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 AUTH.NAME AUTHOR AFFILIATION  
 MORGAN,H.E. Southern California Edison Co.  
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SUBJECT: LER 89-018-00:on 890630,plant shutdown required by Tech  
 Specs due to low pressure safety injection pump MSF.  
 W/8 ltr.

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**Southern California Edison Company**

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July 31, 1989

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

Subject: Docket No. 50-362  
30-Day Report  
Licensee Event Report No. 89-008  
San Onofre Nuclear Generating Station, Unit 3

Pursuant to 10 CFR 50.73(d), this submittal provides the required 30-day written Licensee Event Report (LER) for an occurrence involving the completion of a plant shutdown required by Technical Specifications. Neither the health and safety of plant personnel or the public was affected by this occurrence.

If you require any additional information, please so advise.

Sincerely,

Enclosure: LER No. 89-008

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

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**LICENSEE EVENT REPORT (LER)**

Facility Name (1) <b>SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 3</b>										Docket Number (2) <b>0   5   0   0   0   3   6   2</b>				Page (3) <b>1 of 0 7</b>										
Title (4) <b>PLANT SHUTDOWN REQUIRED BY TECHNICAL SPECIFICATIONS DUE TO LOW PRESSURE SAFETY INJECTION PUMP MECHANICAL SEAL FAILURE</b>																								
EVENT DATE (5)			ER 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	6	3	0	8	9	8	9	---	0	0	8	---	0	0	0	7	3	1	8	9	NONE	0   5   0   0   0   0   1   1		
OPERATING MODE (9)			THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)																					
POWER LEVEL (10)			20.402(b)			20.405(c)			50.73(a)(2)(iv)			73.71(b)												
0   7   5			20.405(a)(1)(i)			50.36(c)(1)			50.73(a)(2)(v)			73.71(c)												
			20.405(a)(1)(ii)			50.36(c)(2)			50.73(a)(2)(vii)			Other (Specify in												
			20.405(a)(1)(iii)			X 50.73(a)(2)(i)			50.73(a)(2)(viii)(A)			Abstract below and												
			20.405(a)(1)(iv)			50.73(a)(2)(ii)			50.73(a)(2)(viii)(B)			in text)												
			20.405(a)(1)(v)			50.73(a)(2)(iii)			50.73(a)(2)(x)															
LICENSEE CONTACT FOR THIS LER (12)																								
Name <b>H. E. Morgan, Station Manager</b>										TELEPHONE NUMBER														
										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	MANUFAC- TURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFAC- TURER	REPORTABLE TO NPRDS															
X	B   P	S   E   A   L	X   9   9   9	NO																				
SUPPLEMENTAL REPORT EXPECTED (14)																								
X Yes (If yes, complete EXPECTED SUBMISSION DATE)										Expected Submission Date (15)		Month	Day	Year										
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ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

At 0806 on 6/27/89, with Unit 3 at 75% power, Low Pressure Safety Injection (LPSI) pump 3P015 was removed from service for Preventive Maintenance (PM). At 0855 on 6/29/89, upon completion of the PM, an Inservice Test (IST) was conducted on 3P015. Excessive mechanical seal leakage was observed necessitating seal replacement. Since seal replacement would require more time than remained in the Technical Specification 3.5.2, Action Statement "a", at 0630 on 6/30/89, unit shutdown was initiated. In accordance with procedures, an Unusual Event (UE) was declared. At 0745 on 6/30/89, the UE was terminated. At 1134, the unit entered Mode 3 and at 1830, entered Mode 4. The mechanical seal was replaced and the pump was returned to service on 7/8/89.

Investigation has determined that the seal failure was caused by oil in contact with the seal o-ring. The source of the oil is unknown, however, it is believed to be from either an overfilling of the lower motor bearing oil reservoir or leakage from the threaded connection between the lower bearing oil gauge fill tube and the lower bearing cartridge.

To prevent reoccurrence the following actions have been or will be taken: 1) a spray deflector has been installed on the LPSI pump which will prevent oil from entering the mechanical seal if leakage from or overflow of the lower motor bearing occurs; 2) similar spray deflectors will be installed on appropriate safety related pumps; 3) this event has been reviewed with appropriate personnel; and 4) procedures which cover the evolution of adding oil to LPSI and similar pumps will be reviewed and revised as appropriate.

Investigation into the source of the oil is continuing. Also, during review of this event, discrepancies between the Updated Final Safety Analysis Report and actual plant conditions were identified. These issues will be discussed in a supplement to this LER.

# LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION UNIT 3	DOCKET NUMBER 05000362	LER NUMBER 89-008-00	PAGE 2 OF 7
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Plant: San Onofre Nuclear Generating Station  
Unit: Three  
Reactor Vendor: Combustion Engineering  
Event Date: 06-30-89  
Time: 0630

## A. CONDITIONS AT TIME OF THE EVENT:

Mode: 1, 75% Power Operation

## B. BACKGROUND INFORMATION:

San Onofre Units 2 and 3 are each designed with two Low Pressure Safety Injection (LPSI) pumps [BP,P] which are normally aligned for the injection mode of the Safety Injection System [BP, BQ]. The main function of the pumps is to inject large quantities of borated water from the Refueling Water Storage Tank (RWST) [TK] (which contains essentially non-radioactive water) into the Reactor Coolant System (RCS) [AB] during a large break Loss Of Coolant Accident (LOCA). When the RWST is almost empty, a Recirculation Actuation Signal (RAS) is initiated. The RAS is designed to automatically change the mode of operation of the Safety Injection System and the Containment Spray System [BE]. The RAS shifts the systems' pump suctions from the RWST to the containment sump, stops the LPSI pumps and isolates the minimum flow paths.

The LPSI pumps are equipped with mechanical shaft seals [SEAL] and a leakoff line to collect seal leakage. LPSI pump seals are cooled by water from the pump discharge after it is cooled and cleaned.

Technical Specification (TS) section 3.5.2, "ECCS SUBSYSTEMS - Tavg GREATER THAN OR EQUAL TO 350 °F," requires both LPSI pumps to be OPERABLE in Modes 1 - 3 (with pressurizer pressure greater than or equal to 400 psia). With one LPSI pump inoperable, the pump must be restored to OPERABLE status within 72 hours or the unit must be placed in at least HOT STANDBY within the next 6 hours and in HOT SHUTDOWN within the following 6 hours.

## C. DESCRIPTION OF THE EVENT:

### 1. Event:

At 0806 on 6/27/89, Unit 3 LPSI pump 3P015 was removed from service for the performance of Preventive Maintenance (PM). At 0855 on 6/29/89, upon the completion of the PM, an Inservice Test (IST) was conducted. During the test, excessive mechanical seal leakage was observed with the pump running. However, when the pump was secured (not running), the seal did not leak. A Non-Conformance Report

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION UNIT 3	DOCKET NUMBER 05000362	LER NUMBER 89-008-00	PAGE 3 OF 7
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(NCR) was written documenting the observed condition and establishing 500 cc/min as the maximum leakage allowed for operability of the pump. This value was based on the San Onofre Units 2 and 3 Updated Final Safety Analysis Report (UFSAR) description for expected leakage from a gross seal failure for a LPSI pump.

Following verification of the proper torque of the seal gland bolts, seal leakage was determined to be about 1400 cc/min, thereby necessitating replacement of the mechanical seal. (SCE believes that verification of the torque did not affect the seal leakage rate). Since such a seal change would require more time than that which remained in the TS 72-hour action statement, unit shutdown was initiated in accordance with TS 3.5.2, Action Statement "a", at 0630 on 6/30/89. Concurrently, in accordance with procedures, an Unusual Event (UE) was declared.

At 0745 on 6/30/89, the UE was terminated in accordance with procedures.

At 1134 on 6/30/89, the unit entered Mode 3, followed by Mode 4 at 1830.

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

None.

3. Sequence of Events:

<u>DATE</u>	<u>TIME</u>	<u>ACTION</u>
6/27/89	0806	LPSI 3P015 removed from service for PM.
6/29/89	0855	Seal leakage observed during pump IST.
6/30/89	0100 approx.	Proper torque of the seal gland bolts verified. Seal leakage quantified as approximately 1400 cc/min.
6/30/89	0630	Unit shutdown initiated in accordance with TS 3.5.2, Action Statement "a". UE declared.
6/30/89	0745	UE terminated in accordance with procedures.
6/30/89	1134	Unit entered Mode 3.
6/30/89	1830	Unit entered Mode 4.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION  
UNIT 3

DOCKET NUMBER  
05000362

LER NUMBER  
89-008-00

PAGE  
4 OF 7

4. Method of Discovery:

On 6/29/89, during an IST of LPSI pump 3P015, excessive seal leakage was observed.

5. Personnel Actions and Analysis of Actions:

Unit shutdown was properly initiated and completed in accordance with TS requirements. An UE was appropriately declared.

6. Safety System Responses:

Not applicable.

D. CAUSE OF THE EVENT:

1. Immediate Cause:

Investigation has determined that the excessive seal leakage was caused by failure of a seal o-ring. During disassembly of the pump, oil was evident on the external surfaces of the mechanical seal gland and in the vicinity of the Ethylene Propylene Rubber (EPR) o-ring. Oil is known to cause rapid swelling of EPR o-rings. This in turn can cause failure of the carbon insert, leading to gross seal failure.

2. Root Cause:

SCE's investigation has identified two probable sources for oil found in the vicinity of the EPR o-ring. The first source of oil could have been caused by an overfilling of the lower motor bearing oil reservoir resulting in the overflow of the oil down the pump shaft onto the o-ring. The investigation has been unable to definitely determine when, or if, the lower motor oil reservoir was overfilled. Overfilling could have occurred following the removal of an oil sample (as part of the PM work being performed on the pump) on 6/27/89. Records show that no oil had been added to the pump between the last IST on 3/25/89 and performance of the PM.

The second probable source of oil found in the vicinity of the o-ring was discovered on 7/21/89. A minor amount of oil leakage was observed at the lower motor bearing housing. The source of this oil is believed to be the threaded connection between the lower bearing oil gauge fill tube and the lower bearing cartridge. Since a spray deflector had been installed on the pump shaft as corrective action to the event being reported in this LER, the leaking oil is not making contact with the seal o-ring and is, therefore, not an operability concern. At the time of the pump PM and IST (6/27/89 - 6/30/89), oil leakage from the lower motor bearing housing was not observed.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION UNIT 3	DOCKET NUMBER 05000362	LER NUMBER 89-008-00	PAGE 5 OF 7
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E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

- a) The mechanical seal was replaced and the pump returned to service on 7/8/89.
- b) This event has been reviewed with appropriate personnel with emphasis on the need to avoid overfilling oil reservoirs when adding oil to pumps.
- c) As a design enhancement, a spray deflector has been installed on Unit 3 LPSI pump 3P015. The deflector, which is located on the pump shaft, will prevent oil from entering the mechanical seal if leakage from or overflow of the lower motor bearing occurs. Additionally, the deflector should prevent water spray from shaft seal leakage from entering and damaging the lower motor bearing.
- d) Appropriate Maintenance Orders used for adding oil to LPSI pumps and pumps which are similar in design to the LPSI (i.e., single-stage, vertical, centrifugal), have been revised to incorporate precautions to avoid overfilling oil reservoirs.

2. Planned Corrective Actions:

- a) As a design enhancement, spray deflectors will be installed on the remaining Unit 2 and 3 LPSI pumps and containment spray pumps, which are similar in design to the LPSI pumps.
- b) Procedures which cover the evolution of adding oil to LPSI pumps and pumps which are similar in design to the LPSI (i.e., single-stage, vertical, centrifugal), will be reviewed and enhanced to include precautions on overfilling oil reservoirs, as appropriate.

F. SAFETY SIGNIFICANCE OF THE EVENT:

Since it cannot be definitively determined when the seal failure occurred, for purposes of reportability (in accordance with the guidance provided in NUREG 1022), it is presumed to have failed at the time of observance. Since the pump was out of service at the time the leakage was observed, and since the redundant LPSI pump remained operable during the period involved, there is no safety significance associated with the inoperability of LPSI 3P015. Furthermore, unit shutdown was properly initiated and completed in accordance with TS 3.5.2, Action Statement "a".

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION UNIT 3	DOCKET NUMBER 05000362	LER NUMBER 89-008-00	PAGE 6 OF 7
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SCE is continuing to evaluate the consequences of a seal failure should such a failure have occurred during a limiting design basis accident. Because a minor amount of oil leakage was observed at the lower motor bearing housing and, therefore, could be the root cause of the observed failure, SCE feels it is prudent to evaluate such an occurrence. Refer to Part G.4 for information on this continuing evaluation.

G. ADDITIONAL INFORMATION:

1. Component Failure Information:

The LPSI pump mechanical seals are manufactured by the Durametallic Corporation.

2. Previous LERs for Similar Events:

None.

3. Results of NPRDS Search:

A review of NPRDS industry data did not yield any useful information regarding oil-induced LPSI Pump seal failures.

4. Additional Information:

SCE is continuing to evaluate the radiological consequences of a seal failure had such a failure occurred during a design basis event. The conclusions of this investigation will be submitted in a supplemental LER. Based on our preliminary calculations, even if the LPSI pump had been used with the observed leakage during a design basis event, all exposure limitations would have must likely been met. Discussion of our preliminary results follows.

San Onofre Units 2 and 3 are each designed with two LPSI pumps which are normally aligned for the injection mode of the Safety Injection System. The main function of the pumps is to inject large quantities of borated water from the RWST (which contains essentially non-radioactive water), into the RCS during a large break LOCA. When the RWST is almost empty, a RAS is initiated. The RAS is designed to automatically change the mode of operation of the Safety Injection System and the Containment Spray System. The RAS shifts the systems' pump suctions from the RWST to the containment sump, stops the LPSI pumps, and isolates the minimum flow paths.

It is unlikely that the RAS would be overridden and LPSI pumps realigned to provide long term cooling (shutdown cooling) following such an accident (in fact, for the limiting double ended guillotine break of a cold leg, LPSI could not be realigned to provide long term cooling since its RCS suction source [i.e., the hot leg] would contain no water).



LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION UNIT 3	DOCKET NUMBER 05000362	LER NUMBER 89-008-00	PAGE 7 OF 7
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During less severe LOCA scenarios for which use of a LPSI pump for long term cooling could be required, a leakage path for contaminated water into the Safety Equipment Building would be possible from 3P015. However, the dose consequences would be far less severe for the small breaks for which the LPSI pump would be used.

In the worst case, assuming the LPSI pump was running with the observed leakage rate of 1400 cc/min for the entire period of a postulated worst case reactor accident as analyzed in the UFSAR, the 10 CFR 100 limits for the public would not have been exceeded. The 10 CFR 50, Appendix A, General Design Criteria (GDC) 19 limits for Control Room personnel exposure might have been exceeded. This is unrealistic, in light of the fact that the LPSI pump seal in question did not leak when the pump was not operating and the pump does not normally operate during the recirculation phase of the accident. In addition, the UFSAR analysis does not take credit for the fact that makeup air to the Control Room envelope is filtered by HEPA and charcoal filters which are required by TS 4.7.5. Thus, the Control Room exposure due to iodine would actually be much less than the GDC 19 limits. Also, had the LPSI pump been used at all during the recirculation phase, it would have, at most, been used on an intermittent basis. In this case, the amount of the release would still have been significantly less than in the case of continuous use and, therefore, the GDC 19 limit on Control Room Whole Body Dose would not have been exceeded.

It was discovered during our review of this event that a discrepancy exists between the UFSAR and plant design with respect to the Unit 3 LPSI pumps seal leakoff drain line. The UFSAR states that the leakoff line is piped to the Safety Equipment Building floor drain, however, the leakoff line for both LPSI pumps terminates away from the floor drain. The leakoff line for all the Units 2 and 3 High Pressure Safety Injection (HPSI) pumps, Containment Spray pumps, and the Unit 2 LPSI pumps ends in the floor drain.

Investigation into the cause of the Unit 3 LPSI pumps leakoff lines terminating away from the floor drain is continuing and will be included in a supplemental LER. This piping configuration could potentially affect the assumptions of an iodine partition factor of 0.1 for leakage that is available for release from the pump room. Given that the LPSI seal leakage is cool water depositing into a quiescent pit in the Safety Equipment Room within the Safety Equipment Building, the partition factor is still considered to be valid.

Lastly, as part of our evaluation of this event, a review of the San Onofre Units 2 and 3 Leakage Outside of Containment Program was initiated. The conclusion of this evaluation, including any changes to the program, will be reported in a supplement to this LER.