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SUBJECT: LER 88-010-01:on 880506,inoperability of both emergency chilled water sys trains due to low freon level.

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RIDS/ADDS RIDS/ADDS

LICENSEE EVENT REPORT (LER)

Facility Name (1)	Docket Number (2)	Page (3)
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 2	0 5 0 0 0 3 6 1	1 of 1 0

Title (4)

INOPERABILITY OF BOTH EMERGENCY CHILLED WATER SYSTEM (ECWS) TRAINS DUE TO LOW FREON LEVEL

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
Month	Day	Year	Year	/// Sequential Number	/// Revision Number	Month	Day	Year	Facility Names	Docket Number(s)
0 5	0 6	8 8	8 8	--- 0 1 0	--- 0 1	1 0	1 4	8 8	SONGS, UNIT 3	0 5 0 0 0 3 6 2
										0 5 0 0 0

OPERATING MODE (9)	1
POWER LEVEL (10)	1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)

___ 20.402(b)	___ 20.405(c)	___ 50.73(a)(2)(iv)	___ 73.71(b)		
___ 20.405(a)(1)(i)	___ 50.36(c)(1)	X 50.73(a)(2)(v)	___ 73.71(c)		
___ 20.405(a)(1)(ii)	X 50.36(c)(2)	X 50.73(a)(2)(vii)	___ Other (Specify in Abstract below and in text)		
___ 20.405(a)(1)(iii)	X 50.73(a)(2)(i)	___ 50.73(a)(2)(viii)(A)			
___ 20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	___ 50.73(a)(2)(viii)(B)			
___ 20.405(a)(1)(v)	___ 50.73(a)(2)(iii)	___ 50.73(a)(2)(x)			

LICENSEE CONTACT FOR THIS LER (12)

Name	TELEPHONE NUMBER
H. E. Morgan, Station Manager	AREA CODE 7 1 4 3 6 8 - 6 2 4 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
X	K M	C H U	C 1 4 7	NO					

SUPPLEMENTAL REPORT EXPECTED (14)

		Expected Submission Date (15)	Month	Day	Year
___ Yes (If yes, complete EXPECTED SUBMISSION DATE)	XX NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

At 0745 on May 6, 1988, with Unit 2 operating at 100% power and Unit 3 in cold shutdown, Train 'A' of the Emergency Chilled Water System (ECWS) was declared inoperable as a result of a low freon level in Emergency Chiller ME336. Since the Train 'B' Control Room Isolation System (CRIS) monitor (2/3RT-7825) was inoperable at the time, the operators elected to manually start Train 'B' Control Room Emergency Air Cleanup System, which automatically started Emergency Chiller ME335. At 0800, ME335 tripped on low refrigerant temperature, due to low freon level, thereby rendering ECWS Train 'B' inoperable. Since Technical Specification (TS) 3.7.10 for ECWS does not address inoperability of both ECWS trains, this constituted entry into TS 3.0.3. At 0859, a power reduction commenced. At 1135, following the addition of freon and successful testing, ME336 was declared operable and TS 3.0.3 was exited. The power reduction was terminated at this time.

The loss of freon from the system was due to a small leak. However, the operating instruction and the routine operator round sheet were inadequate in that they did not specify minimum Operability guidelines for freon levels; as a consequence, the freon was not maintained at the minimum required level.

As corrective action, operating guidelines for monitoring and maintaining freon level in the emergency chillers have been developed. These guidelines specify the required freon level for chiller standby conditions. Appropriate procedures have been revised to incorporate these guidelines.

Plant: San Onofre Nuclear Generating Station (SONGS)
Units: 2 and 3
Reactor Vendor: Combustion Engineering
Event Date: 05-06-88
Time: 0800

A. CONDITIONS AT TIME OF THE EVENT:

Unit 2: Mode 1, Power Operation.
Unit 3: Mode 5, Cold Shutdown for a refueling outage.

B. BACKGROUND INFORMATION:

The Emergency Chilled Water System (ECWS) (EIIS System Code KM) serves to provide chilled water to remove heat from air conditioning cooling coils that are in service during emergency conditions. These include air conditioning for the Control Room Emergency Air Cleanup System (CREACUS), Engineered Safety Feature (ESF) switchgear room, charging pump rooms, boric acid makeup pump rooms, fuel handling pump room, High-Pressure Safety Injection (HPSI)/Low-Pressure Safety Injection (LPSI)/Containment Spray pump rooms, and Component Cooling Water (CCW) pump rooms.

There are two independent ECWS trains that are common to Units 2 and 3. Each of the ECWS trains is provided with a 100% capacity emergency chiller (EIIS Component Code CHU). These chillers are used in nuclear, industrial and residential applications. The chiller sizing (400 ton) was selected to provide margin above the design basis calculated maximum heat load removal requirement of 320 tons cooling capacity. [The 320 tons is based on a loss of offsite power to both Units 2 and 3 concurrent with a LOCA on one Unit, cooldown to shutdown cooling on the other Unit, and simultaneous FHIS actuations on both Units.]

With a total loss of normal and emergency cooling, local room temperatures would increase (as a function of the room's heat load) above 104 degrees (F), above which electrical equipment and components are not environmentally qualified (but would probably continue to perform their function). The time required to exceed 104 degrees, would depend on ambient temperatures, magnitude of the accident, and the components actuated. Under postulated worst case conditions, certain rooms could exceed 104 degrees in as short a period as 30 minutes or less.

The chillers are normally in a standby condition, and start upon receipt of a signal from the Safety Injection Actuation System (SIAS), Toxic Gas Isolation System (TGIS), Control Room Isolation System (CRIS), or Fuel Handling Isolation System (FHIS). CREACUS is designed to automatically start upon receipt of a TGIS or CRIS signal. The chillers are reset locally, and procedures provide for manual adjustment of the load on the chiller if necessary, for chiller trips.

The chillers were initially charged and factory tested by the vendor for full rated (400 ton) heat removal capacity. SCE purchased the chiller with a factory option of a freon level sight glass. The sight glass is located on the cooler section near the cooling coils [see diagram page 10]. The level of freon in the

sight glass can be influenced by several factors, including whether the chiller has been recently operated and condensing water temperature fluctuations.

The chillers are designed to operate with a minimum condensing water (Component Cooling Water [CCW]) temperature at or above 55 degrees (F). The CCW system is approximately 1 to 2 degrees warmer than the Salt Water Cooling (SWC) system which is dependent upon inlet ocean water temperature. Occasionally, SWC temperatures (which are recorded) have dropped to the 53 to 55 degree range; however, the chiller procedure cautioned to maintain CCW temperature at or above 55 degrees.

The chillers have a low refrigerant (freon) temperature trip which prevents the chilled water from freezing and causing cooler tube damage. A low refrigerant temperature trip occurs when insufficient heat is being transferred from the chilled water to the freon. This can occur if the chilled water flow is abnormally low or if there is insufficient freon inventory to provide adequate cooler tube coverage.

In standby, the saturated pressure and temperature of the freon corresponds to the CCW temperature in the condenser (since CCW flows continuously through the condenser). A lower CCW temperature results in less margin between the pre-start freon temperature and the low refrigerant temperature trip setpoint.

During startup, the chiller compressor rapidly transfers freon gas from the cooler to the condenser. This causes a rapid lowering of the level in the cooler. Since the freon must absorb heat from the cooler as it goes from the liquid to the gaseous phase, the cooler temperature will drop rapidly unless heat is added from the chilled water flowing through the cooler.

The most rapid transfer of heat from the chilled water to the freon occurs when freon covers the chilled water tubes. During startup, tubes become uncovered as the freon level in the cooler decreases. The low refrigerant temperature trip setpoint will be reached unless enough tubes remain covered to adequately transfer heat to the freon to maintain its temperature. To prevent a low temperature trip, the pre-start freon level must be high enough to ensure enough tubes remain covered during startup under all design operating conditions.

Therefore, a CCW temperature of 55 degrees (F) is a worst case condition for quickly reaching the low refrigerant temperature trip point for a particular freon level. This is due to the fact that the margin between the initial freon temperature and the trip setpoint will be at its lowest value.

One factor which tends to mitigate the low CCW temperature situation, would be a higher chilled water temperature (due to an accident's resultant heat loads). This has a mitigating effect because the higher chilled water temperature causes more heat to be transferred to the freon.

SCE has observed the low refrigerant temperature trip on chiller starts under the following conditions: 1 1/2 inch freon level (standby) and 55 degree (F) CCW temperature; 1/2 inch freon level (standby) and CCW at 57 degrees. The chillers

have successfully started and operated at: 2 1/2 inch freon (standby) and CCW at 55 degrees; and, 1/2 inch freon (standby) and CCW at 62 degrees.

Maintenance and operating procedures/instructions for the chillers were based on vendor specifications. The amount of freon contained in the chiller is based on the sizing of each of the chiller components (e.g., cooler, condenser, and flash economizer). Although the chillers were initially charged at startup with the vendor's recommended 1745 pounds of freon, Operability limits and a correlation between the sight glass level and freon inventory were not provided by Carrier or the design organization. SCE developed its own procedural guidance involving freon level such that during chiller operation the freon level in the sight glass should be 1/2 inch. This 1/2 inch operating level is sufficient to ensure that the chiller cooling capacity is 320 tons. However, this guidance was not defined as operability criteria and, hence, not implemented as such. R

C. DESCRIPTION OF THE EVENT:

1. Event:

At 0745 on May 6, 1988, with Unit 2 operating at 100% power and Unit 3 in cold shutdown, Train 'A' of the ECWS was declared inoperable as a result of a low freon level in Emergency Chiller ME336. Since the Train 'B' CRIS monitor (2/3RT-7825) was inoperable at the time, the operators elected to manually start Train 'B' CREACUS, which automatically started Emergency Chiller ME335. At 0800, ME335 tripped on low refrigerant temperature, thereby rendering ECWS Train 'B' inoperable. Since Technical Specification (TS) 3.7.10 for ECWS does not address inoperability of both ECWS trains, this constituted entry into TS 3.0.3. At 0859, a power reduction commenced. At 1135, following the addition of freon and successful testing, ME336 was declared operable and TS 3.0.3 was exited. The power reduction was terminated at this time.

2. Inoperable Structures, Systems or Components that Contributed to the Event:

Since the Train 'B' CRIS monitor (2/3RT-7825) was inoperable when ME336 was declared inoperable, operators elected to manually start Train 'B' CREACUS, which automatically started Train 'B' ECWS.

3. Sequence of Events:

DATE	TIME	ACTION
4/22	Day	NRC inspector observed and informed Shift Superintendent that freon level in ME336 was below the bottom of the sight glass. Inspector requested that the low refrigerant level be evaluated.
5/2	-	CCW temperature drops from approximately 62 to 55 degrees (offshore storm lowering ocean temperature). R

5/5	Grave-yards	Procedural guidance issued on freon level. Low freon level (zero) in Emergency Chiller ME336 was confirmed.
5/6	0745	Train 'A' emergency chilled water system declared inoperable. Train 'B' CREACUS was manually actuated.
5/6	0800	Train 'B' emergency chilled water system declared inoperable following tripping of ME335 on low refrigerant temperature (freon level of approximately 1 1/2 inches). Technical Specification 3.0.3 entered.
5/6	0859	Unit 2 power reduction initiated.
5/6	1135	Train 'A' emergency chilled water system declared operable following return to service of ME336. Technical Specification 3.0.3 exited.

4. Method of Discovery:

Low freon level in ME336 was identified by the NRC resident inspector on April 22, 1988. Once guidance on the minimum freon level for operability was provided, ME336 was declared inoperable. After ME335 was started, Control Room annunciation alerted the operators to the trip of ME335 on low refrigerant temperature.

5. Personnel Actions and Analysis of Actions:

As a minimum, the chillers are operated each month for 10 hours (continuously) as part of the monthly CREACUS surveillance test. As stated previously, the operating instruction guidance on freon level required verification during operation of at least 1/2 inch of freon in the sight glass. This limit was not specifically identified as an OPERABILITY value. There was no guidance on what freon level should be during standby conditions. Operator rounds looked at the chiller but, as stated, no OPERABILITY guidance was provided to Operators.

Because of the absence of guidance on freon level in the sight glass, it was assumed by Operators that the sight glass freon level was not a critical parameter. In fact, the chillers have started and operated satisfactorily in the past with low freon levels (however, under higher CCW temperatures).

Although several instances have occurred (most recently on April 2) where operators have identified low freon level in the sight glass and deficiency tags have been hung, personnel did not recognize that the operability of the chillers might be affected. When OPERABILITY guidance was established, ME336 was declared inoperable. When ME335 tripped on low refrigerant temperature, an entry into Technical Specification 3.0.3 was appropriately

declared; and within one hour, a power reduction was initiated.

Subsequent to the NRC inspector's identification of the condition and his questioning of the operability of ME336 on April 22, it was not until May 5 that guidance was issued on the minimum freon level necessary for operability. Although the question of the effect of low freon level was being pursued, the interaction of key parameters and the design basis, and the inability of the vendor to provide design information, slowed the resolution of this issue. Additionally, this issue was not raised to the appropriate level of management, resulting in its attempted resolution at the first line supervisory level. Notwithstanding these facts, the resolution of this concern was not pursued as diligently and with the priority it should have been. R

6. Safety System Responses:

Not Applicable.

D. CAUSE OF THE EVENT:

1. Immediate Cause:

Low CCW temperatures (as a result of low ocean temperature) coupled with low freon level (as a result of small leaks) resulted in the low refrigerant trip of ME335. In retrospect, it is probable that ME336 would have tripped on low refrigerant temperature had it been started.

2. Intermediate Cause:

ME336

ME336 had a small, known freon leak that required the addition of freon to the chiller periodically. A Maintenance Order (MO) had been generated to add freon to ME336 on April 2, 1988, after an operator had noted the freon level in the sight glass to be low. As previously stated, it was not recognized that low freon level could affect operability of the chiller. The priority assigned to the MO, per procedure, did not ensure that freon was added in a timely manner. With a higher CCW temperature (approximately 61 degrees), the chiller had worked properly for the Technical Specification required monthly 10-hour CREACUS surveillance on April 14. R

On May 5, 1988, procedural guidance was issued requiring, as a pre-start check of the emergency chillers, that freon be visible in the sight glass. Prior to issuance, operability of the chiller had already been questioned by the NRC when no freon level was observed in the sight glass. Subsequently, on May 6, 1988, it was concluded that ME336 should be declared inoperable.

ME335

With a higher CCW temperature (approximately 62 degrees), the chiller had

operated properly for the Technical Specification required monthly 10-hour CREACUS surveillance on April 28. As previously discussed, a lower CCW temperature can result in a low refrigerant temperature trip, which did in fact occur on May 6, 1988.

3. Root Cause:

After initial startup testing, no guidance was provided on a minimum level (standby) to ensure the chillers are OPERABLE nor the minimum level during standby necessary to provide the design basis 320 ton cooling capacity.

Therefore, this event was caused by a failure to adequately address the operational performance of the system design, to identify such fundamental parameters as freon level and/or CCW temperature effects, which are required to ensure the operability of the system (see Sections E.2 and G.2 below).

E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

a) Freon was added to both emergency chillers.

b) Operating guidelines for acceptable freon levels in the emergency chillers were established.

c) Freon leaks in ME336 were repaired.

d) The procedure governing the prioritization of maintenance on the emergency chillers was revised to elevate the priority of future work associated with the emergency chillers.

e) Procedure S023-0-9.1 established a program to perform a careful inspection of "critical components" (selected components listed in the procedure) on a regular basis. An inspection sheet is provided containing appropriate information regarding operating/standby parameters (i.e., fluid levels, performance data, etc.) to guide the operator on the inspection. The objective of the program is to conduct a thorough inspection of the "critical components" in order to detect and correct trip hazards or water intrusion problems and to monitor and assess negative trends developing in the operating/standby parameters. This program should help to foster a questioning attitude among operators with regard to those fundamental parameters necessary for system or component operability.

2. Planned Corrective Actions:

a) Investigation into modifying the control system of the emergency chillers in order to optimize critical performance parameters (e.g., condensing water temperature, freon level), is continuing.

b) SCE has completed a study to evaluate general deficiencies in the area of design, engineering and technical work which, in part, caused the conditions being reported in this LER. One conclusion reached was that the design organization's output is focused on construction activities and has not properly integrated the design assumptions and intent in a manner that provides clear, adequate direction to the operating organization for the development of maintenance and operating philosophies/procedures. The DCP/PFC process will be enhanced to require more explicit treatment of these concerns in the design development with appropriate direction being provided to the operating organization.

c) A special review of standby HVAC systems, their associated fundamental parameters, and surveillance limits, will be conducted to ensure that fundamental parameters are incorporated into surveillances and operating instructions.

F. SAFETY SIGNIFICANCE OF THE EVENT:

During some periods, if an emergency had arisen involving loss of normal cooling coupled with an accident, there could have been (it is not possible to firmly establish other than for May 6 whether such instances did, in fact, occur) an impairment of the emergency chilled water system safety function. Depending on the magnitude of the event, the ability to mitigate the consequences of the event could (and possibly would) have been impaired. This impairment might have been mitigated by personnel actions from both the Operations and Maintenance work force.

Specifically, subsequent analysis of the safety significance of the two cases (discussed below) of chiller performance during low level and performance during low level plus low CCW temperature, are as follows:

LOW FREON LEVEL AND LOW CCW TEMPERATURE

As previously discussed, under low freon level and low CCW temperature conditions, the chiller may trip on low freon refrigerant temperature. For the conditions beginning May 2 (both low freon and low CCW temperature for both chillers), both chillers would have probably tripped on low refrigerant temperature within 5 minutes of starting. During these conditions, personnel actions would have to be relied upon to restart the chiller to prevent component temperatures from exceeding their design temperature limits.

LOW FREON LEVEL

SCE has concluded that when freon level in the sight glass has been below a calculated value of 1.6 inches, there was insufficient freon to cover the cooling coils to provide the design basis 320 tons of cooling capacity. A review of maintenance records indicates that there have been instances where chiller freon level was below 1.6 inches. Since the actual sight glass

freon level has not been recorded (except on May 6, 1988) during operation or during Operator rounds, it is not possible to definitively establish (other than for May 6) whether or not both emergency chillers had less than 1.6 inches simultaneously or if one chiller was less than 1.6 inches while the other was removed from service for routine maintenance or surveillance.

The May 6 freon levels in the chillers (approximately 1 1/2 inches in ME335 and zero in ME336), could place the system outside the design basis. During these conditions, personnel actions would have to be relied upon to restore freon level in the chiller to prevent component temperatures from exceeding their design temperature limits.

G. ADDITIONAL INFORMATION:

1. Component Failure Information:

The emergency chillers are hermetic centrifugal liquid chillers manufactured by the Carrier Corporation, Serial Nos. 23903 and 23904, for Emergency Chillers ME335 and ME336, respectively.

2. Previous LERs on Similar Events:

Several events relating to the control of design and engineering work have been identified. The following LERs are currently under review, and will be revised if appropriate:

LER 1-88-06 reported a condition where the Unit 1 Backup Nitrogen Systems (as designed, installed and operated) did not satisfy the licensing and design basis for the systems.

LER 1-88-01 reported that several components requiring environmental qualification were not included in the administrative controls for the environmentally qualified equipment. Additionally, other components were found to be in an unqualified configuration.

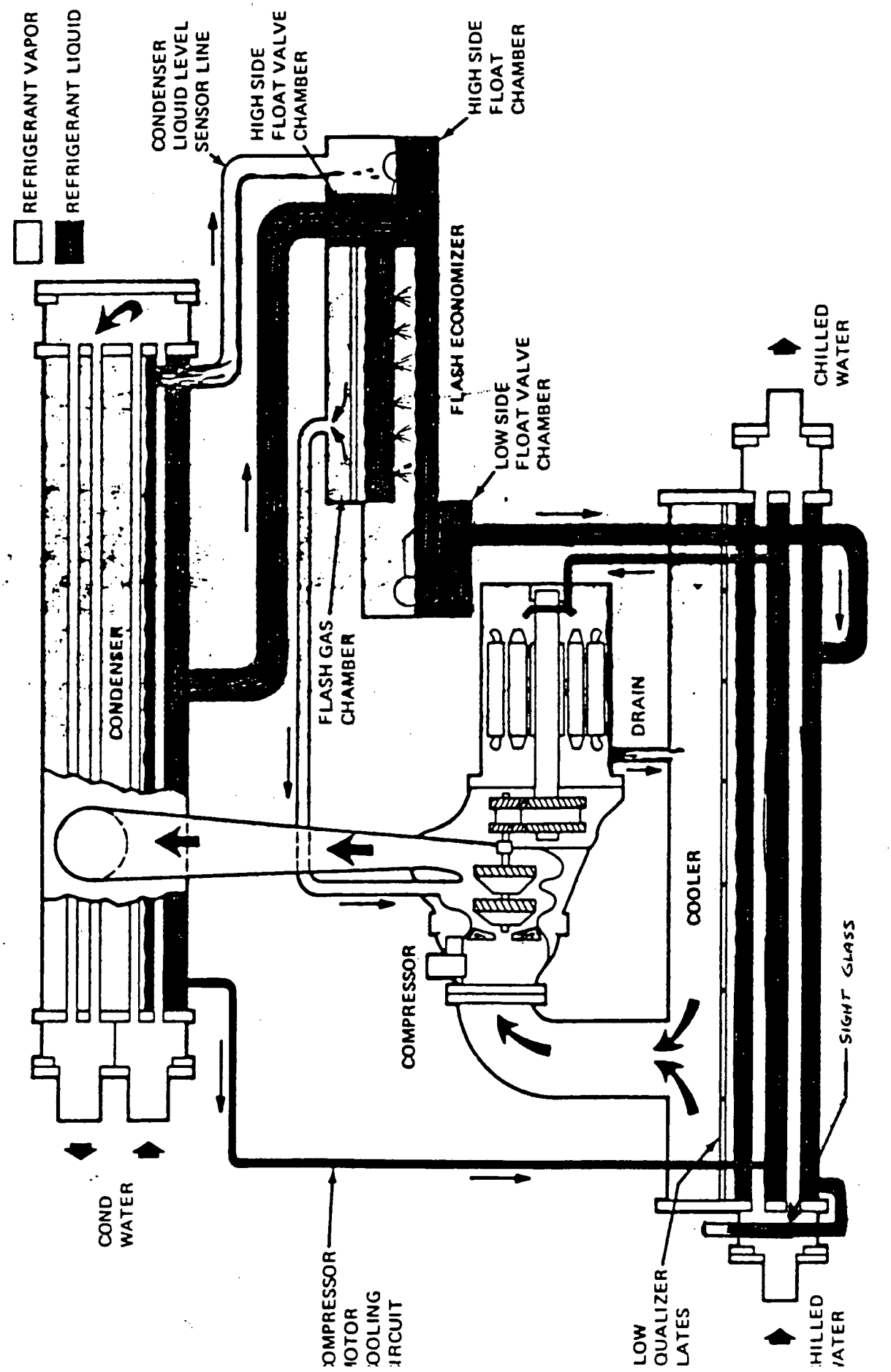
LER 1-87-15 reported that certain systems were susceptible to single failure.

LER 1-88-09 reported a condition in which the emergency diesel generators could have exceeded an intended electrical load limit.

LER 2-88-08 reported a condition in which the Component Cooling Water system leakage exceeded the design criteria.

LER 2-88-17 reported that a spent fuel pool siphon event occurred as a result of the failure to transfer the design intent to utilize administrative controls on certain locked valves.

The root cause investigation for these LERs is in progress.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CHILLED WATER
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DRAIN
COOLER
COMPRESSOR
SIGHT GLASS
COND WATER
COMPRESSOR MOTOR COOLING CIRCUIT
LOW EQUALIZER PLATES
CHILLED WATER

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STATION MANAGER

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October 14, 1988

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Docket Nos. 50-361
30-Day Report
Licensee Event Report No. 88-010, Revision 1
San Onofre Nuclear Generating Station, Units 2 and 3

References: (a) Letter, H. E. Morgan (SCE) to USNRC Document Control Desk, dated June 6, 1988

(b) Letter, R. P. Zimmerman (NRC) to Mr. Kenneth P. Baskin (SCE), dated June 22, 1988

Pursuant to 10 CFR 50.73(a)(2)(iv), reference (a) provided the required 30-day written Licensee Event Report (LER) for an occurrence involving the emergency chilled water system. Reference (b) requested additional review of the event relating to chiller operability. As discussed with the resident inspectors, we understand that a revision to reference (a) will satisfy your needs for additional information. Please find enclosed the subject LER revision. Neither the health and safety of plant personnel nor the health and safety of the public was affected by this occurrence.

If you require any additional information, please so advise.

Sincerely,

H E Morgan

Enclosure: LER No. 88-010 Revision 1

cc: F. R. Huey (USNRC Senior Resident Inspector, Units 1, 2 and 3)
J. B. Martin (Regional Administrator, USNRC Region V)
Institute of Nuclear Power Operations (INPO)

IE22
1/1