NRC FORM 366 (MMM-YYYY) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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FACILITY NAME (1)	Docket Number (2)	Page (3)
San Onofre Nuclear Generating Station (SONGS) Unit 2	05000-361	1 of 7

TITLE (4): Emergency Chilled Water Chiller Inoperable Due Incorrectly Wired Switch

EVENT DATE			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									SONGS Unit 3	50 362
09	03	1998	1998	-- 021 --	00	10	26	1998	FACILITY NAME	DOCKET NUMBER

		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check One or More) (11)			
OPERATING MODE	5	20.2201(b)	20.2203(a)(2)(v)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)
POWER LEVEL	000	20.2203(a)(1)	20.2203(a)(3)(i)	50.73(a)(2)(ii)	50.73(a)(2)(x)
(10)		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
		20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	OTHER
		20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
R.W. Krieger, Vice President, Nuclear Generation	949-368-6255

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
Yes (If yes, complete EXPECTED SUBMISSION DATE)	X	No				

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

On 9/25/1998, Train B Emergency Chilled Water (ECW) chiller failed to start using the control room start push button. Subsequent investigation determined the chilled water low temperature cutout switch had been incorrectly wired following maintenance on 9/3/1998. Because this caused the chiller to be inoperable, and the condition had exceeded the allowable Technical Specification (TS) outage time (7 days), this condition is being reported in accordance with 10CFR50.73(a)(2)(i).

The cause of the switch being incorrectly wired was cognitive personnel error. Technicians failed to implement program requirements for lifting and landing leads. The incorrectly wired switch was not detected because 1) the technician who performed the verification of the wiring failed to implement program requirements, and 2) the return to service test failed to detect the incorrect wiring. The wiring was corrected and the chiller declared operable at 1418 PDT on 9/26/98.

SCE estimated this condition had small safety significance.

Plant: San Onofre Nuclear Generating Station Units 2 & 3
Reactor Vendor: Combustion Engineering
Event Date: September 3, 1998
Event Time: 0512 PDT

	Unit 2	Unit 3
Mode:	5, Cold shutdown	1, Power operation
Power:	000 percent	99.9 percent
Temperature:	123 degrees F	546 degrees F
Pressure:	350 psia	2250 psia

Background

Chilled water for the HVAC systems of the support buildings is divided into two systems: Normal Chilled Water System and Emergency Chilled Water System (ECW). ECW is composed of two 100% capacity loops or trains (each loop shared by Units 2 and 3). The purpose of the ECW system is to remove heat from emergency equipment rooms via room cooling coils that are in service when the normal cooling system is not available. For each train, chilled water is pumped by the chilled water pump(s) through a freon cycle chiller unit to its chilled water loop(s) which contain various cooling loads. Chilled water from the loads in each of two loops returns to the suction of the chilled water pump(s). The emergency chiller units remove heat from chilled water and transfers the heat to the component cooling water system. See Figure 1.

The ECW chiller (CHU) starts automatically on Safety Injection Actuation Signal (SIAS), Toxic Gas Isolation Signal (TGIS), Control Room Isolation Signal (CRIS) or Fuel Handling Isolation Signal (FHIS) from either Unit 2 or 3. The auxiliary building emergency HVAC system is designed to permit continuous personnel comfort, access, equipment safety and operation as applicable. Table 1 summarizes the design basis temperatures.

The ECW chillers are equipped with a protective circuit. The circuit includes, among others, a refrigerant low temperature cutout, chilled water low temperature cutout, and motor overload trip. The chiller unit will shutdown if the refrigerant low temperature cutout or motor overloads occur and must be reset before restart. Chilled water low temperature starts a recycle timer which stops the chiller. If there is a demand for additional cooling, the ECW chiller will automatically restart after at least 15 minutes.

"Dynamic calibration" of the chilled water low temperature cutout switch refers to the process of calibrating the trip setpoint. The dynamic calibration is performed with the switch's leads lifted, and the switch jumpered out to preclude tripping the chiller at the low temperature set point. The chilled water temperature is then lowered by lowering the unit's thermostat until the chilled water low temperature cutout switch changes state. At that point, the chilled water temperature is recorded, verifying the switch's setpoint, as adjusted.

Technical Specifications

Technical Specification (TS) 3.7.10 requires two trains of ECW to be operable in Modes 1, 2, 3, and 4. An ECW train is considered OPERABLE when:

a. The associated pump and compression tank are OPERABLE; and

b. The associated piping, valves, heat exchanger, refrigeration unit, and instrumentation and controls required to perform the safety related function are OPERABLE. A refrigeration unit is considered OPERABLE when it is aligned to either Unit's operating or standby OPERABLE Component Cooling Water (CCW) critical loop, provided that the OPERABLE CCW critical loop can be placed in operation within 2 hours after a design basis event is detected in the Control Room.

With one train inoperable, TS 3.7.10 Action (A) requires the train be restored within 7 days. If Action (A) is not met, Action (B) requires the Units to be in Mode 3 within 6 hours, and Mode 5 within 36 hours.

With both trains of ECW inoperable, TS 3.0.3 requires the Units be in Mode 3 within 7 hours, Mode 4 within 13 hours, and Mode 5 within 37 hours.

TS 3.7.10 has two Surveillance Requirements (SR).

1. SR 3.7.10.1 requires each ECW manual, power operated, and automatic valve in the flow path, that is not locked, sealed, or otherwise secured in position, be verified to be in the correct position at least every 31 days.

2. SR 3.7.10.2 requires the proper actuation of each ECW System component on an actual or simulated actuation signal be verified at least every 24 months.

Description of the Event

On September 25, 1998, at 0512 PDT, the Train B ECW chiller (ME335) failed to start when a control room operator (utility, licensed) pressed the control room start push button. The local start light illuminated but the oil pump did not start. After approximately 10 minutes, the control room operator pressed the stop push button and secured the chilled water pump. No ME335 associated alarms came in at the control room.

Subsequent investigation determined ECW chiller ME335 failed to start because the contact for the chilled water low temperature cutout switch (2/3TSLJ891B) was open and a contact wire was incorrectly terminated on the normally open (versus normally closed) switch contact. The switch had been incorrectly wired following the dynamic calibration on September 3, 1998 (the event date). The switch's wiring was promptly corrected.

Because the incorrectly wired switch rendered the chiller inoperable (would not start on demand), and the condition had existed longer than the Action A of TS 3.7.10 (7 days), this condition is being reported in accordance with 10CFR50.73(a)(2)(i).

Causes of the Event

The cause of the switch being incorrectly wired was cognitive personnel error. The technicians (utility, non-licensed) who performed the work failed to implement program requirements for lifting and landing leads.

The leads were lifted by a day shift technician in preparation for a dynamic calibration of the switch. That technician believed the task was relatively simple, and that the existing markings on the wire leads and terminals were adequate. The leads were landed by a swing shift technician, who did not utilize the existing markings for the landing the leads (relied upon by the day shift technician). Instead, the swing shift technician used a digital multi-meter to identify the terminals, failing to recognize the switch was in a different (open rather than closed) position due to the dynamic calibration in progress. The landing process was complicated by 1) inadequate shift turn over, and 2) the technician's decision to terminate the test quickly when he heard an unfamiliar noise emanating from the chiller.

The causes for not identifying the incorrect wiring were:

1. The technician (utility, non-licensed) who performed the verification of the wiring failed to implement program requirements for that activity.

The verifier only checked that the leads were tight. In addition to checking the leads for tightness, the verifier should have checked that the wires were terminated to the correct terminals.

2. The return to service (RTS) test for the chiller performed on September 4, 1998, failed to detect the incorrect wiring. The cause was incorrect assumptions (cognizant personnel error) regarding the work scope (installing jumpers and lifting leads) and system impact of the dynamic calibration of the chilled water low temperature cutout switch. The dynamic calibration was performed in parallel with the RTS test for the chiller's routine maintenance outage, instead of a stand alone test.

Corrective Actions

1. On September 25, 1998, at approximately 1200, the chilled water low temperature cutout switch wiring was corrected. The chiller started satisfactorily. Following venting of the chiller's condenser, the chiller was declared operable at 1418 PDT on September 26, 1998 (the time of full compliance with TS 3.7.10).

2. The ECW Train A chilled water low temperature cutout switch was verified to be correctly wired.

3. The Maintenance Division will review the event at shop meetings with craft personnel and supervision.

4. The appropriate individuals involved with the incorrectly wired switch will be disciplined.

5. As an interim action, until completion of the evaluation of the retest program and revision of the procedure governing work authorizations, SO123-XX-5 (see Item 7), senior Operations management is approving all retests.

6. As an interim action until completion of the lifting and landing leads and verification work practices evaluations (see Items 8 and 9), all wiring requiring the lifting and landing of leads will use SO123-II-15.3 "Temporary System Alteration and Restoration Form."

7. As a result of the inadequate retest on ME335, SCE evaluated its practices for returning equipment to service following maintenance. This evaluation included a reexamination of the retests associated with approximately 40 work authorization packages and approximately 110 maintenance orders performed in the third quarter of 1998. This evaluation confirmed the adequacy of the program as a whole but did identify one change directly related to this event and some improvements that are being incorporated into the program. Based on this evaluation, SCE concludes this was an isolated occurrence.

   The one specific change is a revision to the procedure governing work authorizations, SO123-XX-5, such that the procedure specifies that retests should not be performed in parallel with other scheduled activities on the same component/system without approval by the Retest Review Committee.

8. SCE has evaluated the work practices associated with lifting and landing leads, and concluded there is no pervasive mis-wiring of electrical circuits. Independent of programs to control proper termination of electrical components, preventative maintenance, and surveillance testing exist that would detect mis-wiring. These tests include circuit functional testing (approximately 760 preventative and surveillance items), control loop testing (approximately 1650 preventative and surveillance items), Engineered Safety Features (ESF) subgroup relay semiannual tests (approximately 40 procedures), motor operated valve testing (approximately 180 preventative and

maintenance activities), and routine verification/comparison of indications. Performance of these diverse tests has not detected an adverse trend.

In addition, the lifting and landing leads work practice evaluation included personnel interviews to assess the understanding of the requirements and expectation of the use of SO123-II-15.3 and reviews of past SCE's Nuclear Oversight Division (NOD) observations. The results of the interviews and NOD work support the conclusions that the problem identified in this LER is an isolated occurrence.

9. SCE has evaluated work practices associated with verification, and concluded that the inadequate verification associated with the mis-wiring is an isolated human error involving inattention to detail with contributing factors. This evaluation included review of hundreds of procedures for performing maintenance activities, interviews of a sampling of maintenance, construction and computer technician personnel, and six detailed observations of maintenance activities involving verification of temporary system alterations, self/cross checking and use of SO123-II-15.3. The evaluation confirmed the adequacy of the verification work practices as a whole but did identify enhancements that are being incorporated into certain procedures.

10. Although the dynamic calibration procedure SO123-II-8.25 has been completed successfully on many occasions, the procedure will be revised to require a post maintenance test to start the chiller following completion of the dynamic calibration and will be enhanced to include more specificity concerning the location of the leads on the temperature switch.

11. The importance of this event will be emphasized during stand downs required by the Vice President-Nuclear Generation during which the responsible division manager will review this event, the event described in LER 2-1998-020, and associated management policies, with site personnel. This action will be completed by November 30, 1998.

Safety Significance

SCE estimated the reported condition constituted an incremental increase in core damage probability of approximately 7.6E-6 for Unit 2 and 4.2E-6 for Unit 3 from the period September 4, 1998, the date emergency chiller ME335 was returned to service in an inoperable condition, through September 26, 1998, the date emergency chiller ME335 was rewired and returned to service. The risk assessment included the effects of all actual plant configurations during the period of emergency chiller ME335 inoperability due to the incorrectly wired switch. This increase in risk is characterized as small based on Regulatory Guide 1.174, even when combined with the increase described in LER 1998-020.

As stated in the Background section, the emergency chillers are common to both Units 2 and 3. During the period when ME335 (Train B) was unknowingly inoperable (September 3 through September 25, 1998), SCE did perform work on various Train A components in each unit. Consequently, there were cases when Train A and Train B safety equipment was simultaneously inoperable. However, because the normal room coolers were always available, the significance of this occurrence is limited to the unlikely Loss-of-Offsite-Power accident scenarios. For example, Unit 3 Diesel Generator 3G002 was out of service between September 8 and September 10, 1998.

Additional Information

In the past three years, SCE has not reported any events with similar causes and corrective action to the condition reported herein (i.e., incorrectly wired component causing a system to be inoperable).

TABLE 1 - ECW Design Basis Data

System	Type (a)	Temperature Summer (b)	Temperature Winter
Control Room Active Areas	AC	75* (d)	N/A
Technical Support Center (TSC)	AC	84(d)	N/A
Central Alarm Station	AC	94(d)	N/A
Control room cabinet area	AC	75(d)	N/A
Computer room	AC	84	N/A
ESF switchgear, and vital power/distribution rooms, evacuation room	V	95 75	50 70
ESF Battery rooms	V	95(c)	N/A(c)
Emergency chiller rooms	V	95(d)	N/A
Charging pump rooms and boric acid makeup pump rooms	AC	104	N/A
Lockers, rest rooms, equipment storage, Turbine Lab, etc.	V	85 (max.)	N/A
Telecommunication room	(e)	95	N/A
Offices	V	104	N/A

* Essential areas only. Temperature in non-essential areas could be higher than indicated.

(a) AC - Air conditioning
V - Ventilating

(b) If the emergency chiller(s) are not running temperature may increase beyond the design conditions listed here during a design basis accident in the areas served by the Emergency Chilled Water System (ECWS). Operations may be required to realign CCW to the emergency chillers and/or start the CCW pumps in order to establish cooling within two hours.

(c) Yearly average maximum for batteries = 77F; Minimum electrolyte temperature limit = 60F

(d) During a HELB temperature may increase beyond the design conditions.

(e) No air is supplied to this room.

Figure 1 - Emergency Chilled Water System