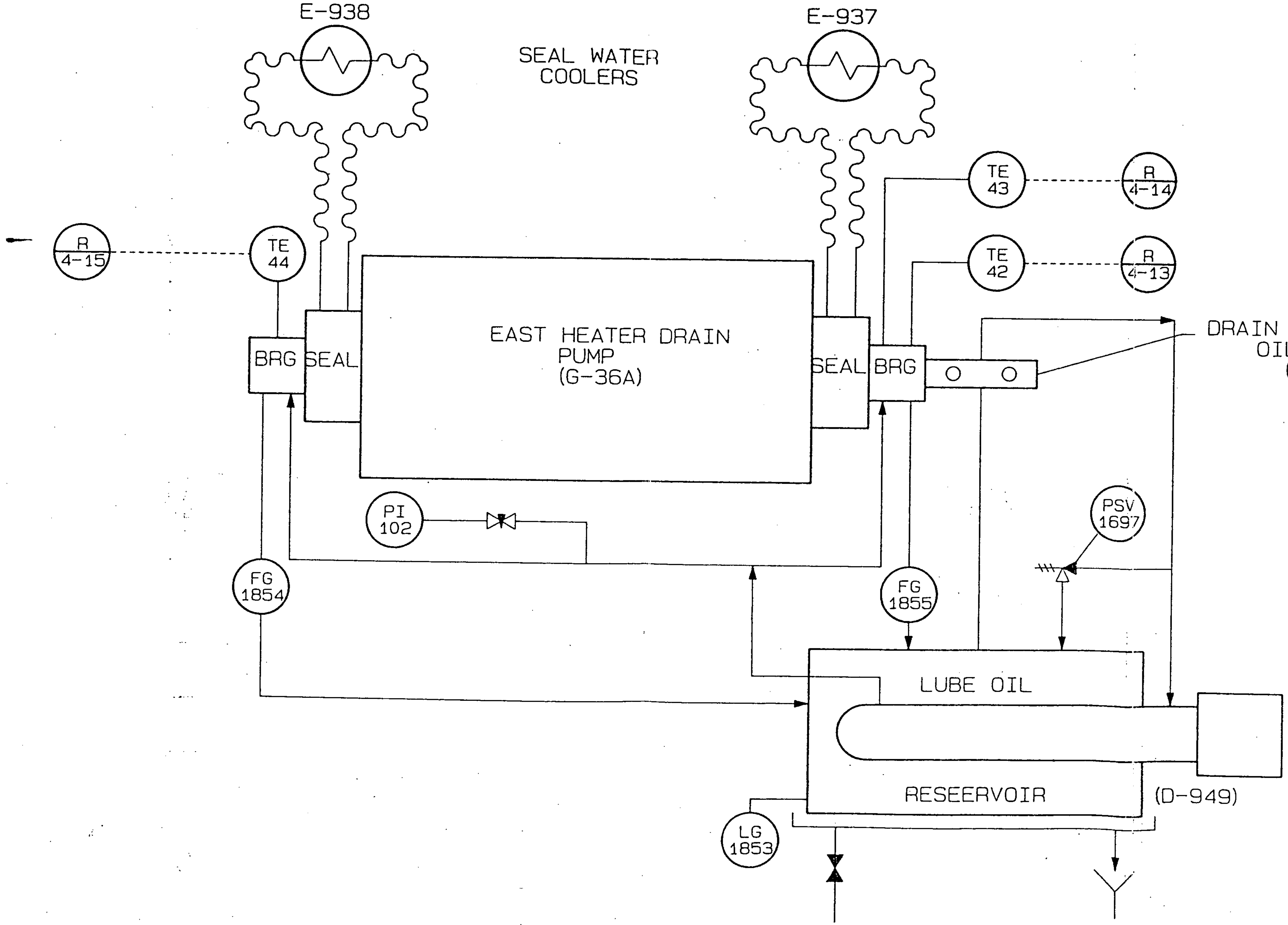
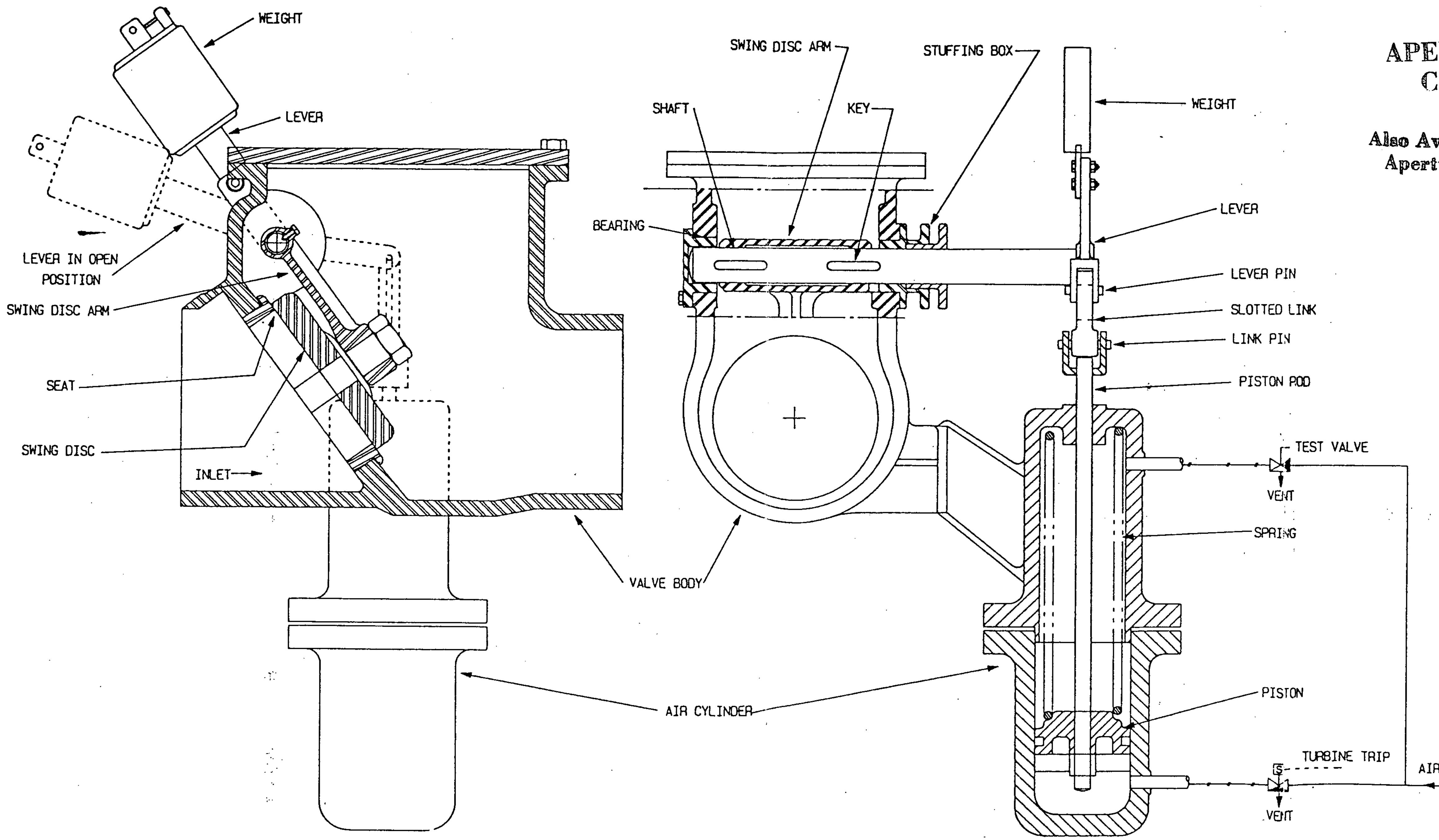


FIGURE 2
SD-S01-220-2-0

MA1250000

BLEEDER TRIP VALVE



TI
APERTURE
CARD

Also Available On
Aperture Card

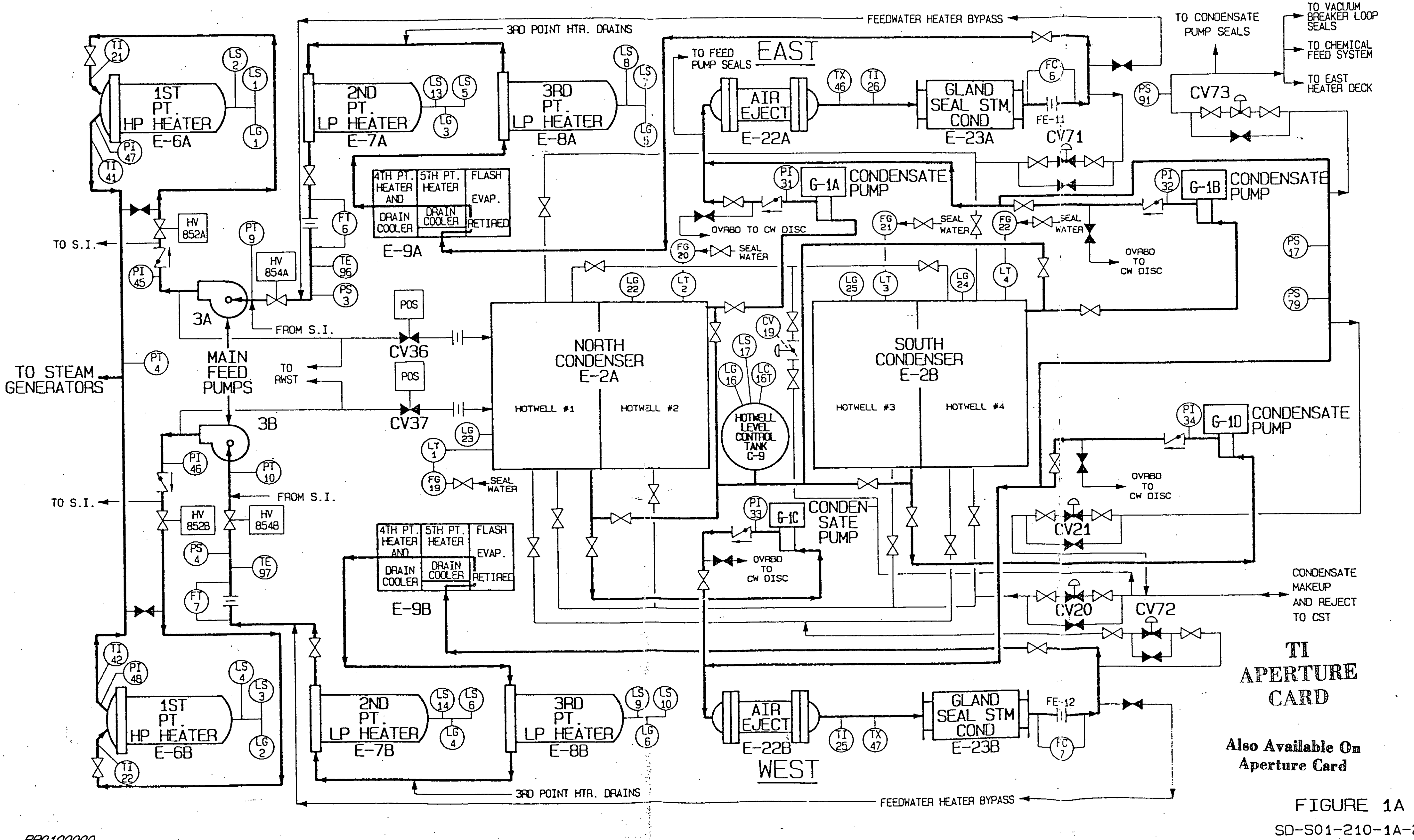
N

DD0000000

FIGURE 3
SD-S01-220-3-2

8711100274-93

CONDENSATE AND FEEDWATER SYSTEM



TI APERTURE CARD

Also Available On Aperture Card

FIGURE 1A
SD-S01-210-1A-2

8711100274-94

CONDENSATE PUMPS SIMPLIFIED ELEMENTARY

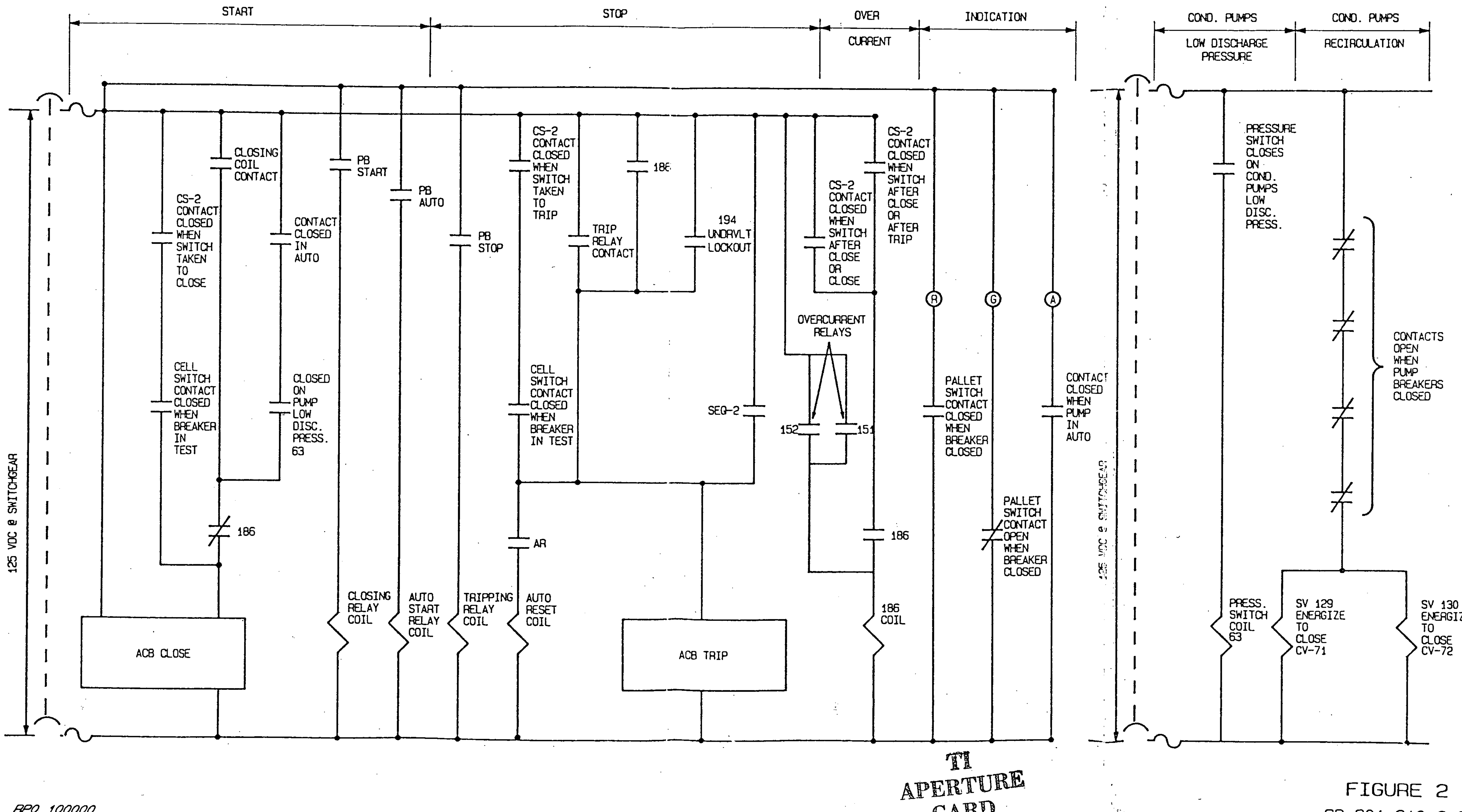


FIGURE 2
SD-S01-210-2-2

8711100274-95

HV-852 A & B AND HV-854 A & B ACTUATION SCHEME

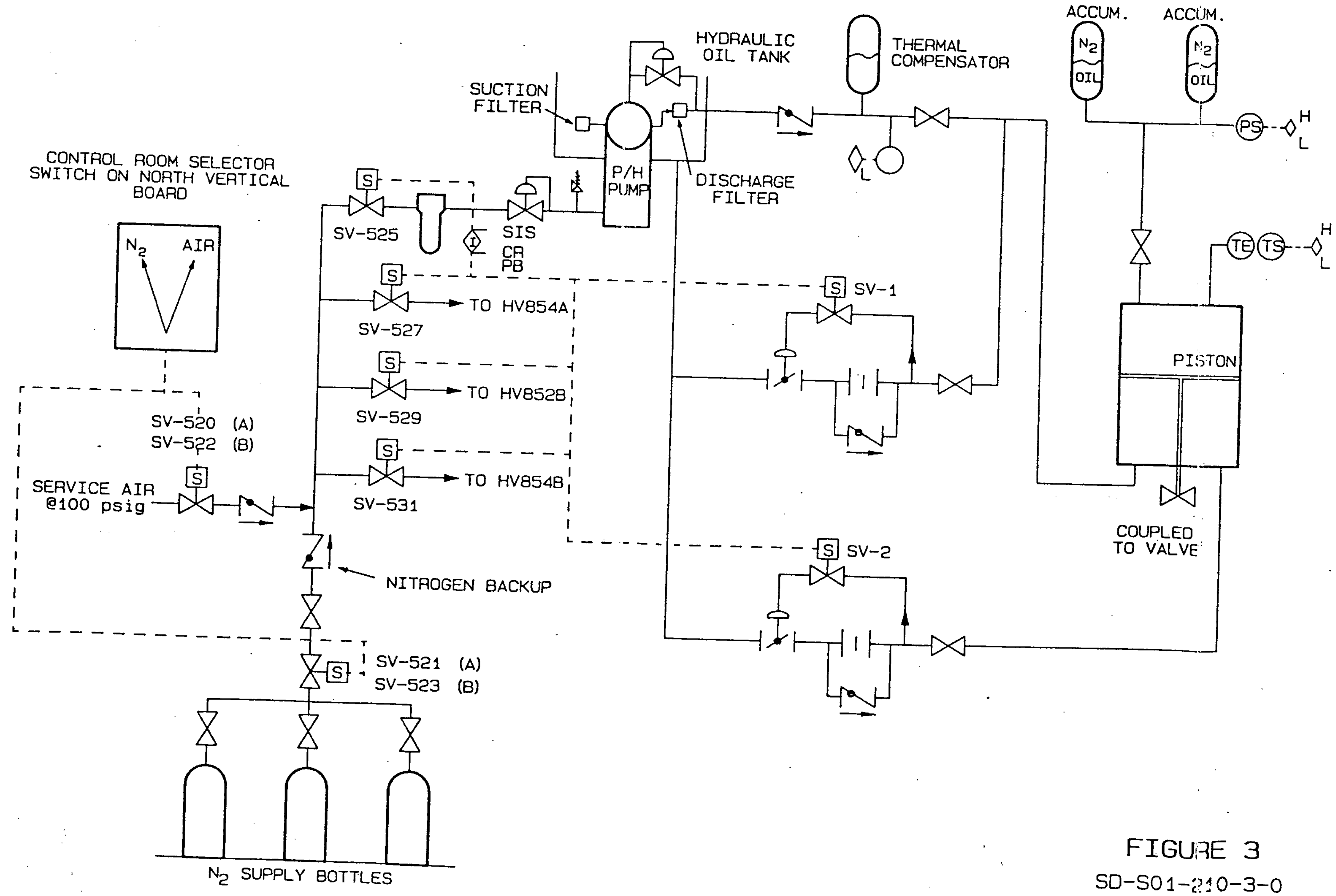


FIGURE 3
SD-S01-210-3-0

TI APERTURE CARD

Also Available On Aperture Card

8711100274-96

SIMPLIFIED ELEMENTARY HV-852 & 854

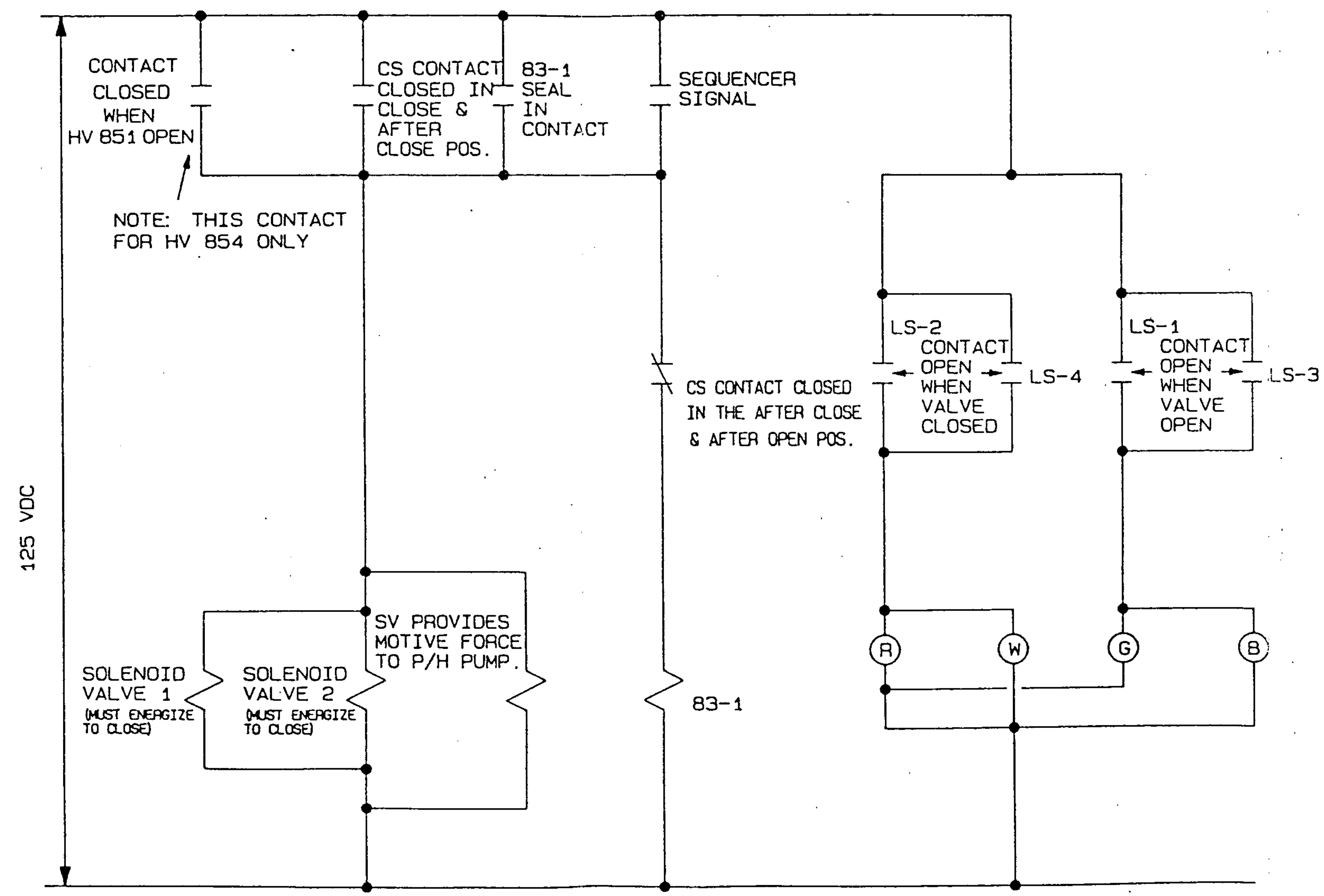


FIGURE 4
SD-SO1-210-4-3

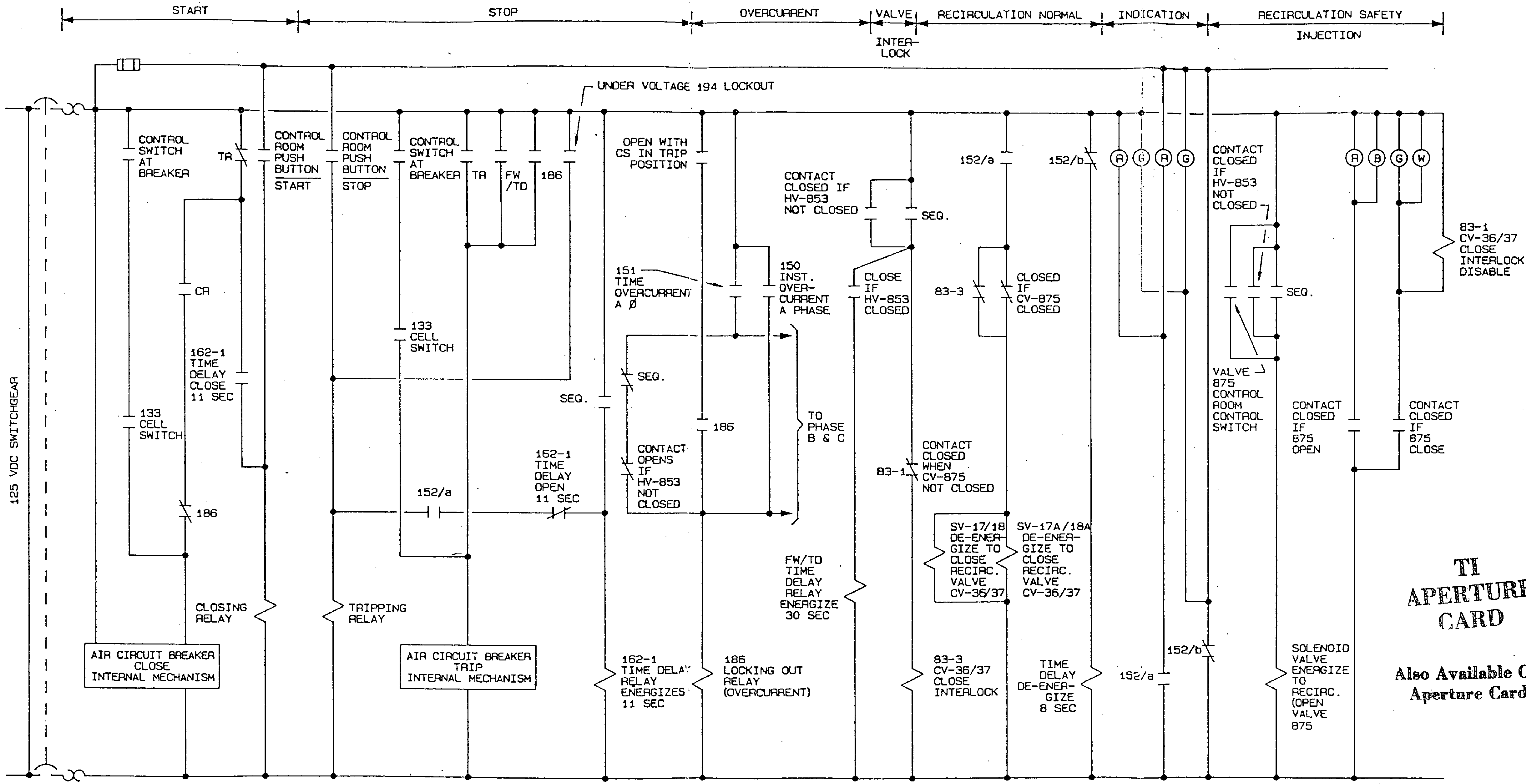
A50639000

TI APERTURE CARD

Also Available On Aperture Card

8711100274-97

SIMPLIFIED ELEMENTARY FOR MAIN FEEDWATER PUMPS



TI APERTURE CARD

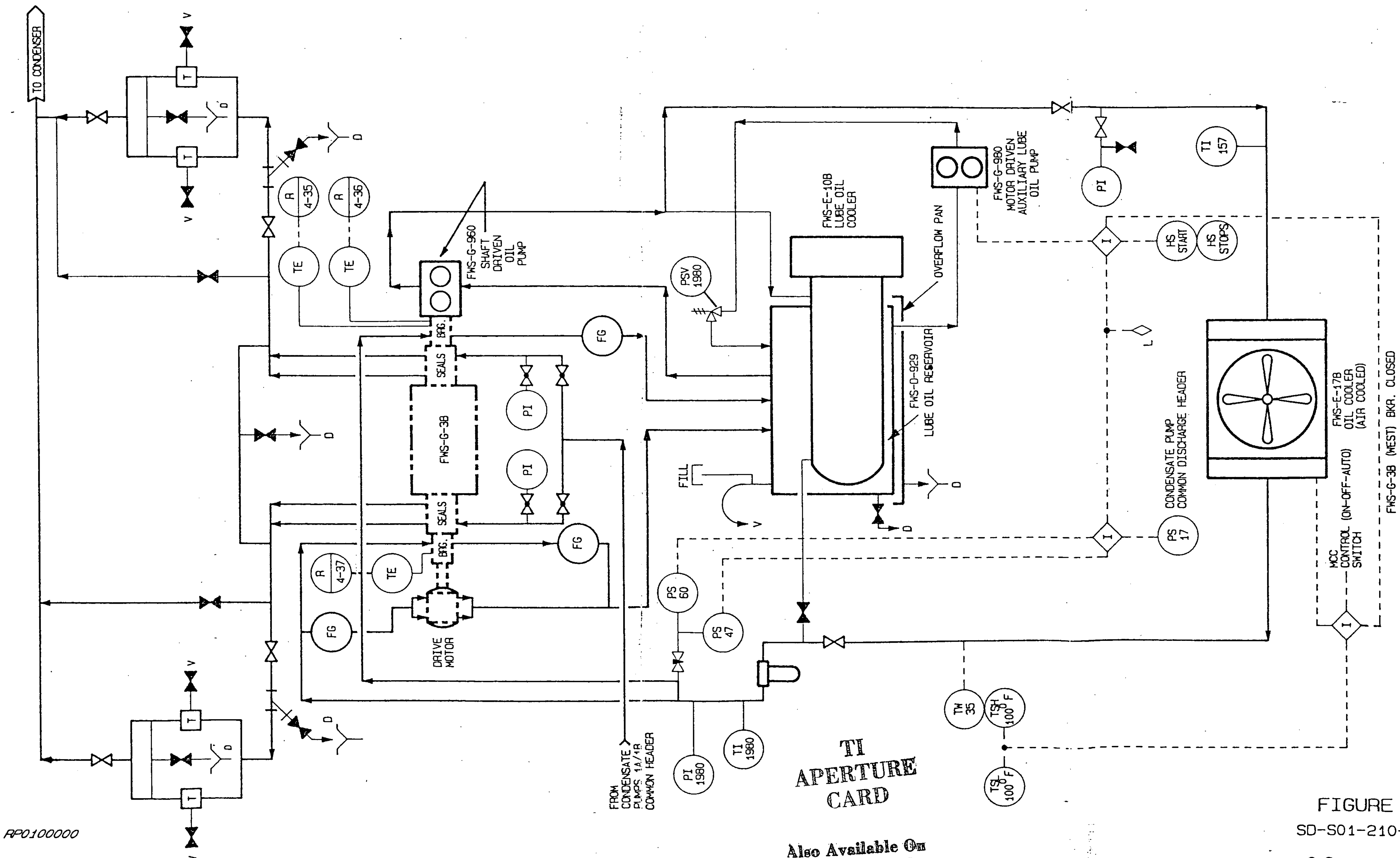
Also Available On Aperture Card

MA0638500

FIGURE 5
SD-S01-210-5-1

8711100274-98

MAIN FEEDWATER PUMP (FWS-G-3B) LUBE OIL AND SHAFT SEAL SYSTEM



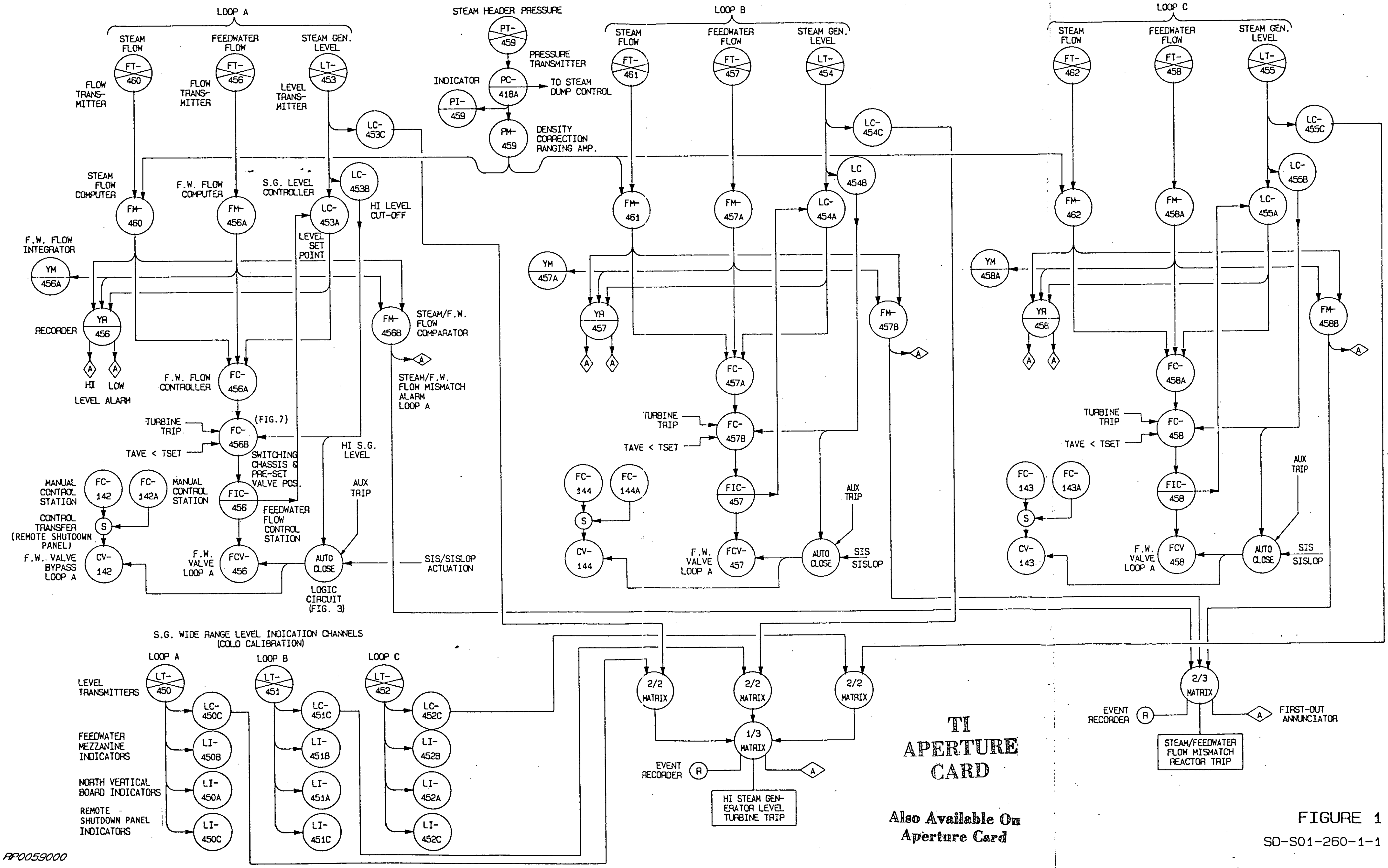
TI APERTURE CARD

Also Available On Aperture Card

FIGURE 6
SD-S01-210-6-2

8711100274-99

FEEDWATER CONTROL SYSTEM BLOCK DIAGRAM



TI APERTURE CARD

Also Available On Aperture Card

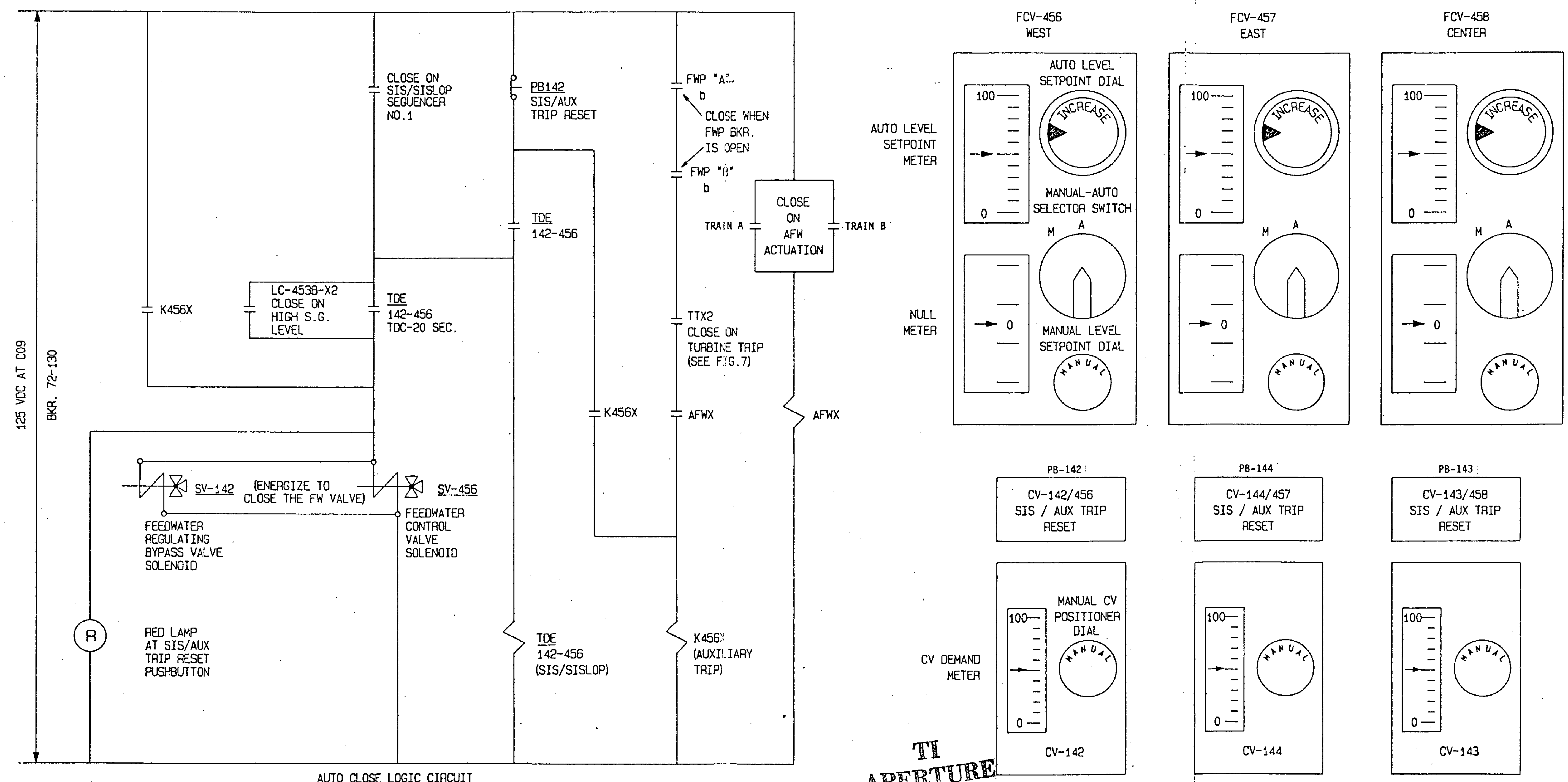
RP0059000

FIGURE 1 | R

SD-S01-260-1-1

8711100274 - 100

ELEMENTARY DIAGRAM SOLENOID VALVES FOR FEEDWATER CONTROL & BYPASS VALVES



RP0100000

TI APERTURE CARD

Also Available On Aperture Card

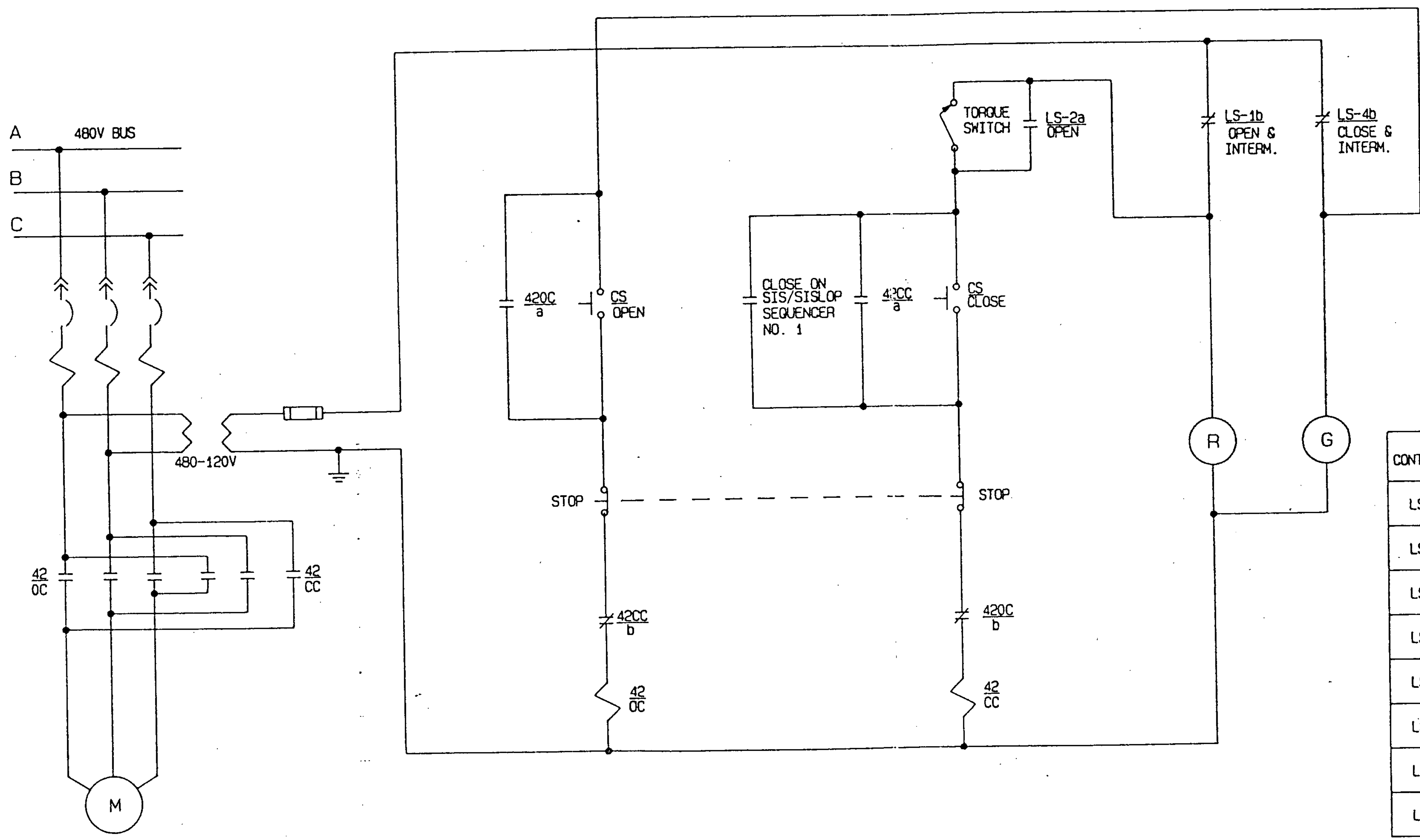
FIGURE 3
SD-S01-260-3-1

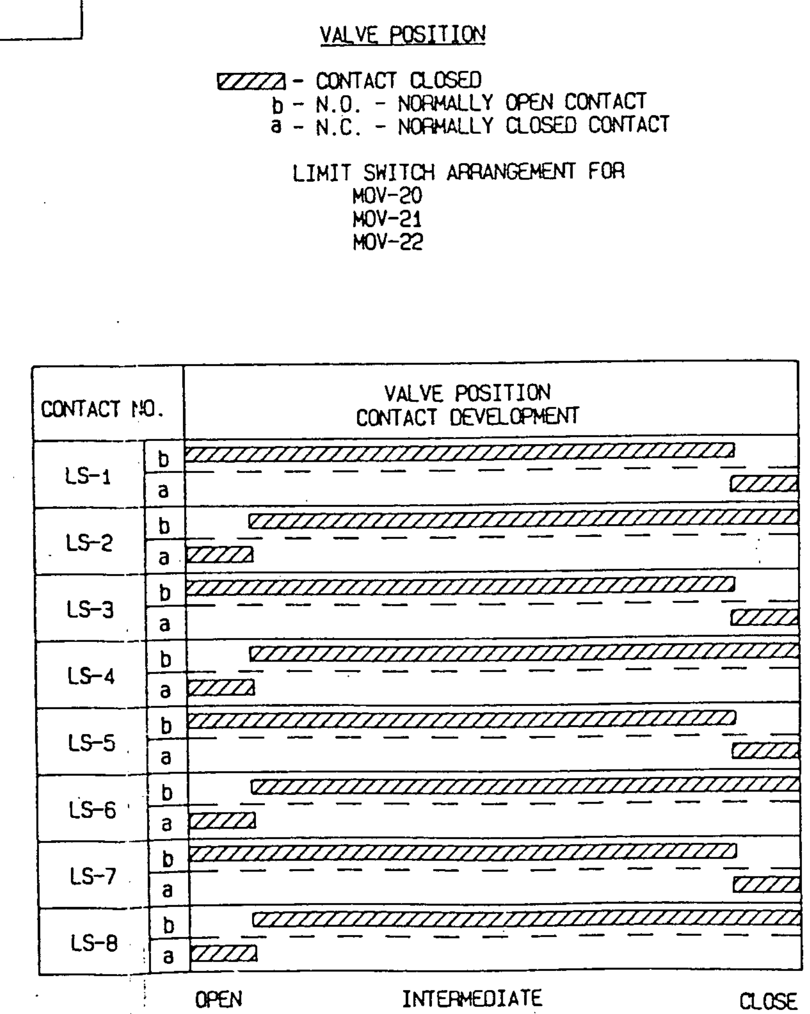
8711100274 - 101

ELEMENTARY DIAGRAM
FEEDWATER BLOCK VALVES
MOV-20, 21 & 22

TI
APERTURE
CARD

Also Available On
Aperture Card





R
R
R

FIGURE 6
SD-S01-260-6-1

RP000000

8711100274 -102

±15 VDC THROWOVER PANEL

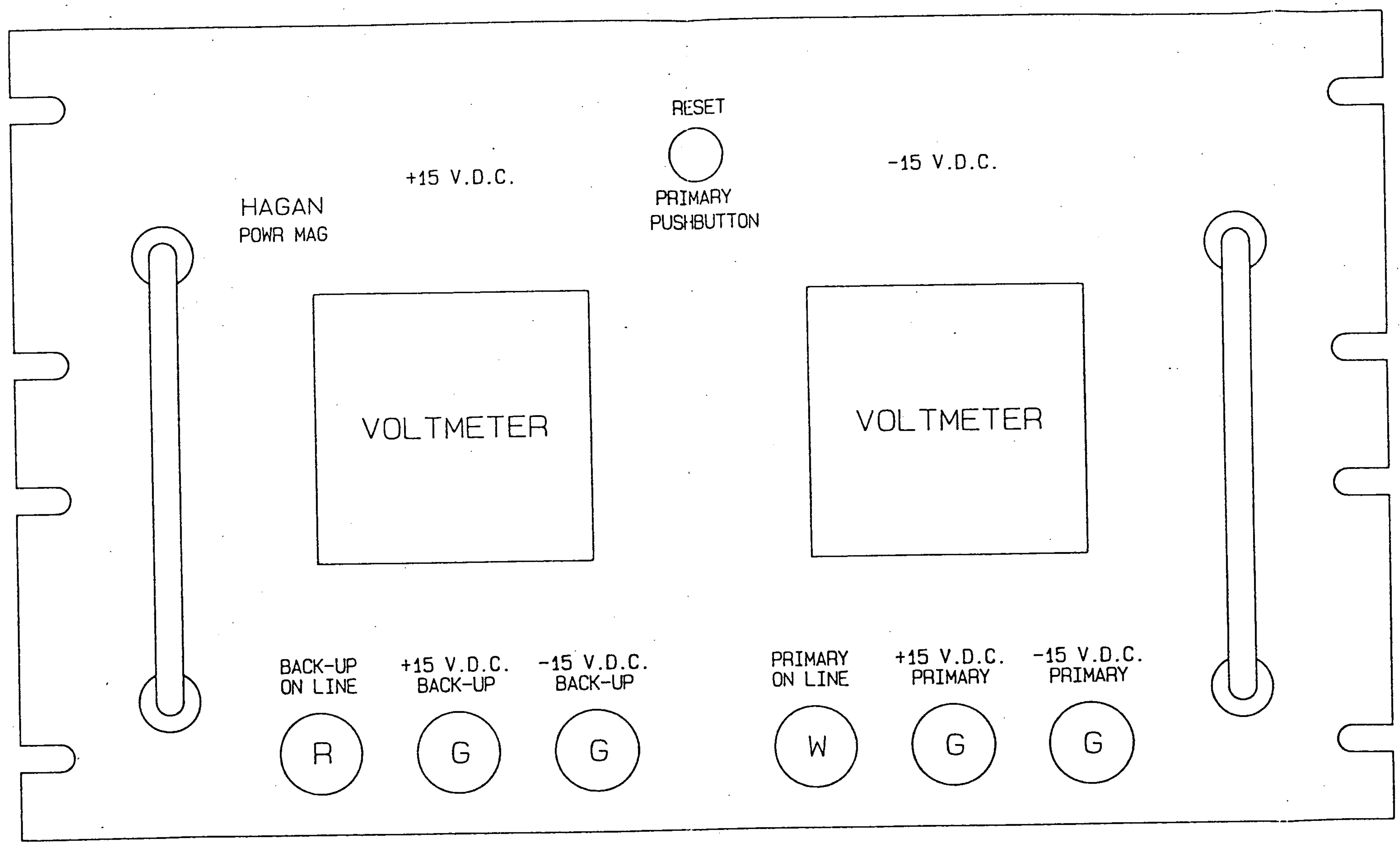
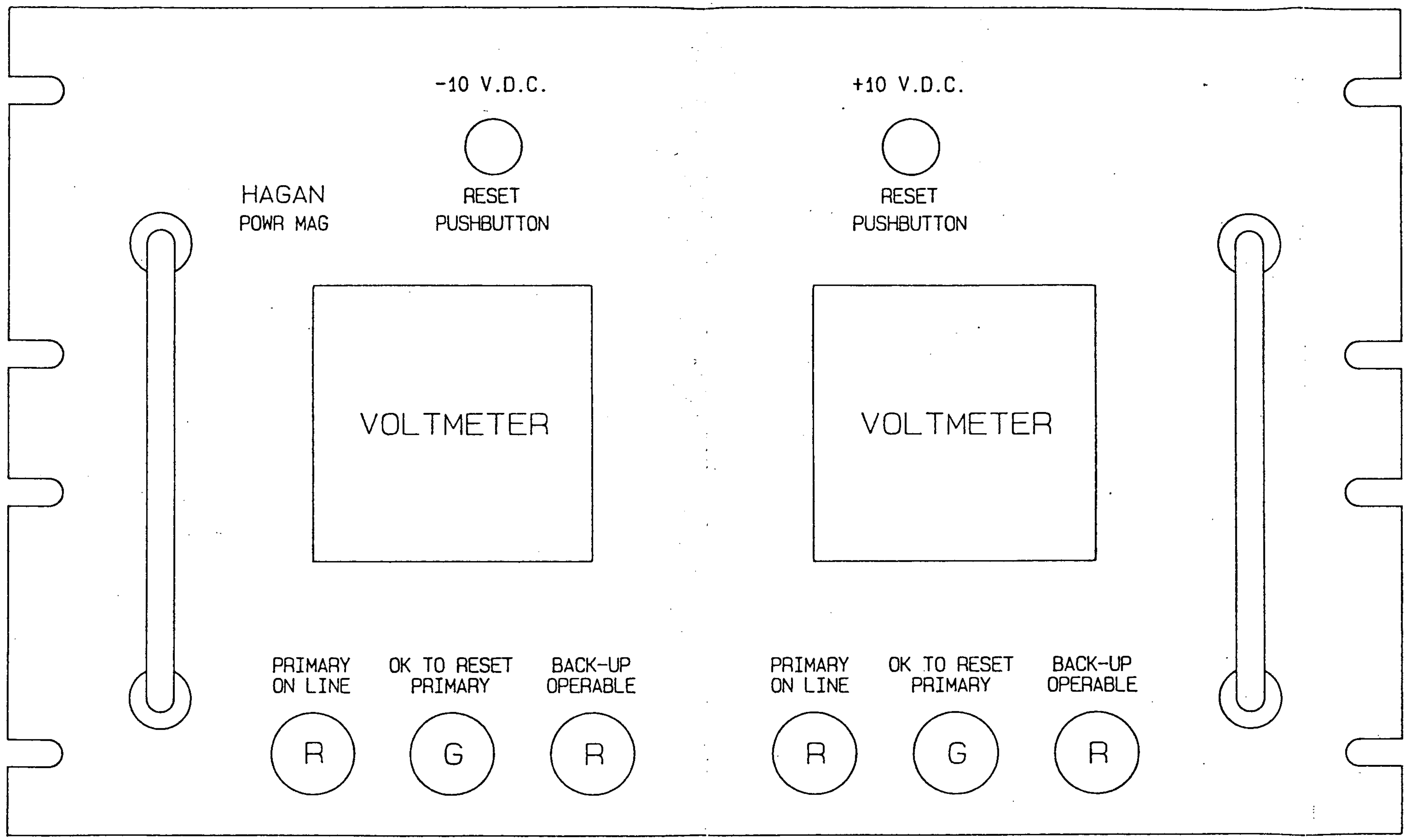


FIGURE 8
SD-S01-260-8-0

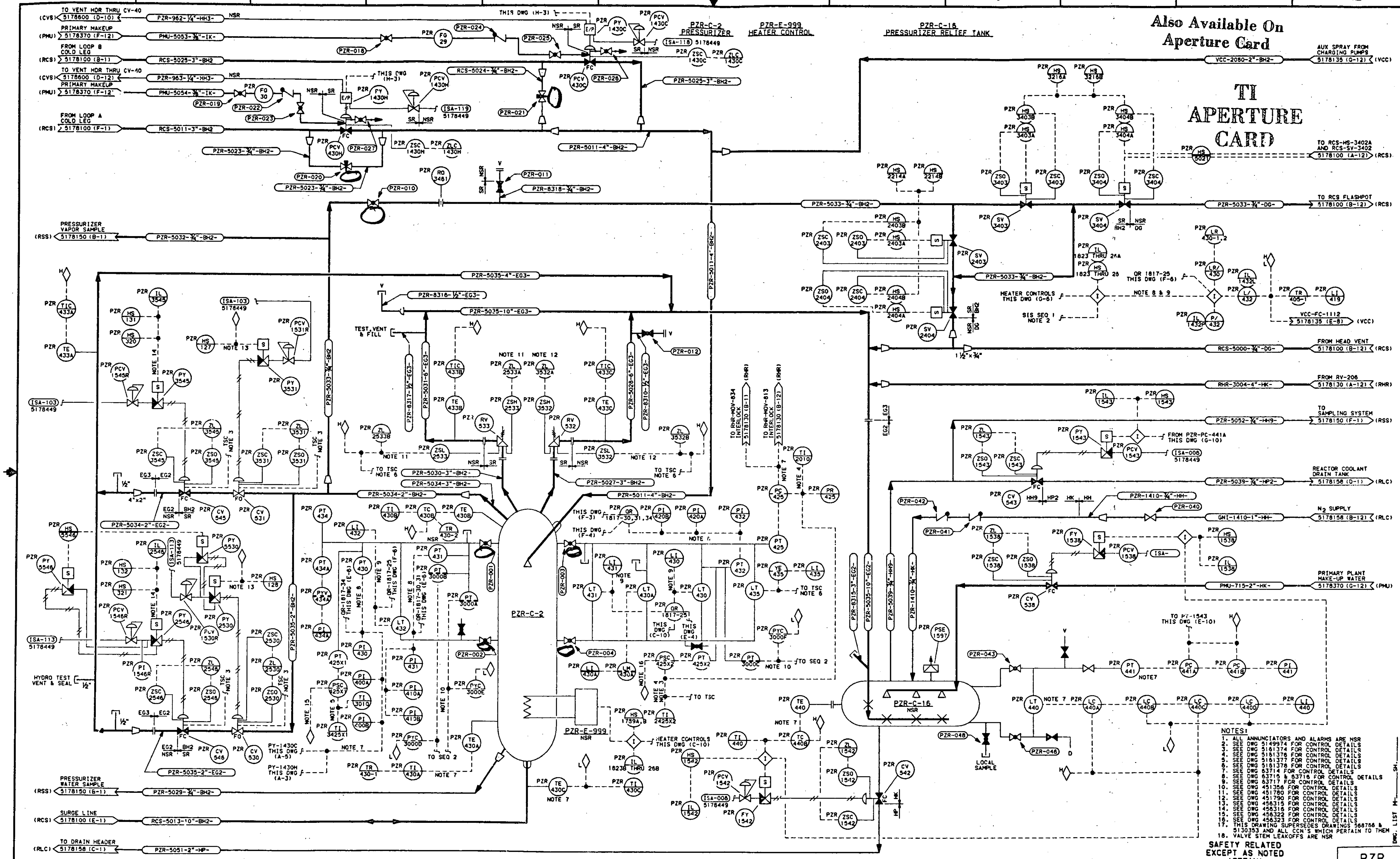
RP0100000

±10 VDC THROWOVER PANEL



RP0100000

FIGURE 9
SD-S01-260-9-0



NOTES:

1. ALL ANNUNCIATORS AND ALARMS ARE NSR
2. SEE DWG 5149974 FOR CONTROL DETAILS
3. SEE DWG 5181374 FOR CONTROL DETAILS
4. SEE DWG 5181376 FOR CONTROL DETAILS
5. SEE DWG 5181377 FOR CONTROL DETAILS
6. SEE DWG 5181378 FOR CONTROL DETAILS
7. SEE DWG 63714 FOR CONTROL DETAILS
8. SEE DWG 63715 & 63716 FOR CONTROL DETAILS
9. SEE DWG 63717 FOR CONTROL DETAILS
10. SEE DWG 451356 FOR CONTROL DETAILS
11. SEE DWG 451780 FOR CONTROL DETAILS
12. SEE DWG 451790 FOR CONTROL DETAILS
13. SEE DWG 456315 FOR CONTROL DETAILS
14. SEE DWG 456316 FOR CONTROL DETAILS
15. SEE DWG 456322 FOR CONTROL DETAILS
16. SEE DWG 456323 FOR CONTROL DETAILS
17. THIS DRAWING SUPERSEDES DRAWINGS 568756 & 5130353 AND ALL CCN'S WHICH PERTAIN TO THEM
18. VALVE STEM LEAKOFFS ARE NSR

SAFETY RELATED
EXCEPT AS NOTED
(SREAN)

WP 82-297

DWG. LIST M- ___ SH. ___
* REVISE ON CADD SYSTEM ONLY *

5178000	P & I DIAGRAM LEGEND SH 1	5154618	SCHEMATIC-RCS OVERPRESS SYSTEM
5178001	P & I DIAGRAM LEGEND SH 2	5159539	ELEM DIAGRAM-RV-532 & RV-533 POSITION
5178002	P & I DIAGRAM LEGEND SH 3	5180711	ELEM DIAGRAM-PT-3000A, PT-3000B, PT-3000C
63720	REACTOR CONTROL & PROTECTION SYSTEM		TRAIN B
5150338	ELEM DIAGRAM-PRESS HTR CTRL GRP A & B		
5150339	ELEM DIAGRAM-PRESS HTR CTRL GRP C & D		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

NO.	REVISIONS	M	DATE	P.E.	QAE	SUPV	APPROVED	ENGR	CK'D	MADE	J.O.
10	AS BUILT-INCORP DCN #11		6/3/91					Who	AAR	GAC	3831
9	AS BUILT-INCORP DCN #10			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
8	AS BUILT-INCORP DCN #9			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
7	AS BUILT-INCORP DCN #8			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
6	AS BUILT-INCORP DCN #7			SEE	CDM	FILES	FOR SIGNATURES			DVY	3083
5	AS BUILT-INCORP DCN #6			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
4	AS BUILT-INCORP DCN #5			SEE	CDM	FILES	FOR SIGNATURES			BLS	3083
3	AS BUILT-INCORP CC #2			SEE	CDM	FILES	FOR SIGNATURES			BLS	8881
2	AS BUILT-INCORP DCN#4			SEE	CDM	FILES	FOR SIGNATURES			GJK	8744
1	AS BUILT-INCORP DCN#3 CC#1 CANCELED			SEE	CDM	FILES	FOR SIGNATURES			GJK	8744
0	ISSUED AS BUILT			SEE	CDM	FILES	FOR SIGNATURES			JV	8252

E4-652-CADD 03-85

LOCATION: SAN ONOFRE NUCLEAR GEN. STA. UNIT 1

P & I DIAGRAM
PRESSURIZER &
PRESSURIZER RELIEF TANK

Southern California Edison

PZR

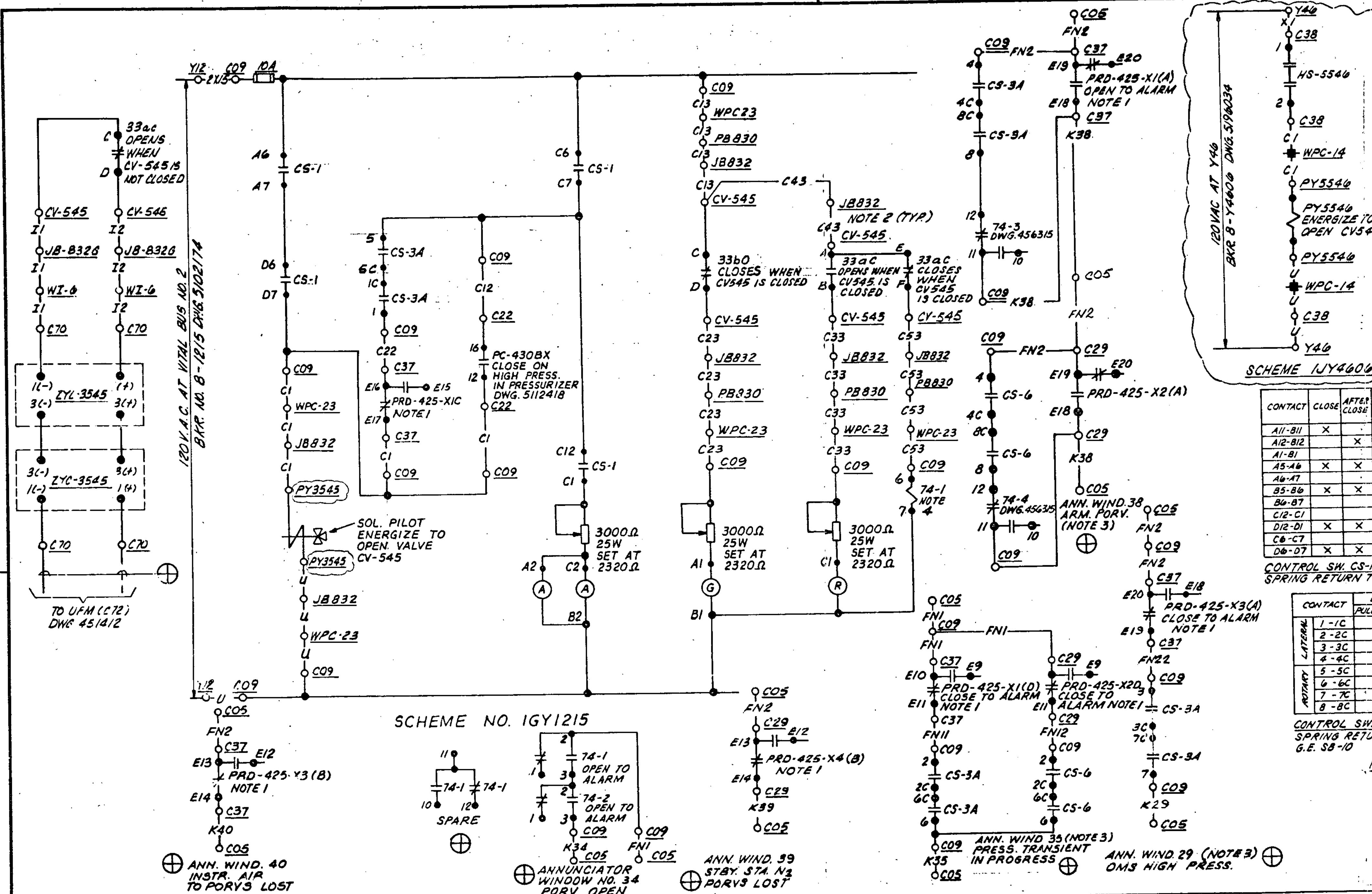
SHEET NO.
M

SCALE: NONE
___ OF ___ SHTS.

06-11-87
CASTRO

8711100274-105 568776

5178105-10



HS5546 SWITCH DEVELOPMENT

DECK	POSITION OPEN	POSITION NORMAL	POSITION CLOSED	CONTACTS
1	X			1–2
		X		3–4
2			X	5–6
			X	7–8
3		X		9–10
	X			11–12

NOTE:
SWITCH ESCUTCHEON IS SHOWN ON DWG 5194860

CV-545 & CV-546

LIMIT SWITCH	CONTACT	VALVE POSITION OPEN	VALVE POSITION INTER	VALVE POSITION CLOSE
33b0	A-B	■		
	C-D			■
	E-F			■
	G-H	■		
33ac	A-B	■		
	C-D			■
	E-F			■
	G-H	■		

CONTACT	CLOSE	AFTER CLOSE	PULL FOR AUTO AFTER CLOSE	PULL FOR AUTO AFTER OPEN	AFTER OPEN	OPEN
A11-B11	X					
A12-B12		X	X	X	X	
A1-B1						X
A5-A6	X	X	X			
A6-A7				X	X	X
B5-B6	X	X	X			
B6-B7				X	X	X
C12-C1			X	X		
D12-D1	X	X			X	X
C6-C7			X	X		
D6-D7	X	X			X	X

PULL FOR
CLOSE AUTO OPEN

CONTROL SW. CS-1 & CS-4
SPRING RETURN TO NEUTRAL

	CONTACT	DISABLE PULL IN	DISABLE PULL OUT	ENABLE (W/PULL OUT ONLY)
LATERAL	1 -1C		X	X
	2 -2C		X	X
	3 -3C		X	X
	4 -4C		X	X
ROTARY	5 -5C			X
	6 -6C			X
	7 -7C			X
	8 -8C			X

DISABLE ENABLE

CONTROL SW. CS-3A & CS-6
SPRING RETURN TO DISABLE
G.E. SB-10

NOTES.
1. FOR CONTACT INFORMATION REFER TO FOXBORO BULLETIN MI-2A0-113, JAN. 1974.
2. CONTROL CABLES FOR CV-545 & CV-546 WERE SPLICED WITH RAYCHEM HEAT SHRINKABLE TUBING, TYPE WCSF-070-6-N OR WCSF-115-6-N INSIDE JB832 & JB828
3. ANN. WINDOWS AS NOTED ARE SHARED BY BOTH OMS (OVERPRESS MITIGATING SYSTEM) TRAINS.
4. ALARM RELAYS 74-1 & 74-2 ARE CONSOLIDATED CONTROLS CORP. PLUG-IN TYPE, MODEL NO. BN13-1, 120VAC

VALVE	FUNCTION	SCHEME NO.	BREAKER NO. (DWG. 5102174)	LOCATION										INTLK. CONTACTS		CONTROL SW.		ANNUNCIATOR WINDOW NO'S.					ANNUNCIATOR WIRE NO'S					INTLK			
CV-545	PRESS. POWER RELIEF	1GY1215	8-1215	C09	C22	C37	Y12	WPC-23	C05	JB832	PY3545	PB830	PC-4308X	PRD-425-X1-C	CS-1 (HS-7321)	CS-3A (HS-3201)	36	40	29	34	38	K35	K40	K29	K34	K38	PRD-425-X1(A)	PRD-425-X1-(D)	PRD-425-X3(A)	74-1
CV-546	PRESS. POWER RELIEF	1FY1112	8-1112	C09	C22	C29	Y11	EPC-23	C05	JB828	PY2546	PB826	PC-4318X	PRD-425-X2-C	CS-4 (HS-7321)	CS-6 (HS-3201)		39					K39				PRD-425-X2-(A)	PRD-425X2-(D)	PRD-425X4(A)	74-2

NOTE 5. CONTROL (HAND) SWITCH IDENTIFICATION NUMBERS IN PARENTHESIS REFER TO (DUPLICATE) IDENTIFICATION NUMBERS IN INSTRUMENT INDEX.

VALVE	LOCATION			DEVICE	
CV-545	WI-6	C70	JB-8326	ZYL-3545	ZYC-3545
CV-546	EI-5	C69	JB-828F	ZYL-2546	ZYC-2546

REDRAWN FROM DWG. 455451 & WEST DWG. 323139-8 SH 7

SONGS 1
SAFETY RELATED
EXCEPT AS NOTED

Reference Drawings	
456290	LOGIC DIAGRAM CV 545 & 546
A112598	APD ANN. ARRANGEMENT
5149964	EQUIP. LOCATION INDEX
5149629	DEVICE FUNCT. & SYMBOLS

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	J.O. No.
6	AS BUILT-INCORP DCN-11, 12 & 13	4-3-86		OG			EACo	3009
5	AS BUILT-INCORP CC 7, 9 DCN 10 (#8 NOT USED)	3-19-85					EACo	3083
4	INCORP. CC #6 (AS CONSTRUCTED TMI-II JUNE 1981 OUTAGE)	2-2-82						7764
3	INCORPORATED ... (REV. NOTES 4 & 5) AS CONSTRUCTED FOR JAN. 1980 OUTAGE	5-5-81				EJF	CoFE	7764
2	INCORP. CCN #3 EFFECT. DATE IMMED.	7-5-79					EACO	7538
1	INCORP. CCN 1	6-2-78				PK	MK	7319
0	ISSUED FOR CONSTRUCTION	11-13-78						7419

Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM PRESS. POWER RELIEF CV-545 & 546

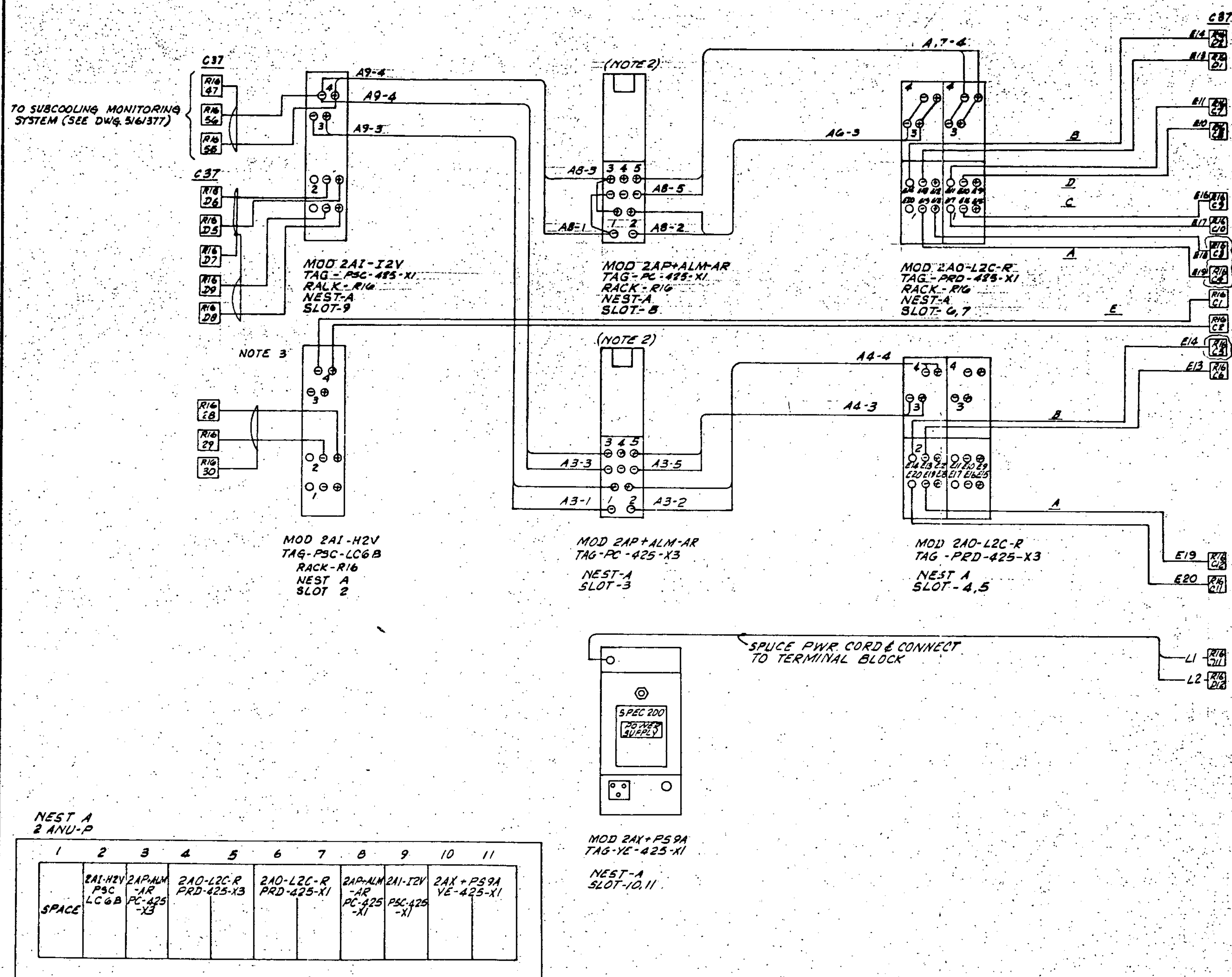
Southern California Edison Company SCE

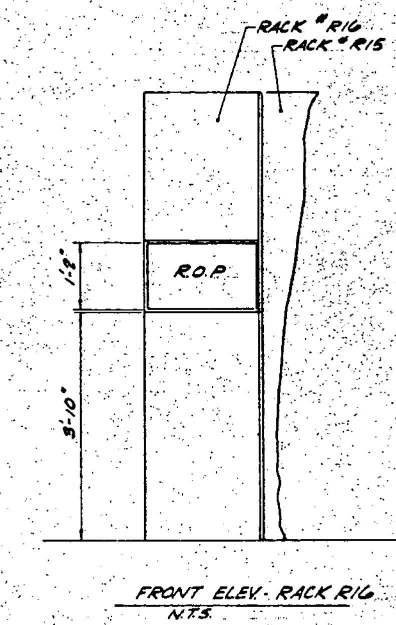
456316-6

8711100274-106

TI APERTURE CARD

Also Available On Aperture Card





FRONT ELEV. RACK R16
N.T.S.

NOTES:

1. FOR EXTERNAL WIRING SEE DWG. 568269
2. INTERNAL JUMPERS SET FOR OUTPUT NO. 1 (TERMINAL #2) TO LOW ALARM ACTION.
   INTERNAL JUMPERS SET FOR OUTPUT NO. 2 (TERMINAL #5) TO HIGH ALARM ACTION.
3. SYSTEM WIRING AS SHOWN IS PART OF CONDENSATE STORAGE TANK LEVEL INDICATION AND ALARM.
4. SAFETY APPLICATION - PROVIDE REDUNDANT SAFETY GRADE CONDENSATE STORAGE TANK LEVEL INDICATION AND ALARM IN THE MAIN CONTROL ROOM TO ALLOW THE OPERATOR TO ANTICIPATE THE DEMAND FOR THE AUXILIARY FEEDWATER SYSTEM PRIMARY WATER SUPPLY AND PREVENT A LOW PUMP SUCTION PRESSURE CONDITION.
5. FOR INTERNAL WIRING, USE #18 AWG SIS WIRE, B/M. M-34557. ITEM 16 UNLESS OTHERWISE INDICATE W/SHIELD SYMBOL WHICH SHALL BE 2/C #16 SHIELDED, CODE 516.

TI APERTURE CARD

Also Available On Aperture Card

SONGS I
SAFETY RELATED
ROP MITIGATING SYSTEM

Reference Drawings	
456315	E.D. CV-530 & 531
456316	E.D. CV-545 & 546

No.	Revisions	Date	J.O. No.
4	AS BUILT-INCORP CC 12,13 DCN 14		3083
3	ISSUED FOR "AS CONSTRUCTED" INC CC #11 CC #4 TO 10 CANCELLED	9-17-81	7764
2	INCORP. CCN 2 & 3 EFF. DATE IMMED.	5-2-78	7419
1	INCORP. CCN 1, EFF. DATE IMMED.	6-6-78	7419
0	ISSUED FOR CONSTRUCTION	1-15-77	7419

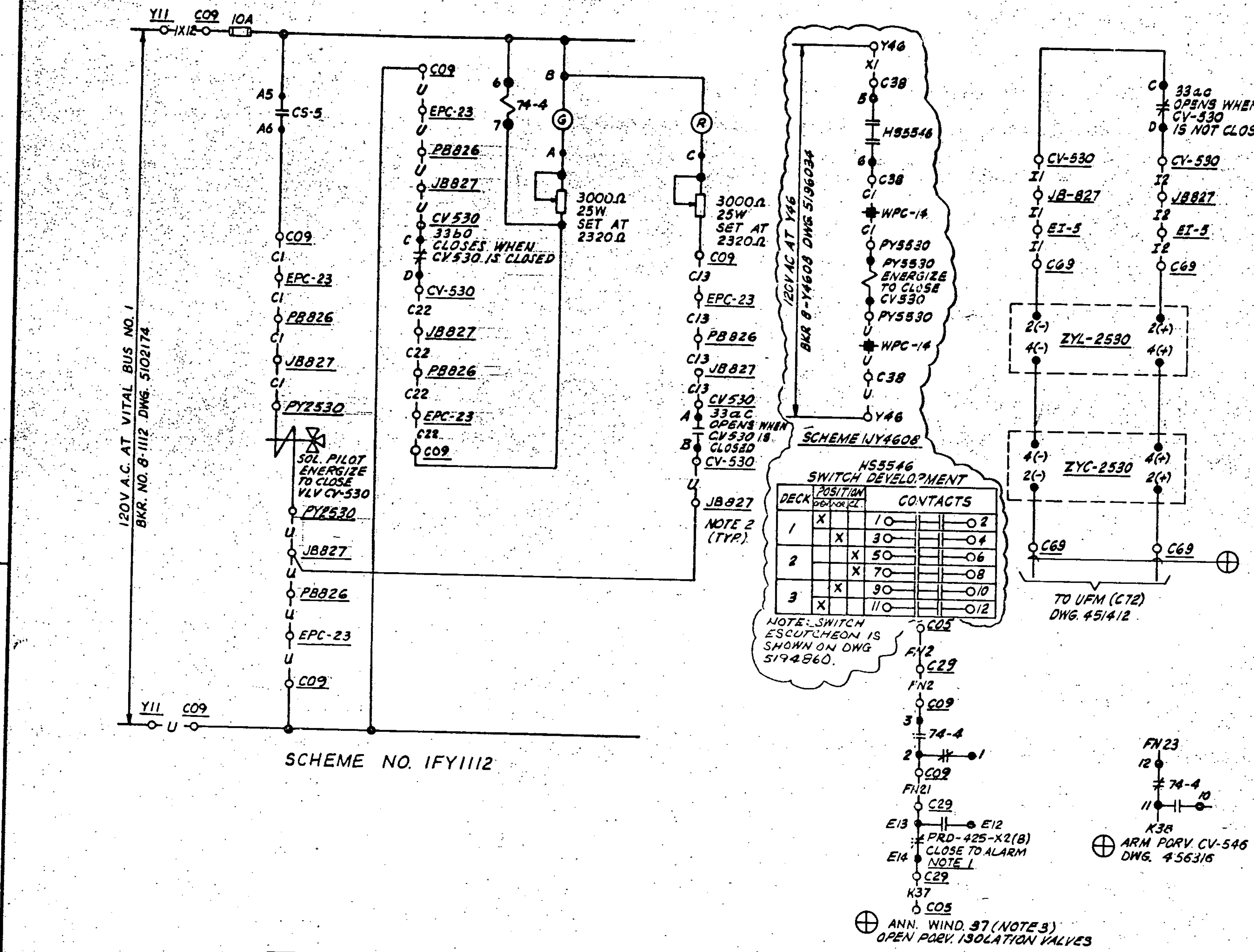
Location SAN ONOFRE NUCLEAR GEN. STA.

LOOP DIAGRAM
REACTOR OVERPRESSURE
MITIGATING SYSTEM

SCE EDISON Rosemead California

Scale: NONE

456322 4



CONTACT	CLOSE	NEUTRAL AFTER CLOSE	NEUTRAL AFTER OPEN	OPEN
A11-B11	X			
A12-B12		X	X	
A1-B1				X
A5-A6	X	X		
A6-A7			X	X
B5-B6	X	X		
B6-B7			X	X

CONTROL SW. CS-2 & CS-5
SPRING RETURN TO NEUTRAL

CLOSE | OPEN

CV-530 & CV-531				
LIMIT SWITCH	CONTACT	VALVE POSITION OPEN	INTER	CLOSE
33b0	A-B			
	C-D			
	E-F			
	G-H			
33aC	A-B			
	C-D			
	E-F			
	G-H			

DEVICE TABLE

DEVICE	TYPE	DESCRIPTION
74-3 74-4	8N13-3	AUXILIARY RELAY, PLUG-IN TYPE CONSOLIDATED CONTROL CORP. 120 V.A.C.

NOTE:
1. FOR CONTACT INFORMATION REFER TO FOXBORO BULLETIN MI-2A0-113, JAN. 1974.
2. CONTROL CABLES FOR CV-530 & CV-531 WERE SPLICED WITH RAYCHEM HEAT SPRINKABLE TUBING, TYPE WCSF-070-6-N OR WCSF-115-6-N, INSIDE JB-827 (JB-831)
3. ANN. WINDOW AS NOTED IS SHARED BY BOTH OMS (OVERPRESS MITIGATING SYSTEM) TRAINS.

TMI-II W.P. #2.1.3a, 2.2.2b

VALVE	FUNCTION	SCHEME NO.	BRKR. NO.	CONT. SW.	LOCATION								ANNUNCIATOR WINDOW	WIRE NO'S.		INTLK.	DEVICE NO.		
CV-530	POWER RELIEF ISOLATION	1FY1112	8-1112	CS-5	PY2530	EI-5	EPC-23	PB.826	J8827	C29	Y11	C69	37	FN2, FN21,	K37	PRD-425-X2(B)	74-4	ZYL-2530	ZYC-2530
CV-531	POWER RELIEF ISOLATION	1GY1215	8-1215	CS-2	PY3531	WI-6	WPC-23	PB.830	J8831	C37	Y12	C70		FN2, FN21,		PRD-425-X1(B)	74-3	ZYL-3531	ZYC-3531

SONGS I
SAFETY RELATED
EXCEPT AS NOTED ⊕

REDRAWN FROM DWG. 455449 & WEST. DWG. 323139-B SH. 7

Reference Drawings	
456290	LOGIC DIAGRAM CV-530 & 531
8112392	APD ANN. ARRANGEMENT.
N-1542 SH.53	E.D. VERT. BD. INSTR. PWR. SUPPLY
N-1542 SH.55	E.D. VERT. BD. INSTR. PWR. SUPPLY
N-1542 SH.56	E.D. VERT. BD. INSTR. PWR. SUPPLY
5149964	EQUIP. LOCATION INDEX
5149629	DEVICE FUNCT. & SYMBOLS

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	I.O. No.
7	AS BUILT-INCORP DCN 14,15	8-18-86			GG	ARR	EAG	3009
6	AS BUILT-INCORP. DCN. 13	3-13-86		GG			EAG	3066
5	AS BUILT-INCORP. CC #10,12 (#11 NOT USED)	4-2-85					EAG	3083

No.	Revisions	Date	Approved	O.K.	O.K.	Ck'd.	Made	I.O. No.
4	INCORP. CC #9 (AS CONSTR. TMI-II JUNE 1981 OUTAGE)	2-2-82						7764
3	INCORPORATED CC #6 (DELETED NOTE 4) AS CONSTRUCTED FOR TMI JAN. 1980 OUTAGE	3-5-81				EJF		7764
2	INCORP. CCN 4 & 5	4-2-79					BC	7419
1	INCORP. CCN 1 & 2	6-2-77				DK		
0	ISSUED FOR CONSTRUCTION							7419

Scale NONE

Location SAN ONOFRE NUCLEAR GEN. STA.

ELEMENTARY DIAGRAM
POWER RELIEF ISOLATION
CV-530 & 531

Southern California Edison Company SCE

456315-7

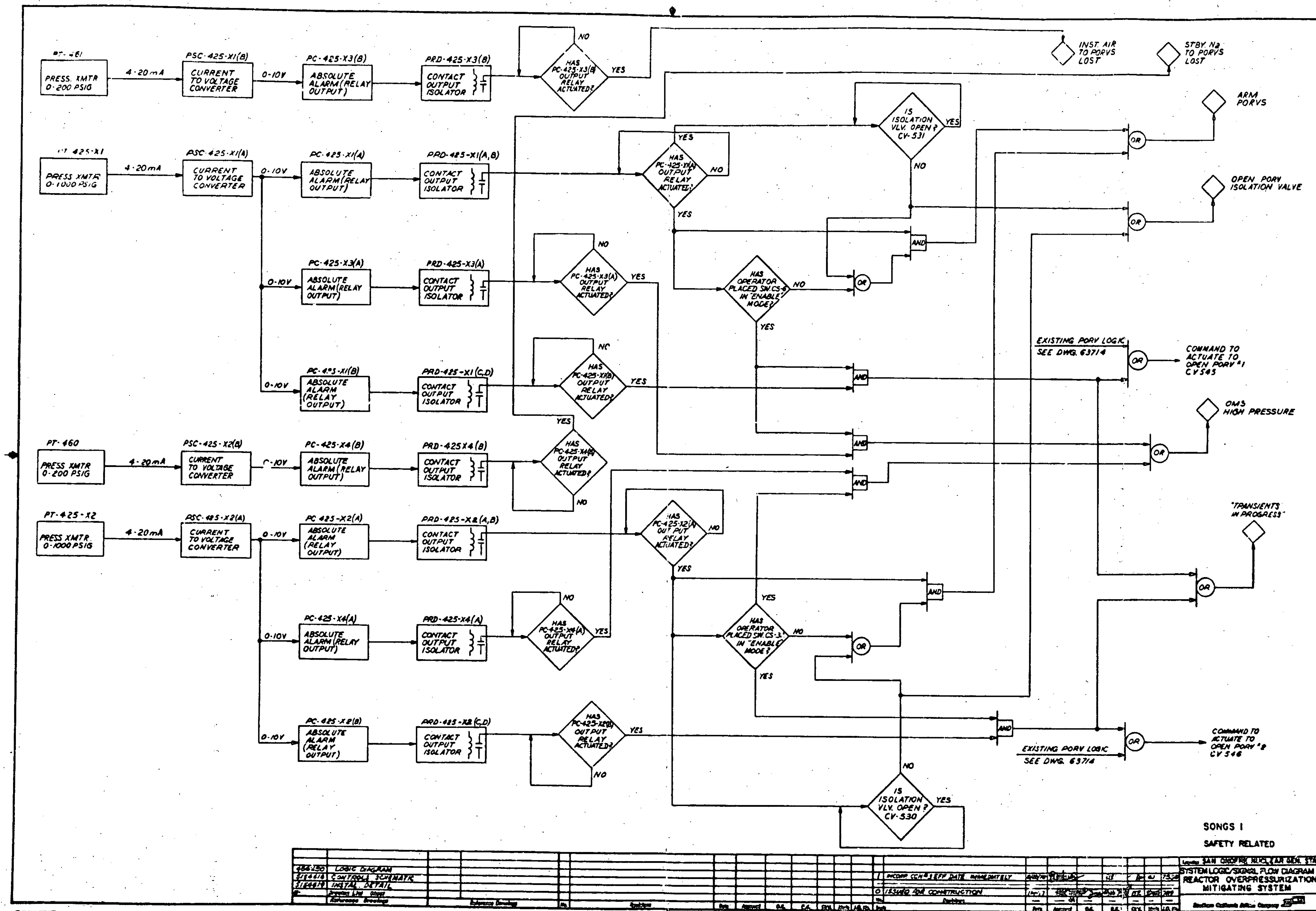
TI APERTURE CARD

Also Available On Aperture Card

20X

Southern California Edison Company

8711100274-108



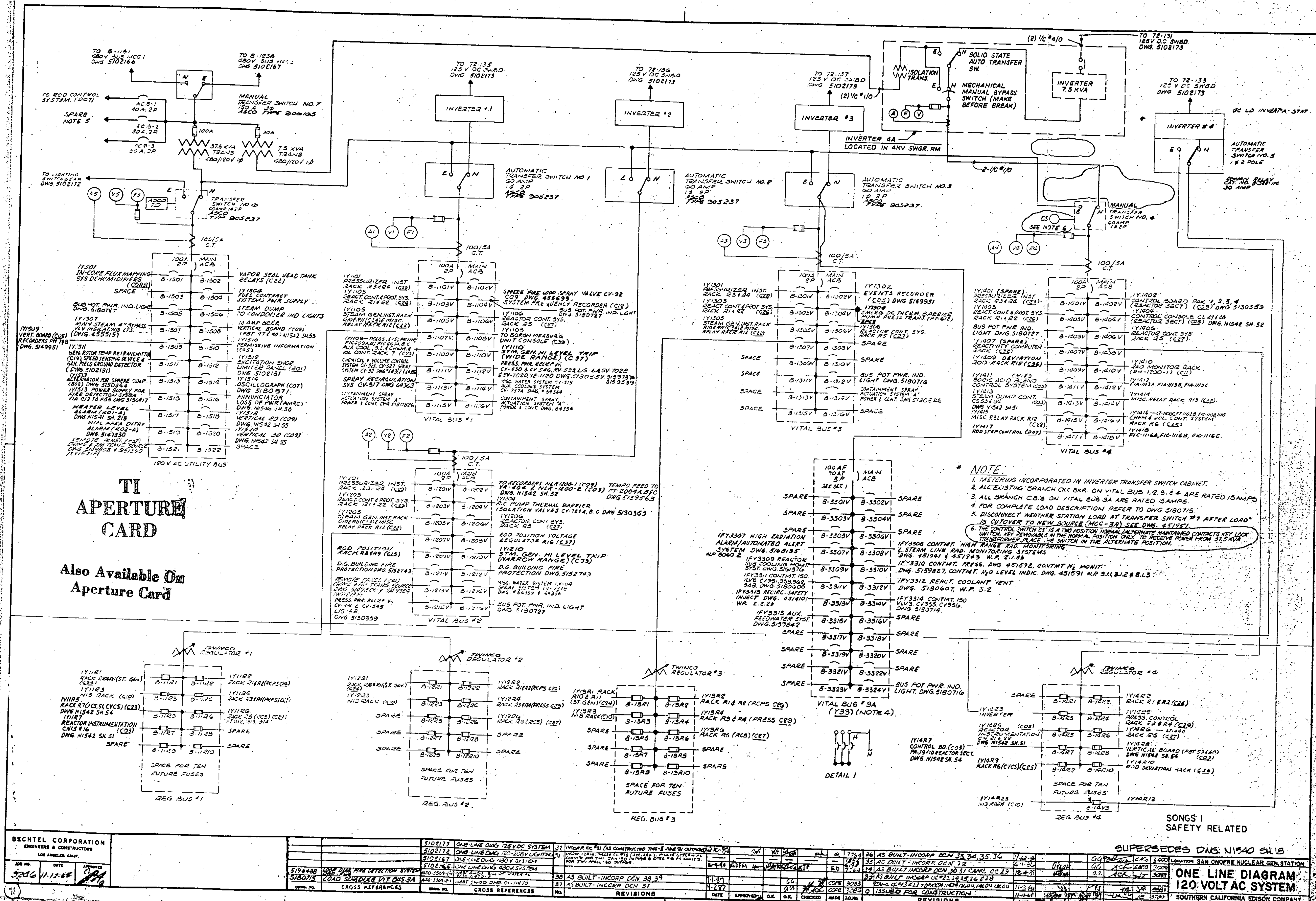
26X

TI APERTURE CARD

Also Available On Aperture Card

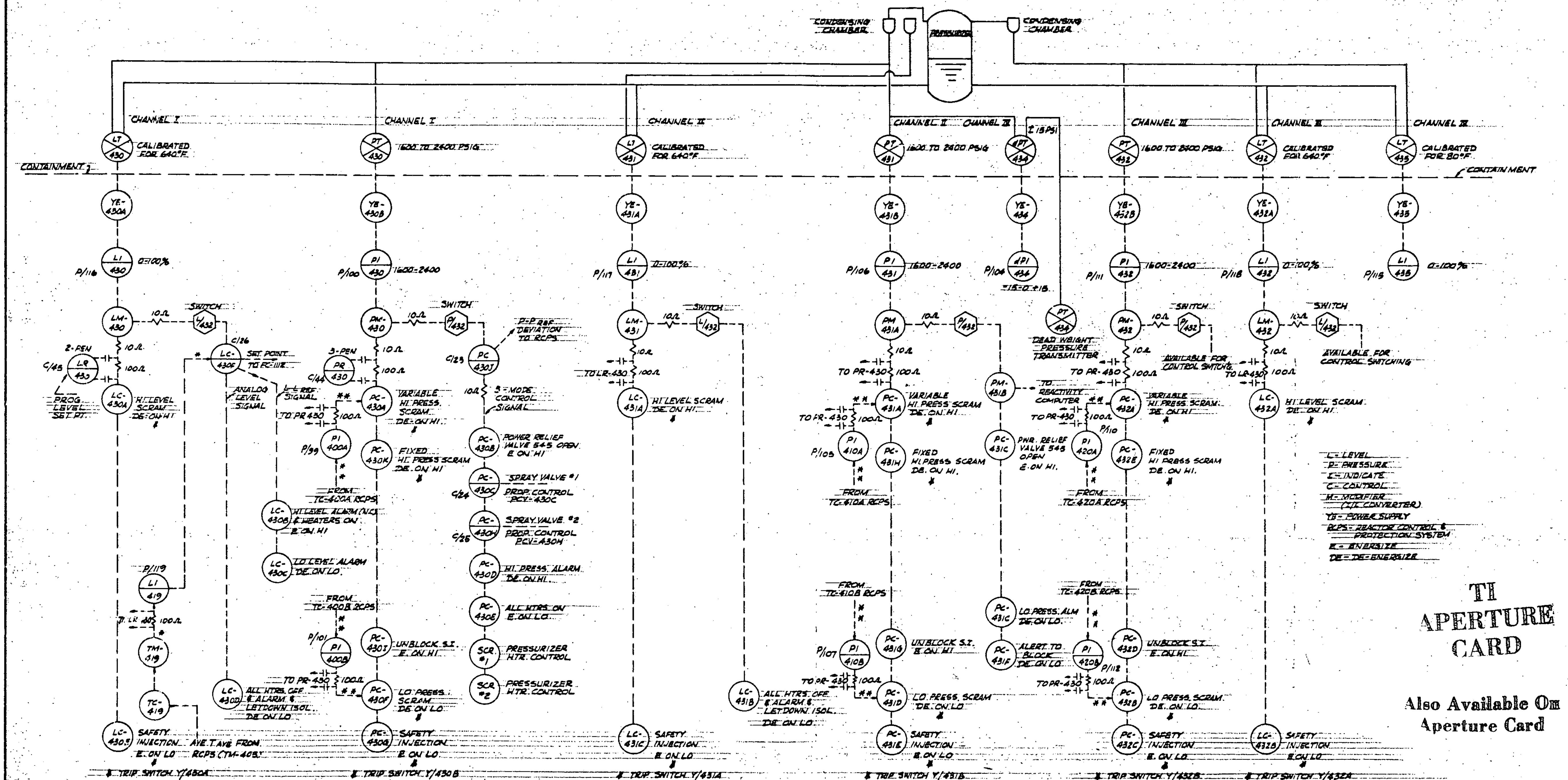
MICROFILMED FROM

8711100274-109



8711100274-110

5102174-38



\# DENOTES BISTABLES WHICH CAN BE OVER-RIDDEN BY THE TRIP SWITCH. THE TRIP SWITCH FOR EACH CHANNEL PLACES ALL SCRAM & S.I. BISTABLES OF THAT CHANNEL IN THE TRIPPED MODE. THIS PERMITS MAINTENANCE WORK ON ONE CHANNEL WHILE PERMITTING SAFE PLANT OPERATION ON THE REMAINING TWO CHANNELS WHICH OPERATE ON ONE-OUT-OF-TWO LOGIC FOR SCRAM & S.I.

NOTES:

1. SAFETY INJECTION IS ACTUATED BY AN ENERGIZE SIGNAL MODE.
2. SCRAM IS ACTUATED BY A DE-ENERGIZE SIGNAL MODE.
3. * PROGRAMMED SET POINT AS A FUNCTION OF (T AVE) AVE.
4. ** PROGRAMMED SET POINT CALCULATED BY REACTOR CONTROL & PROTECTION SYSTEM.
5. ALL BISTABLE OUTPUTS ARE ON-OFF VOLTAGES DERIVED DIRECTLY FROM THE BISTABLE SUPPLY.
6. CHANNELS ARE SUPPLIED BY FOUR REGULATED 118VAC POWER SUPPLIES (I, II, III & IV) AS FOLLOWS:

SUPPLY	I	II	III	IV
CHANNEL	L-430 P-430	L-431 P-431	L-432 P-432	L-433 P-434

TI APERTURE CARD

Also Available On Aperture Card

8711100274-111

No.	Revisions	Date	Approved	O.K.	O.K.	Ch'd.	Made	J.O. No.
0	RECORD REVISION - CREATED DRAWING	7-12-73		C.S.	RGS	JS	CAPS	8104

Reference Drawings

Location SAN ONOFRE NUCLEAR GEN. STATION

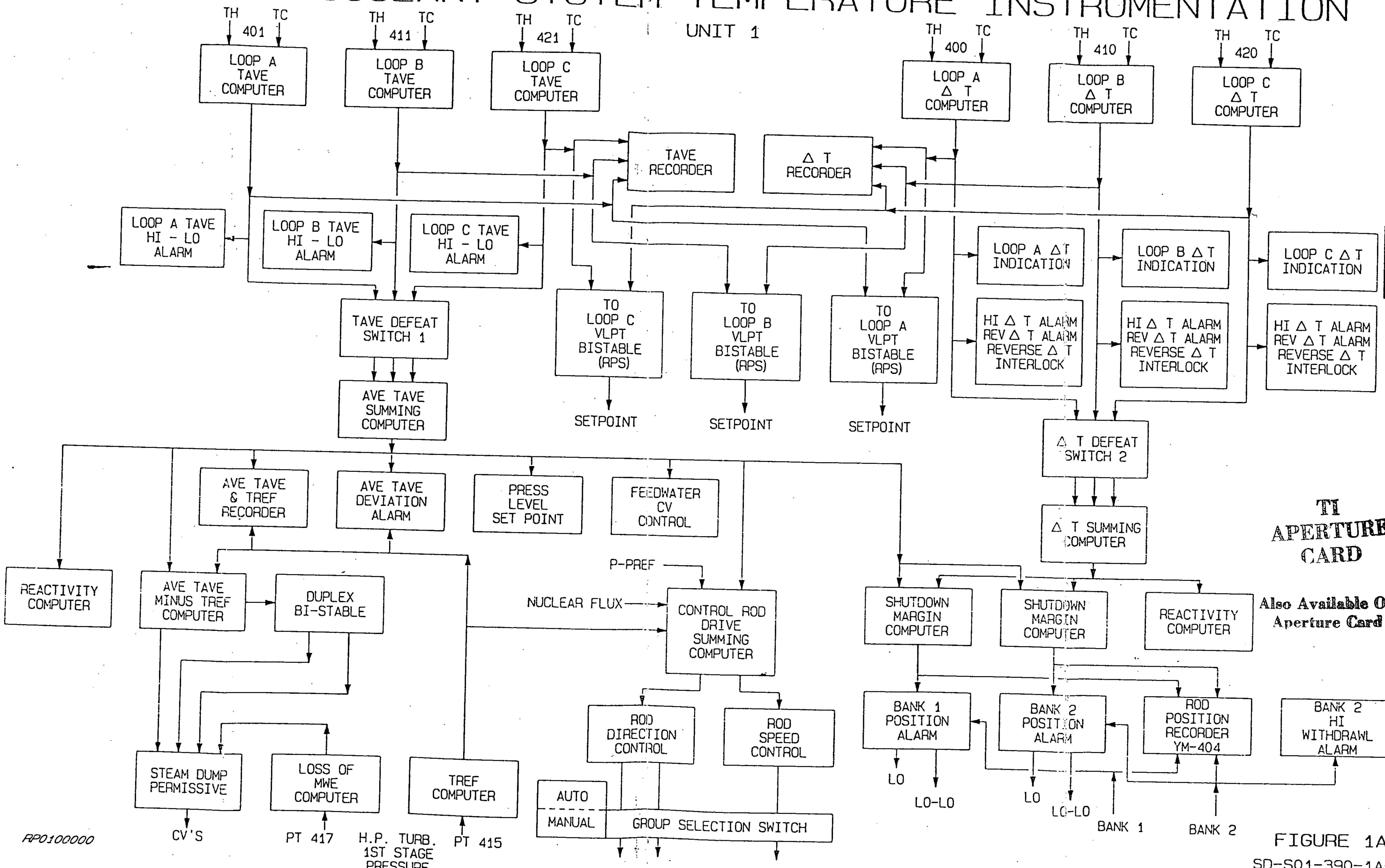
SCE PRESSURIZER CONT. SYS. BLOCK DIAGRAM FIG. 2-6
EDSK 322674 SHEET 1.

Southern California Edison Company

5126359-0

REACTOR COOLANT SYSTEM TEMPERATURE INSTRUMENTATION

UNIT 1



TI APERTURE CARD

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FIGURE 1A
SD-S01-390-1A-1

8711100274 - 112

REACTOR COOLANT SYSTEM FLOW INSTRUMENTATION

UNIT 1

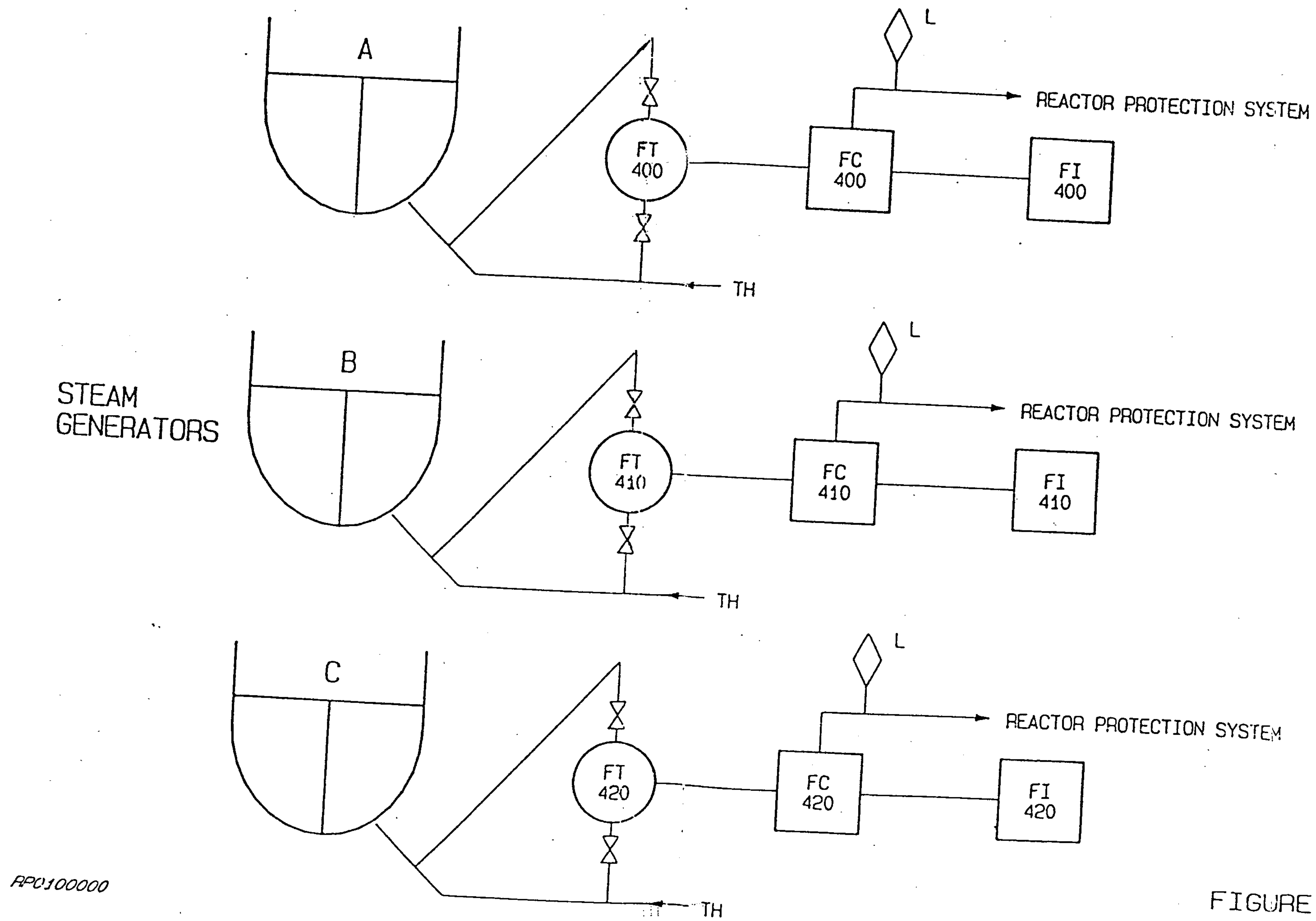
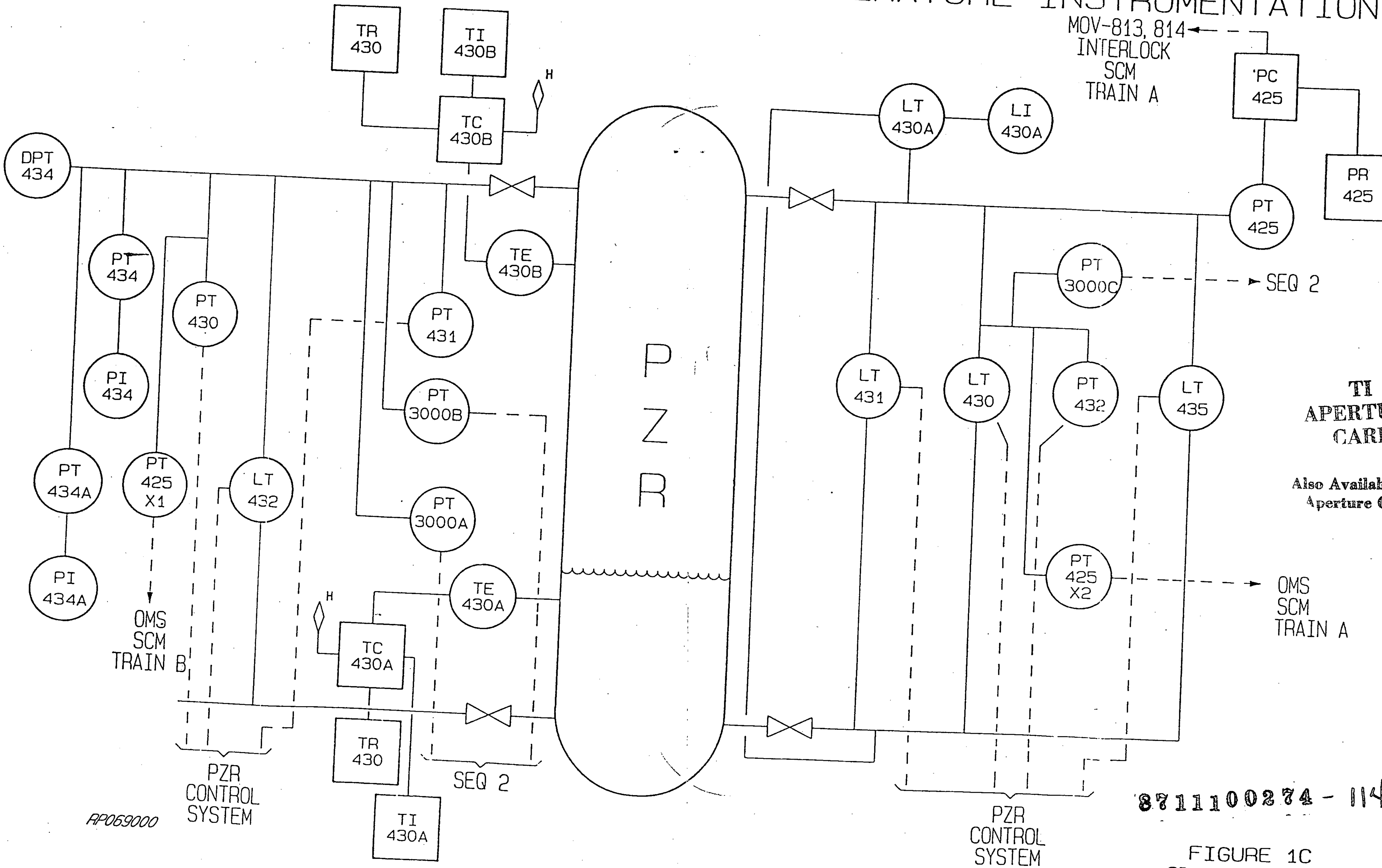


FIGURE 1B
SD-S01-390-1B-0

PRESSURIZER PRESSURE, LEVEL & TEMPERATURE INSTRUMENTATION



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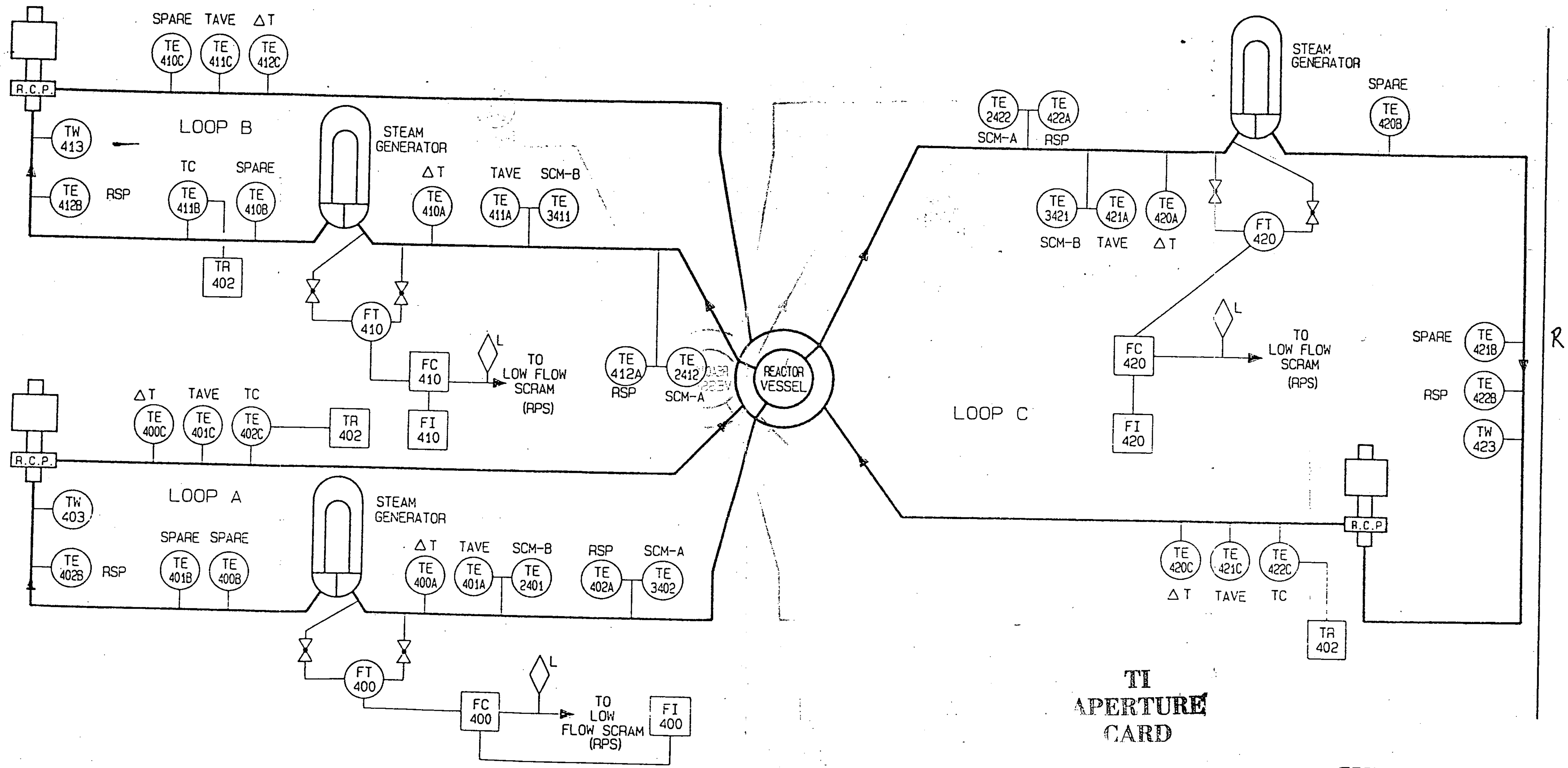
8711100274 - 114

FIGURE 1C
SD-S01-390-1C-0

REACTOR COOLANT SYSTEM TEMPERATURE & FLOW INSTRUMENTATION



RP0109400

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FIGURE 2
SD-S01-390-2-1

8711100274-115

PRESSURIZER PRESSURE INSTRUMENTATION

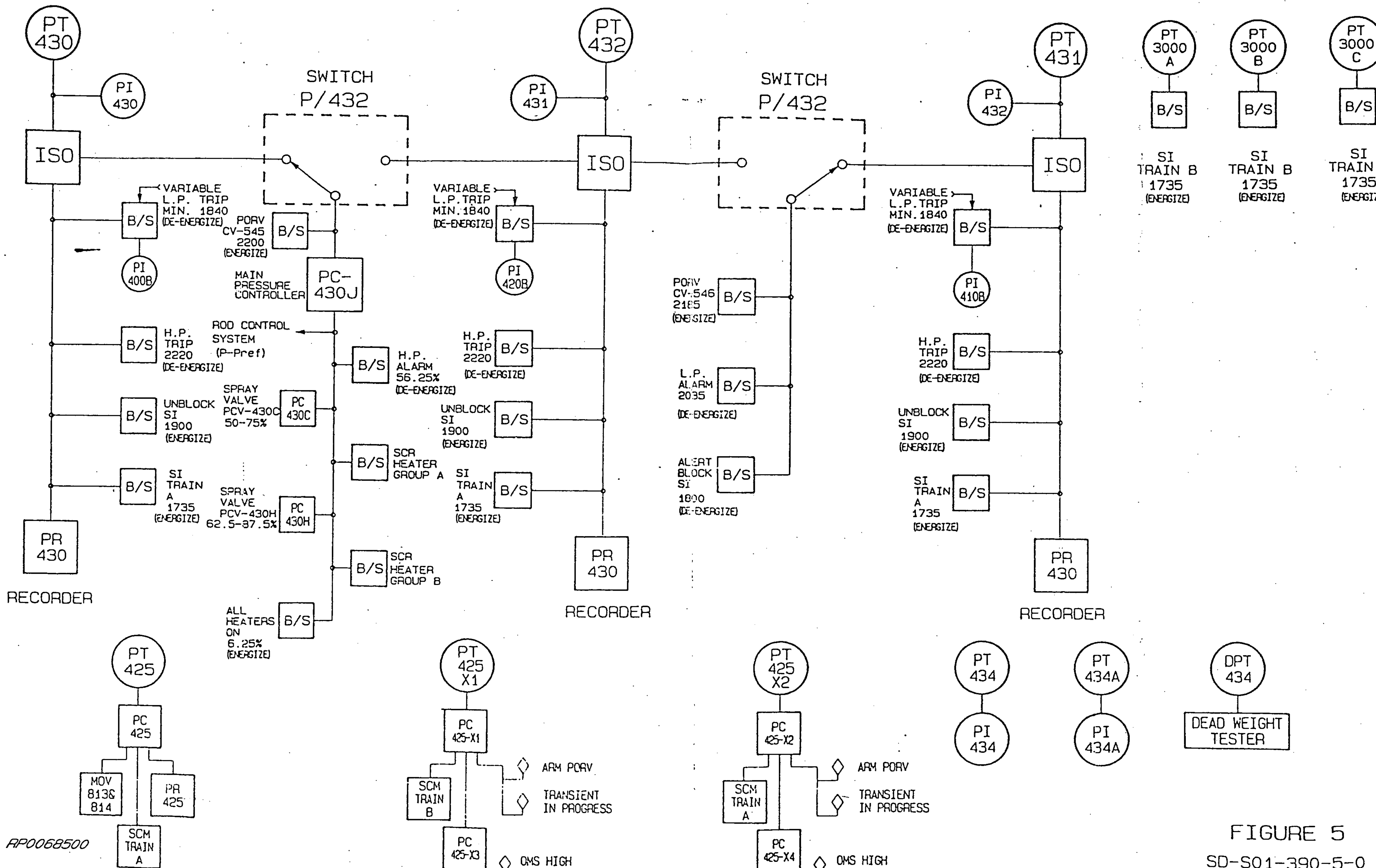


FIGURE 5
SD-S01-390-5-0

8711100274 - 116

FIGURE 6: PC-430J CONTROLLER OUTPUT

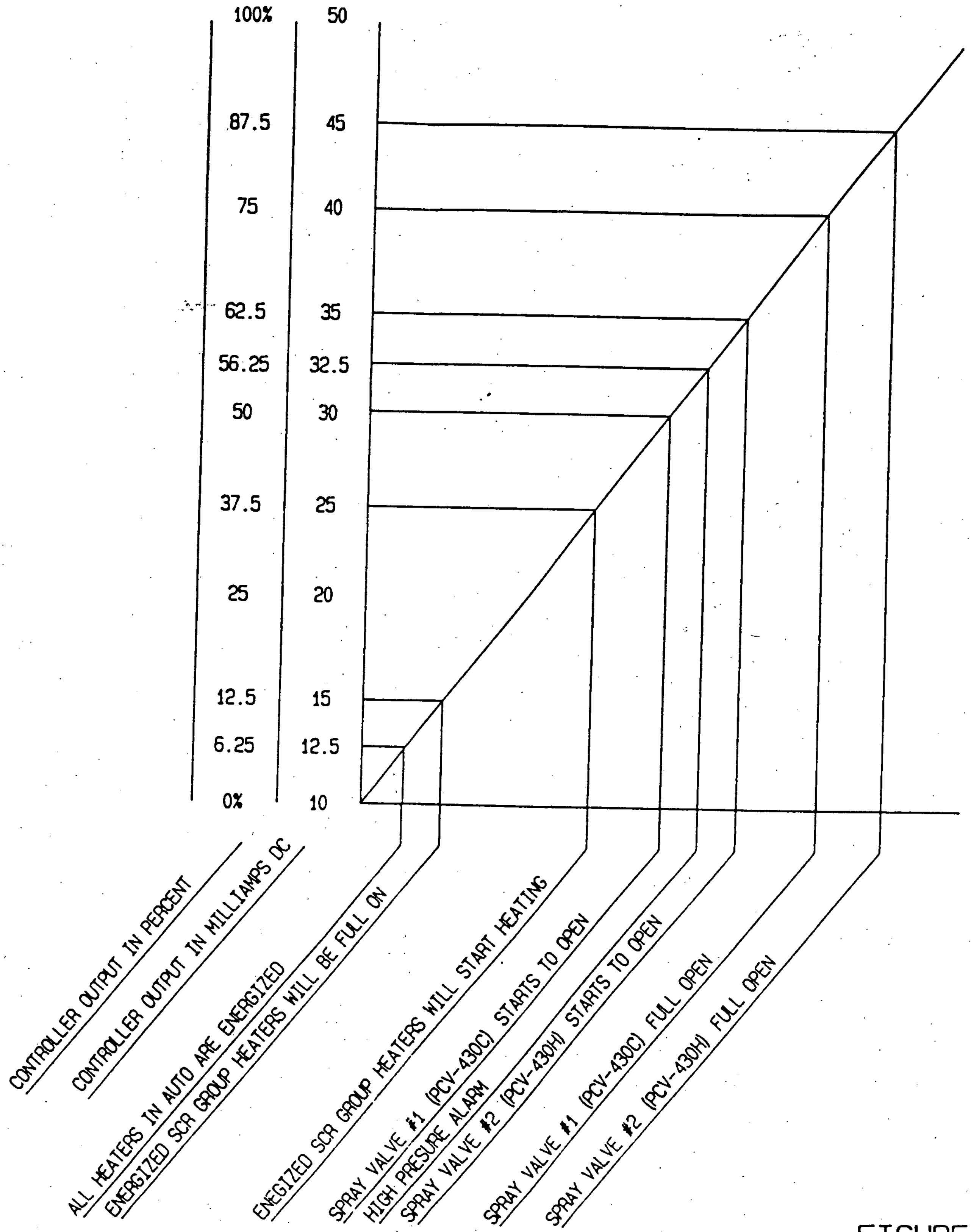
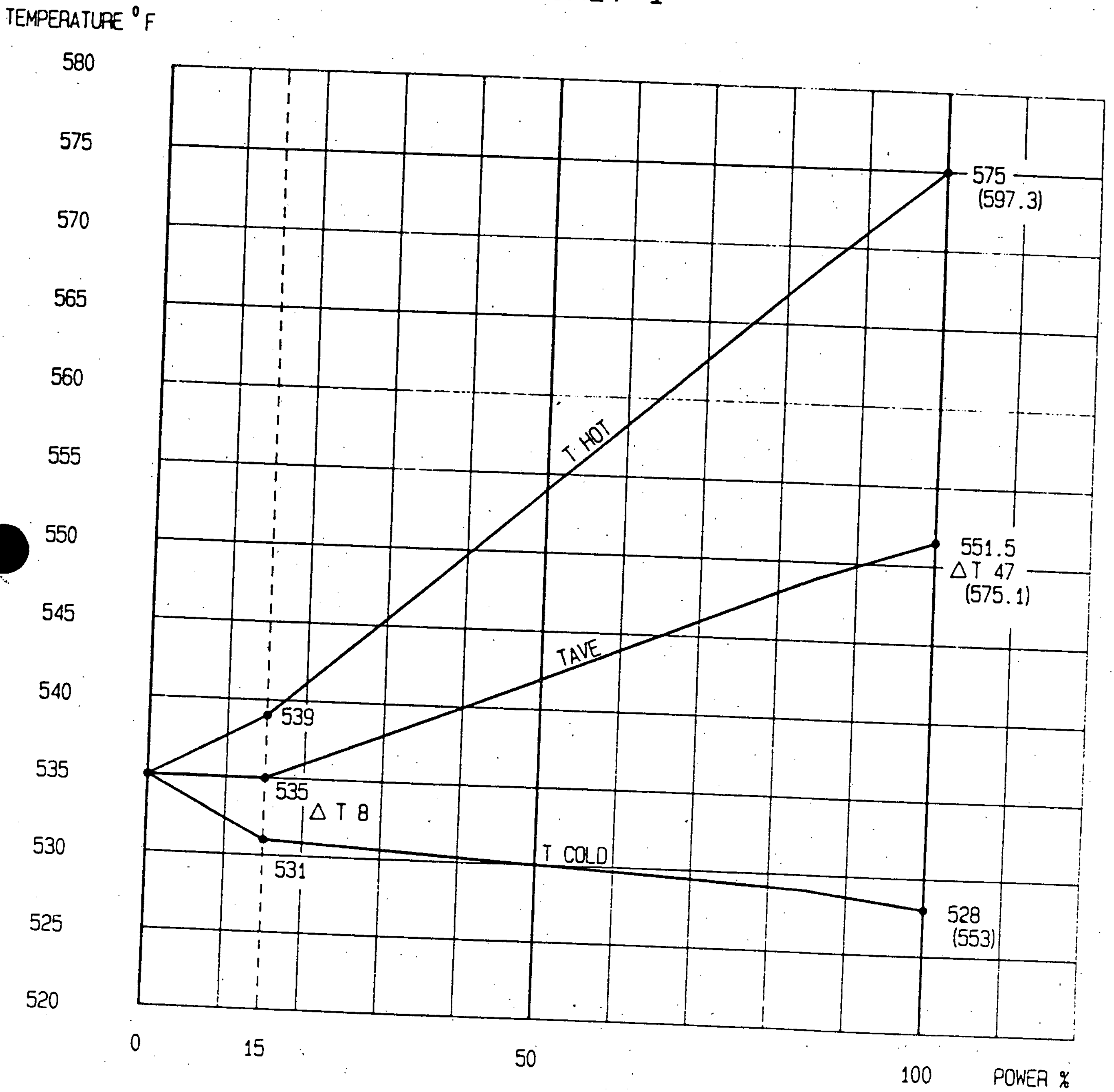


FIGURE 6
SD-S01-390-6-0

TAVE PROGRAM

UNIT 1



(DESIGN) TEMPERATURES - SEE SD-S01-280, REACTOR COOLANT SYSTEM

RP0100000

FIGURE 11
SD-S01-390-11-0

APPENDIX A

DEVELOPMENTAL RESOURCES

D

Study Guides

3, Reactor Coolant System

6, Overpressurization Mitigating System

7, Reactor Coolant System Instrumentation

11, Primary System Pressure and Level Control and Pressurizer Relief Tank

12, Reactor Control and Protection System

Bechtel System Descriptions

10, Reactor Control and Protection System

FSAR

Section 2.5, Reactor Coolant System

Section 5.2, Reactor Control and Protection System

Lesson Plans

1001, Reactor Coolant Instrumentation

1028, Reactor and Protection System

1077, Reactor Control (Portion of RCPS)

1105, Press. and Press. Relief Tank Press. and Level Control

1158, Reactor Coolant System Instrumentation

IXC208, Sub-cooling Monitoring System

Student Handouts

Reactor Control System

Pressurizer and Pressurizer Relief Tank and Pressure Control

Design Changes

PFC 1-86-3383.OSE, Pressurizer Instrument Cabinet Heaters (no longer required in service) N

APPENDIX B

ANNUNCIATORS

REACTOR PLANT NO. 1 ANNUNCIATORS

WINDOW NAME (NUMBER)	INPUT	SETPOINT
RC Pump Reverse ΔT Interlocks Defeated (65)	TC-402-X TC-412-X TC-422-X	Cold Leg Temp. < 520°F
Pressurizer Hi Temp. (17)	TC-430A-X (Liquid) TC-430B-X (Vapor)	680°F
Spare (57)		

R PFO 1-86-3383

REACTOR PLANT NO. 2 ANNUNCIATORS

WINDOW NAME (NUMBER)	INPUT	SETPOINT
Reac Cool Hi Tavg Loop A (7)	TA-401A-X	557°F
Reac Cool Hi Tavg Loop B (8)	TA-411A-X	557°F
Reac Cool Hi Tavg Loop C (9)	TA-421A-X	557°F
Shutdown Margin Bank 1 (2) Low (11), (12)	Control Bank 1 (2) Rod Position and Shutdown Margin Monitor	P-5 Permissive

APPENDIX B

ANNUNCIATORS

REACTOR PLANT NO. 2 ANNUNCIATORS (Continued)

WINDOW NAME (NUMBER)	INPUT	SETPOINT
Reac Cool Lo Tavg Loop A (27)	TA-401B-X	533°F
Reac Cool Lo Tavg Loop B (28)	TA-411B-X	533°F
Reac Cool Lo Tavg Loop C (29)	TA-421B-X	533°F
Reac Cool Hi ΔT Loop A (47)	TC-400C-X	51°F
Reac Cool Hi ΔT Loop B (48)	TC-410C-X	51°F
Reac Cool Hi ΔT Loop C (49)	TC-420C-X	51°F
Reac Cool High Reverse ΔT Loop A (67)	TC-400D-X	-5°F
Reac Cool High Reverse ΔT Loop B (68)	TC-410D-X	-5°F
Reac Cool High Reverse ΔT Loop C (69)	TC-420D-X	-5°F

APPENDIX B

ANNUNCIATORS

REACTOR PLANT FIRST OUT ANNUNCIATORS

WINDOW NAME (NUMBER)	INPUT	SETPOINT	
Pressurizer Hi Level Reac. Trip (1)	LC-430A LC-431A LC-432A	2 out of 3 50% Pressurizer Level [1]	R
Reac. Cool Reduced Pwr Lo Flow Reac. Trip (3)	FC-400-X1 FC-410-X1 FC-420-X1 RCP"A"-152b RCP"B"-152b RCP"C"-152b	2 out of 3 85% RCS Loop Flow RCP Breaker Open	R
Pressurizer High-Level Heaters On (6)	LC-430B-X	+4% of Programmed Level	
Pressurizer High Pressure (7)	PC-430D-X	56.25% of PC-430J Output	
Reac Cool Avg Tavg Deviation (8)	TA-405A-X TA-405B-X	± 5°F	
Pressurizer Fixed Hi Press Reac. Trip (11)	PC-430K PC-431H PC-432E	2 out of 3 2200 psig	
Reac. Cool Full PWR Lo Flow Reac. Trip (13)	FC-400-X2 FC-410-X2 FC-420-X2 RCP"A"-152b RCP"B"-152b RCP"C"-152b	1 out of 3 85% RCS Loop Flow RCP Breaker Open	R
Pressurizer Low-Level (16)	LC-430C-X	-4% of Programmed Level	
Pressurizer Low-Pressure (17)	PC-431C-X	2035 psig	

[1] Temporary setpoint to compensate for lack of single failure criteria associated with PT-459, Main Steam Header pressure instrument. The lower Pressurizer level trip setpoint prevents the PZR from going solid upon failure of the Steam Flow/Feedwater Flow mismatch trip. Normal setpoint is 70% PZR level. N

APPENDIX B

ANNUNCIATORS

REACTOR PLANT FIRST OUT ANNUNCIATORS (Continued)

WINDOW NAME (NUMBER)	INPUT	SETPOINT
Pressurizer Low-Low-Level Heaters Off (26)	LC-430D-X LC-431B-X	10% Level
Shutdown Margin Bank 1 Lo-Lo (27)	Control Bank 1 Rod Position and Shutdown Margin Monitor	P-5 Permissive
Shutdown Margin Bank 2 Lo-Lo (28)	Control Bank 2 Rod Position and Shutdown Margin Monitor	P-5 Permissive
OMS High Pressure (29)	PT-425-X3	480 psig
Pressurizer Variable Lo Press Reactor Trip (31)	PC-430F PC-431D PC-432B	2 out of 3 Tech. Spec. 26.15 (0.894 ΔT+Tavg) - 14341 1840 psig-Minimum
Pressurizer Transients In Progress (35)	PT-425-X1 or X2	500 psig
Open PORV Isolation Valves (37)	PT-425F-X1 and 74-3 or PT-425-X2 and 74-4	400 psig

R

D

APPENDIX B

ANNUNCIATORS

REACTOR PLANT FIRST OUT ANNUNCIATORS (Continued)

WINDOW NAME (NUMBER)	INPUT	SETPOINT
ARM PORVs (38)	PT-425-X1 or X2	400 psig

APPENDIX B

ANNUNCIATORS

REACTOR PLANT MATRIX PARTIAL TRIP ANNUNCIATORS

Pressurizer Hi Level Reac. Trip Channel I, II, III (1), (2), (3)	LC-430A LC-431A LC-432A	50% Pressurizer Level [1] 50% Pressurizer Level [1] 50% Pressurizer Level [1]
Reac. Cool. Lo Flow Reac. Trip Loop A, B, C (7), (8), (9)	FC-400 FC-410 FC-420	85% RCS Loop Flow 85% RCS Loop Flow 85% RCS Loop Flow
Pressurizer Fixed Hi Pressure Reactor Trip Channel I, II, III (11), (12), (13)	PC-430K PC-431H PC-432E	2200 psig 2200 psig 2200 psig
Pressurizer Lo Pressure Safety Injection Train A, B Channel I (14, 4)	PT-430G PT-3000A	1735 psig
Pressurizer Lo Pressure Safety Injection Train A, B Channel II (15, 5)	PT-431E, PT-3000B	1735 psig
Pressurizer Lo Pressure Safety Ijection Train A, B Channel III (16, 6)	PC-430F PC-431D PC-432B	1735 psig
Pressurizer Variable Low Pressure Reactor Trip Channel I, II, III (31), (32), (33)	PC-430F PC-431D PC-432B	Tech. Specs. 26.15(0.894ΔT + Tavg) - 14341 1840 psig-Minimum

R

R

D

[1] Temporary setpoint to compensate for lack of single failure criteria associated with PT-459, Main Steam Header pressure instrument. The lower Pressurizer level trip setpoint prevents the PZR from going solid upon failure of the Steam Flow/ Feedwater Flow mismatch trip. Normal setpoint is 70% PZR level.

N

APPENDIX B

ANNUNCIATORS

PERMISSIVE INFORMATION DISPLAY ANNUNCIATORS

WINDOW NAME (NUMBER)	INPUT	SETPOINT
Single Loop Loss of Flow Reactor Trip Defeated (2)	Power Range Instruments NIS-1205, 1206 1207 + 1208) and Turbine First Stage Pressure (PT-415)	P-8 Permissive (AP-10A, AP-10C)
S.I. Block Permissive LO Pressure Channel I, II, III (13, 14, 15)	2 out of 3 Pressurizer Pressure Transmitters	≥ 1900 psig

APPENDIX B

ANNUNCIATORS

AUXILIARY FEEDWATER ANNUNCIATOR

WINDOW NAME (NUMBER)	INPUT	SETPOINT
Train A Margin to Saturated Condition Below 41°F (3)	TYB-2010	40°F
Train B Margin to Saturated Condition Below 41°F (8)	TYB-3010	40°F
Subcooling Monitoring System Temp Signal Loss Train A (13)	TS-2001, 2002, 2003, & 2004	Loss of Input
Subcooling Monitoring System Temp Signal Loss Train B (18)	TS-2001, 2002, 2003, & 2004	Loss of Input

APPENDIX C

INSTRUMENTATION

REACTOR COOLANT SYSTEM INSTRUMENTATION

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)
TE-402A	HOT LEG A (Th)	Remote Shutdown Panel	TI-5402B (100-700°F)
TE-3402A	HOT LEG A (Th)	Sub-cooling Monitoring System A	TI-3402A (100-700°F)
TE-401A	HOT LEG A (Th)	Taverage Calculation	TQ-401A (100-700°F)
TE-2401A	HOT LEG A (Th)	Sub-cooling Monitoring System B	TI-2401A (100-700°F)
TE-400A	HOT LEG A (Th)	ΔT Calculation	TT-400 (100-700°F)
FT-400	Loop A Flow	Reactor Protection System	FI-400 (0-100%)
TE-400B	Intermediate Leg A	Spare	(100-600°F)
TE-401B	Intermediate Leg A	Spare	(100-600°F)

APPENDIX C

INSTRUMENTATION

REACTOR COOLANT SYSTEM INSTRUMENTATION (Continued)

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)
TE-402B	Intermediate Leg A	Remote Shutdown Panel	TI-402B (100-700°F)
TE-400C	Cold Leg A (Tc)	ΔT Calculation	TT-400 (100-600°F)
TE-401C	Cold Leg A (Tc)	Taverage Calculation	TQ-401A (100-600°F)
TE-402C	Cold Leg A (Tc)	Indication Only	TR-402 (100-600°F)
TT-400	ΔT Computer	ΔT Calculation	TR-400, TI-400 (-15 to 60°F) TM-404A
TQ-401A	Taverage Computer	Taverage Calculation	TR-401, TM-405A (525 to 600°F)
TM-405A	Average Taverage Summing Computer	Average Taverage Calculation	TR-405 (525 to 600°F) See 2.3.1
TM-404A	ΔT Summing Computer	Average ΔT Calculation	See 2.3.2

APPENDIX C

INSTRUMENTATION
(CONTINUED)

REACTOR COOLANT SYSTEM INSTRUMENTATION

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)
TE-412A	Hot Leg B (Th)	Remote Shutdown Panel	TI-5412A (100-700°F) |R
TE-2412A	Hot Leg B (Th)	Sub-cooling Monitoring System A	TI-2412A (100-700°F)
TE-411A	Hot Leg B (Th)	Taverage Calculation	TQ-411A (100-700°F) |R
TE-3411A	Hot Leg B (Th)	Sub-cooling Monitoring System	TI-3411A (100-700°F)
TE-410A	Hot Leg B (Th)	ΔT Calculation	TT-410 (100-700°F)
FT-410	Loop B Flow	Reactor Protection System	FI-410 (0-100%)
TE-410B	Intermediate Leg B	Spare	(100-600°F)
TE-411B	Intermediate Leg B	Indication Only	TR-402 (100-600°F)

APPENDIX C

INSTRUMENTATION
(CONTINUED)

REACTOR COOLANT SYSTEM INSTRUMENTATION

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)	
TE-412B	Intermediate Leg B	Remote Shutdown Panel	TI-412B (100-700°F)	R
TE-410C	Cold Leg B (Tc)	Spare	(100-600°F)	
TE-411C	Cold Leg B (Tc)	Taverage Calculation	TQ-411A (100-600°F)	R
TE-412C	Cold Leg B (Tc)	ΔT Calculation	TT-410 (100-600°F)	
TT-410	ΔT Computer	ΔT Calculation	TR-400, TI-410 (-15 to 60°F) TM-404A	
TQ-411A	Taverage Computer	Taverage Calculation	TR-401, TM-405A (525 to 600°F)	R
TM-405A	Average Taverage Summing Computer	Average Taverage Calculation	TR-405 (525 to 600°F) See 2.3.1	
TM-404A	ΔT Summing Computer	Average ΔT Calculation	See 2.3.2	

APPENDIX C

INSTRUMENTATION
(CONTINUED)

REACTOR COOLANT SYSTEM INSTRUMENTATION

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)
TE-422A	Hot Leg C (Th)	Remote Shutdown Panel	TI-5422A (100-700°F) |R
TE-2422A	Hot Leg C (Th)	Sub-cooling Monitoring System A	TI-2422A (100-700°F)
TE-421A	Hot Leg C (Th)	Taverage Calculation	TQ-421A (100-700°F) |R
TE-3421A	Hot Leg C (Th)	Sub-cooling Monitoring System B	TI-3421A (100-700°F)
TE-420A	Hot Leg C (Th)	ΔT Calculation	TT-420 (100-700°F)
FT-420	Loop C Flow	Reactor Protection System	FI-420 (0-100%)
TE-420B	Intermediate Leg C	Spare	(100-600°F)
TE-421B	Intermediate Leg C	Spare	(100-600°F)

APPENDIX C

INSTRUMENTATION
(CONTINUED)

REACTOR COOLANT SYSTEM INSTRUMENTATION

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)
TE-422B	Intermediate Leg C	Remote Shutdown Panel	TI-422B (100-700°F) |R
TE-422C	Cold Leg C (Tc)	Indication Only	TR-402 (100-600°F)
TE-421C	Cold Leg C (Tc)	Taverage Calculation	TQ-421A (100-600°F) |R
TE-420C	Cold Leg C (Tc)	ΔT Calculation	TT-420 (100-600°F)
TT-420	ΔT Computer	ΔT Calculation	TR-400, TI-420 (-15 to 60°F) TM-404A
TQ-421A	Taverage Computer	Taverage Calculation	TR-401, TM-405A (525 to 600°F) |R
TM-405A	Average Taverage Summing Computer	Average Taverage Calculation	TR-405 (525 to 600°F) See 2.3.1
TM-404A	ΔT Summing Computer	Average ΔT Calculation	See 2.3.2

APPENDIX C

INSTRUMENTATION
(CONTINUED)

PRESSURIZER PRESSURE INSTRUMENTATION

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)
PT-430	Pressurizer Pressure	Reactor Protection System, Control through P/432, and Sequencer System A	PI-430 (1600-2400 psig) PR-430 (1600-2400 psig) PI-400B (1600-2400 psig)
PT-431	Pressurizer Pressure	Reactor Protection System, Control through P/432, and Sequencer System A	PI-430 (1600-2400 psig) PR-430 (1600-2400 psig) PI-410B (1600-2400 psig)
PT-432	Pressurizer Pressure	Reactor Protection System, Control through P/432, and Sequencer System A	PI-430 (1600-2400 psig) PI-430 (1600-2400 psig) PI-420B (1600-2400 psig)
PT-425	Wide Range Pressurizer Pressure	MOV-813 & 814 Interlock, and Sub-cooling Monitoring System A	PR-425 (0-600 psig) (0-3000 psig)
PT-425-X1	Pressurizer Pressure	Used to Generate Saturation Temperature	Sub-cooling Monitoring System B

APPENDIX C

INSTRUMENTATION
(CONTINUED)

PRESSURIZER PRESSURE INSTRUMENTATION

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)
PT-425-X2	Pressurizer Pressure	Used to Generate Saturation Temperature	Sub-cooling Monitoring System A
PT-434	Pressurizer Pressure	Dedicated Shutdown Panel	PI-434 (0-2500 psig)
PT-434A	Pressurizer Pressure	North Vertical Board	PI-434A (0-2500 psig)
PT-3000, A, B, & C	Pressurizer Pressure	Safety Injection Actuation	Sequencer System B
DPT-434	Pressurizer Pressure	Compare Pressure Indications	Deadweight Tester

APPENDIX C

INSTRUMENTATION
(CONTINUED)

PRESSURIZER LEVEL INSTRUMENTATION

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)
LT-430	Pressurizer Level	Reactor Protection System; Control and Chemical and Volume Control System through L/432	LI-420 (0-100%) LR-430 (0-100%) (4.7-37.2 ft)
LT-431	Pressurizer Level	Reactor Protection System, and Control through L/432	LI-431 (0-100%) LR-430 (0-100%) (4.7-37.2 ft)
LT-432	Pressurizer Level	Reactor Protection System; Control, and Chemical and Volume Control System through L/432	LI-432 (0-100%) LR-430 (0-100%) (4.7-37.2 ft)
LT-430A	Pressurizer Level	Auxiliary Control Panel	LI-430A (0-100%) (4.7-37.2 ft)
LT-435	Pressurizer Level	North Vertical Board (Cold Calibrated for Cooldown Indication)	LI-435 (0-100%) (4.7-37.2 ft)

APPENDIX C

INSTRUMENTATION
(CONTINUED)

PRESSURIZER TEMPERATURE INSTRUMENTATION

INSTRUMENT	INSTRUMENT NAME	FUNCTION	OUTPUT (RANGE)
TE-430A	Pressurizer Vapor Temperature	Indication and Annunciators	TI-430A (0-700°F) TR-430 (0-700°F)
TE-430B	Pressurizer Liquid Temperature	Indication and Annunciators	TI-430B (0-700°F) TR-430 (0-700°F)

PRESSURIZER LEVEL INSTRUMENTATION

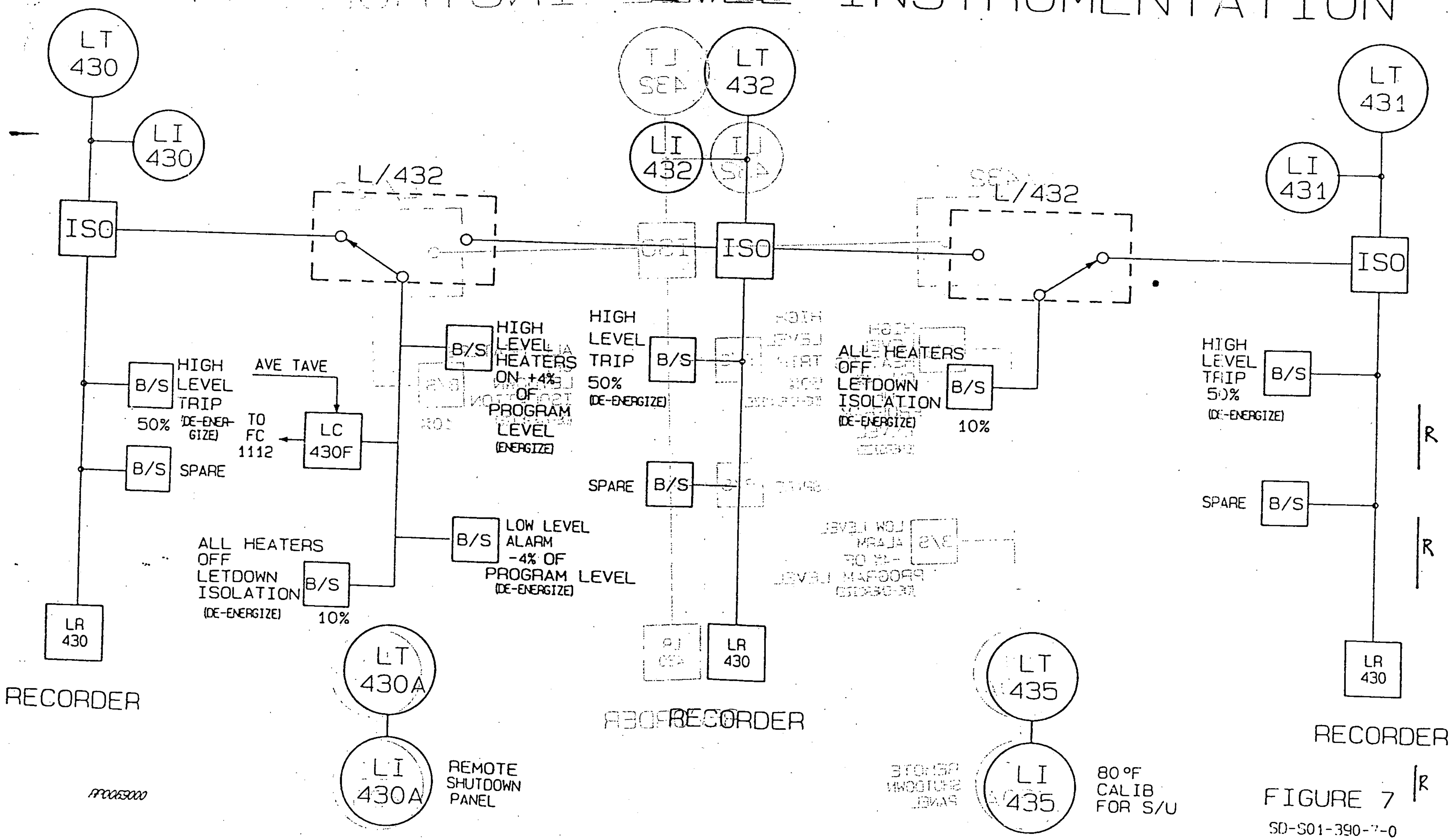


FIGURE 7 R
SD-S01-390-7-0

TI APERTURE CARD

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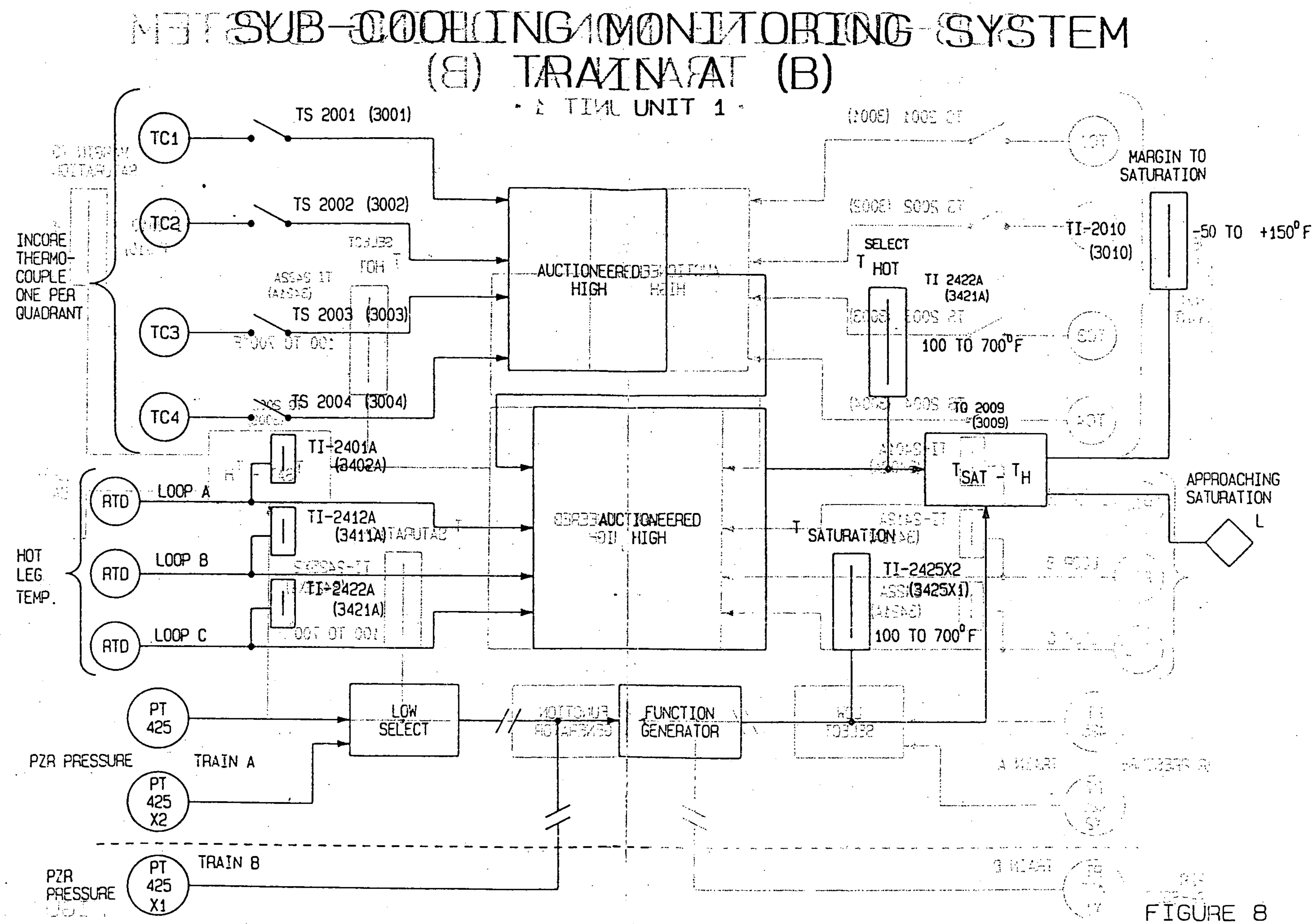

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FIGURE 8
SD-SO1-390-8-2

R

R

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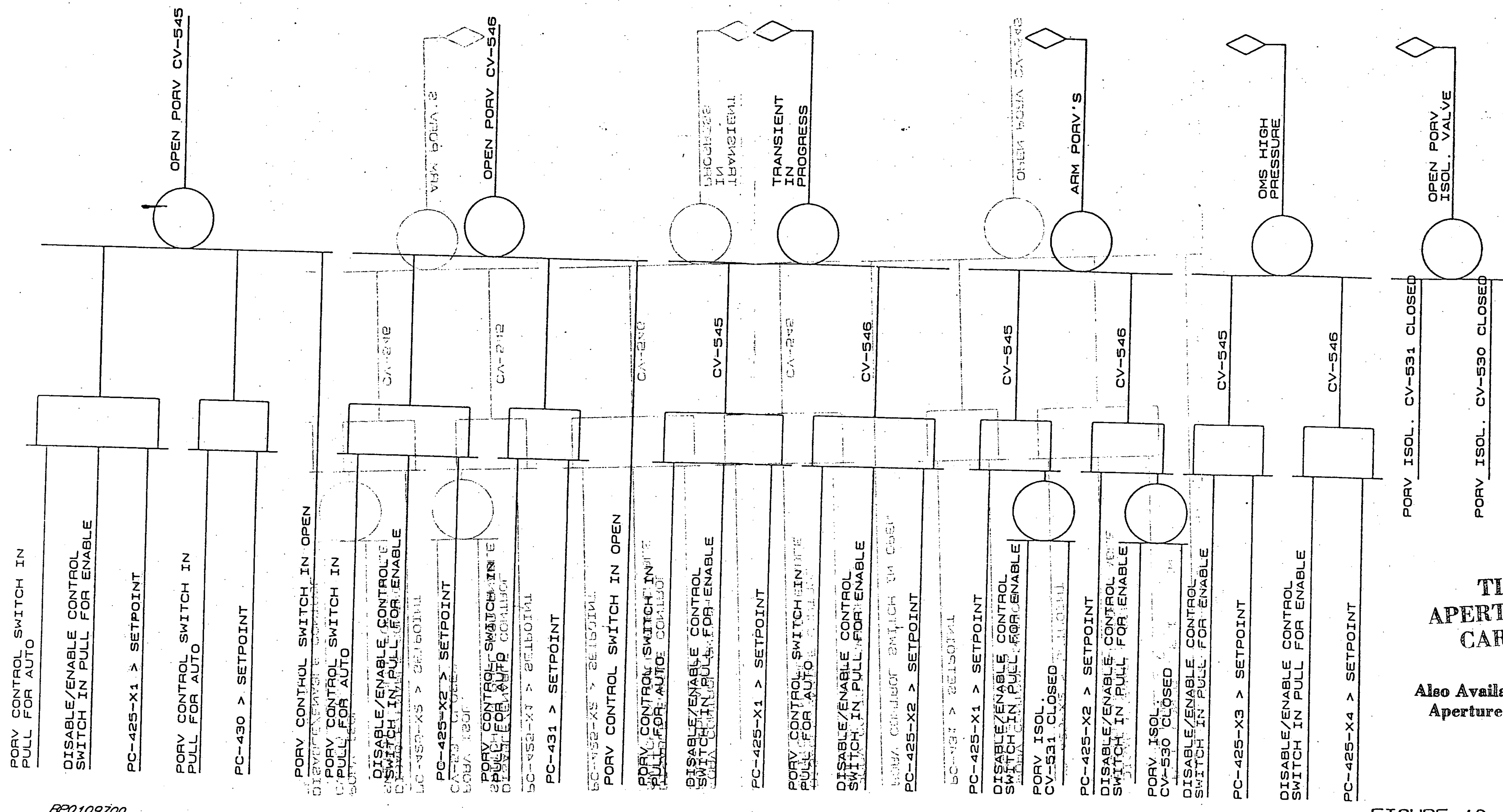
OVERPRESSURE MITIGATION SYSTEM

UNIT 1



TI APERTURE CARD

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FIGURE 10

SD-S01-390-10-0

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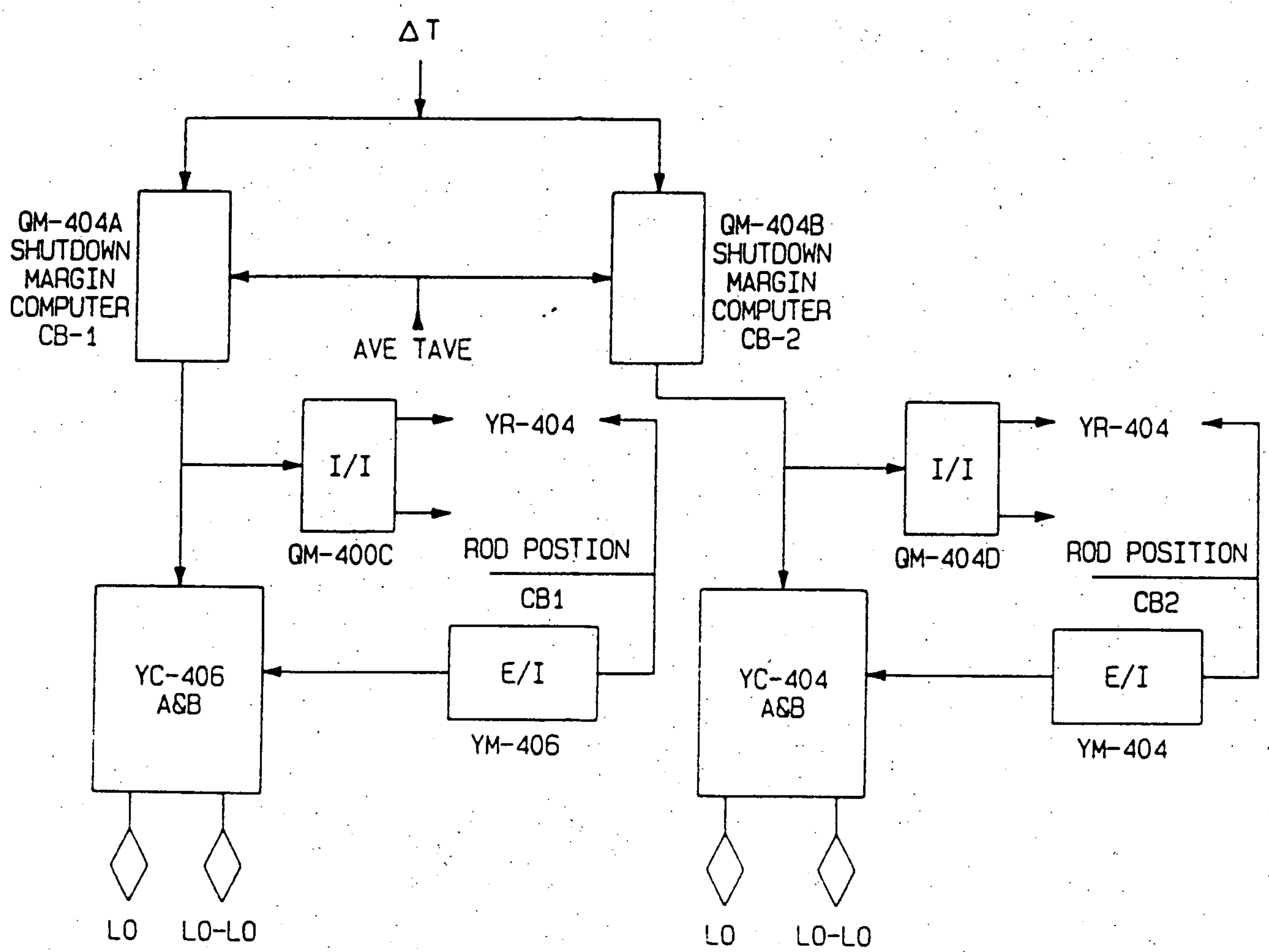
FIGURE 9: SHUTDOWN MARGIN COMPUTER



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