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

Subject: Docket No. 50-361
30-Day Report
Licensee Event Report No. 92-001
San Onofre Nuclear Generating Station, Unit 2

Pursuant to 10 CFR 50.73(d), this submittal provides the required 30-day written Licensee Event Report (LER) for a condition involving the Auxiliary Feedwater System. Neither the health nor the safety of plant personnel or the public was affected by this condition.

If you require any additional information, please so advise.

Sincerely,

R W Krieger

Enclosure: LER No. 92-001

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)

A04

AO-4

LICENSEE EVENT REPORT (LER)

Facility Name (1)	Docket Number (2)	Page (3)
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Title (4)
Steam Line Break Impact on Auxiliary Feedwater Tunnels and Valve Room Equipment

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 1	2 7	9 2	9 2	0 0 1	0 0	0 2	2 6	9 2	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)	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 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
R. W. Krieger, Station Manager	AREA CODE 7 1 4	3 6 8 - 6 2 5 5

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

SUPPLEMENTAL REPORT EXPECTED (14)

Yes (If yes, complete EXPECTED SUBMISSION DATE) [XX] NO

Expected Submission Date (15): Month | Day | Year

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

On 1/27/92, with Unit 2 in Mode 1 at approximately 100% power and Unit 3 in Mode 5, an ongoing program to reconstitute the design basis of San Onofre Units 2 and 3 discovered the potential for a harsh environment in a location not previously recognized. It was concluded that in the remote event of a guillotine break of the turbine driven auxiliary feedwater pump (TDAFWP) steam supply line in the auxiliary feedwater (AFW) pump building, certain equipment located in piping tunnels connected to the AFW pump building would be exposed to an environment which is more harsh than previously evaluated.

SCE promptly isolated the steam supply to the Unit 2 TDAFWP and initiated modifications to block potential steam flow resulting from a postulated pipe break from exposing affected components to a harsh environment. A temporary waiver of compliance from the shutdown requirements of Technical Specification (TS) 3.7.1.2.1, "Auxiliary Feedwater Systems," was requested and granted by the NRC on 1/30/92, since completion of the modification was to extend beyond the TS 72-hour shutdown action requirement. Installation of the Unit 2 steam barriers was completed at 1730 on January 30, 1992. Similar modifications will be implemented in Unit 3 prior to startup from the current refueling outage.

The safety significance of this event was assessed as being low since it was demonstrated that a guillotine break in the piping is unlikely to occur. A probabilistic risk assessment was performed which demonstrated that this event represented a small contribution (i.e., less than 0.1%) to the total estimated core damage frequency due to internal initiating events.

Plant: San Onofre Nuclear Generating Station
Units: Two and Three
Reactor Vendor: Combustion Engineering
Event Date: January 27, 1992
Time: 1250

A. CONDITIONS AT TIME OF THE EVENT:

Unit 2 - Mode 1, Power Operation
Unit 3 - Mode 5, Cold Shutdown (for Refueling)

B. BACKGROUND INFORMATION:

1. Auxiliary Feedwater (AFW) System:

The AFW system [BA] is comprised of two motor [MO] driven AFW Pumps (AFWP) [P] and one Turbine [TRB] Driven AFWP (TDAFWP) and associated tanks, piping, valves, instrumentation and controls. There are two AFW trains, one for each steam generator. Each train contains one set of parallel Containment [NH] Isolation Valves (CIV) [ISV] (i.e., one AC and one DC powered valve for each train). Each motor driven AFWP provides an AFW flow path through one of the AC or DC powered containment isolation valves. The TDAFWP can be aligned to either train to provide an additional flow path through either of the AC or DC powered containment isolation valves. The three pumps are located in the AFW pump building. Certain equipment in the AFWP building is qualified for the harsh environment resulting from a postulated guillotine break of the steam supply line to the TDAFWP. The four containment isolation valves are located in a separate AFW valve room. The AFW pump building and the AFW valve room are interconnected by two pipe tunnels.

2. Technical Specification (TS) Requirements:

TS 3.7.1.2.1, "Auxiliary Feedwater System," requires that in Modes 1 through 3, three independent AFWP and the associated flow paths to the two steam generators remain operable.

In the event that one AFWP or its associated flow path is inoperable, TS 3.7.1.2.1, Action "a" requires that it be restored to operable within 72 hours or the unit be placed in HOT STANDBY (Mode 3) within the next six hours and in HOT SHUTDOWN (Mode 4) within the following six hours. Similarly, with two pumps or two flow paths inoperable, Action "b" requires that the unit be placed in Mode 3 within the next six hours and in Mode 4 within the following six hours. In the event that three AFWPs or the flow paths are inoperable, Action "c" requires that corrective action be immediately initiated to restore at least one AFWP and the associated flow path to operable.

TS 3.3.2, "Engineered Safety Features Actuation System Instrumentation," Table 3.3-5, establishes minimum response time requirements for certain components actuated by the Engineered Safety Features Actuation System (ESFAS) [JE]. The actuated components which are germane to this report include: 1) AFW flow path CIVs HV-4714, HV-4715, HV-4730, and HV-4731, and 2) Steam Generator (SG) [AB, SG] Blowdown CIVs [ISV] HV-4053 and HV-4054.

TS 3.3.3.6, "Accident Monitoring Instrumentation," requires that post-accident monitoring instrumentation be operable in Modes 1 through 3. Among the required instruments are AFW flow transmitters FIT-4720 and FIT-4725 which sense the AFW flow to their respective SGs. These transmitters are located in the AFW pipe tunnels.

C. DESCRIPTION OF THE EVENT:

1. Event:

On January 27, 1992, with Unit 2 in Mode 1 at approximately 100% power and Unit 3 in Mode 5, an ongoing program to reconstitute the design basis of San Onofre Units 2 and 3 concluded that in the remote event of a guillotine break of the AFW turbine steam supply line in the AFWP building: 1) the four AFW CIVs, 2) the two AFW flow transmitters, and 3) the two SG blowdown CIVs could be exposed to environmental conditions which are harsher than conditions for which the equipment has been evaluated. All of these components are located in the AFW valve room and pipe tunnels that connect to the AFW pump building. If such a pipe break were to occur, the TDAFWP would be unavailable due to the loss of the steam supply, and the equipment located in the AFW pipe tunnels associated with the motor driven AFW pump flow paths could be adversely affected by the postulated harsh environment. Consequently, Unit 2 entered Action Statement "c" of TS 3.7.1.2.1, since all three AFW flow paths were considered to be inoperable.

As immediate corrective action, the steam supply to the Unit 2 TDAFWP was isolated at 1250 on January 27, 1992. This action precluded the possibility of a pipe break in the AFWP room, thus restoring the operability of the AFW flow paths associated with both motor driven pumps. This placed Unit 2 in Action "a" of TS 3.7.1.2.1, since the TDAFWP was not available, thus permitting Unit 2 to continue operation under a 72-hour action statement. At the time of discovery, Unit 3 was in an operating mode not requiring the AFW system.

SCE promptly initiated the design and construction of steam barriers in the Unit 2 AFW pipe tunnels to prevent the migration of steam from the AFWP room to areas containing the components which have not been qualified for the resultant harsh environment. When it was recognized that construction of the steam barriers would not be completed before a plant shutdown in accordance with action "a" of TS 3.7.1.2.1 would be required, a temporary waiver of compliance from the shutdown requirements of TS 3.7.1.2.1 was requested and granted verbally by the NRC on January 30, 1992. This permitted reopening the steam supply isolation valves, thus restoring the TDAFWP to operable status. At 1115 on January 30, 1992, the TDAFWP was satisfactorily surveillance tested and declared operable. Installation of the steam barriers in Unit 2 was completed on January 30, 1992 at 1730.

The temporary waiver of compliance also addressed other TS's governing equipment potentially affected by the postulated pipe break. These included TS 3.3.3.6, "Accident Monitoring Instrumentation," which governs the AFW flow transmitters, TS 3.6.3, "Containment Isolation Valves," which governs the SG blowdown isolation valves, and TS 3.3.2, "Engineered Safety Feature Actuation System Instrumentation," which governs the response time requirements for closure of the blowdown isolation valves. The NRC granted a temporary waiver of compliance from the requirements of these TS's, as well as from TS 3.7.1.2.1, "Auxiliary Feedwater System," as discussed above. This approval was formally documented in an NRC letter dated January 31, 1992.

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

   Not applicable.

3. Sequence of Events:

   Not applicable.

4. Method of Discovery:

   As described in Section C.1 above.

5. Personnel Actions and Analysis of Actions:

   Not applicable.

6. Safety System Responses:

   Not applicable.

D. CAUSE OF THE EVENT:

1. Immediate Cause:

The design calculation performed by the Architect Engineer, which defines the post-accident environmental conditions for the AFW pump building, did not consider or define the environment in the AFW pipe tunnels and AFW valve room resulting from a steam line break. Because the valve room and the connecting AFW pipe tunnels were not identified as potential harsh environment areas, the equipment in these spaces was not considered to be within the scope of 10CFR50.49.

2. Root Cause:

The failure to consider the environmental effects of steam flow through the AFW pipe tunnels to the valve room following a steam line break in the AFW building occurred during the design and construction phase of Units 2 and 3. At the present time, it is not likely that the root cause of this design deficiency can be determined due to the lapse of time since the initial oversight occurred in 1977.

E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

Upon initial discovery that components in the AFW valve room and AFW pipe tunnels could have been rendered inoperable by a steam line break in the Unit 2 AFW pump building, the steam line to the AFW pump building was promptly isolated. This action assured continued operability of any components and systems potentially affected by a steam line break.

Since isolating the steam line rendered the TDAFWP inoperable, action was promptly initiated to design and install steam barriers in the AFW pipe tunnels.

To support continued operation while the steam barriers were being installed, remedial actions were taken as described below:

o A fracture mechanics analysis was performed to verify that steam line leakage would be limited by crack size. This Leak-Before-Break (LBB) analysis was performed utilizing the guidance of NUREG-1061 "Evaluation of Potential for Pipe Breaks", volume 3, Section 5.2. The LBB analysis demonstrated on a mechanistic basis that a double ended pipe break of the TDAFWP steam line was unlikely. A through wall crack, up to the critical crack size, would not propagate and would leak at a rate which would be detected by the operating staff. Any such leakage would initially be of insufficient quantity to affect the environmental conditions of the valve room or the region of the pipe tunnel containing the AFW flow transmitters.

- o A probabilistic risk assessment (PRA) was performed using generic HELB frequency values. This assessment concluded that the core damage probability due to a steam line break in the AFW pump building, within the 48 hours during which the steam barriers were to be completed, would be very low.

- o In order to detect and promptly isolate any such leakage before a postulated leak could increase to the point of affecting the valve room environment, the TDAFW steam supply line was monitored every 30 minutes for the detection of pressure boundary leakage.

- o The two AFW pump building doors were required to be maintained open, when AFW was required to be operable, to provide a steam vent path in the event of a steam line break inside the building. With the AFW pump building doors open, the potential flow of steam through the AFW pipe tunnels would be minimized.

Installation of the steam barriers in Unit 2 was completed on January 30, 1992 at 1730.

2. Planned Corrective Actions:

   a. SCE's ongoing program to re-constitute the design basis for San Onofre will continue.

   b. AFW pipe tunnel steam barriers, similar to those installed at Unit 2, will be installed at Unit 3 prior to startup from the present refueling outage.

F. SAFETY SIGNIFICANCE OF THE EVENT:

SCE has evaluated the potential for a break in the high energy steam supply line to the TDAFWP and the resulting harsh environment in the AFW valve room and AFW pipe tunnels. This preliminary evaluation has determined that such an event would not preclude the ability to safely shutdown the plant.

A LBB analysis was performed to demonstrate on a mechanistic basis, that a double ended pipe break of the TDAFWP steam line was unlikely. The LBB fracture mechanics analysis using the guidance of NUREG-1061 indicated that a through wall crack, up to the critical crack size, would not propagate and would leak at a rate which would be detected by the operating staff.

A PRA for this event was performed using generic steam line break frequencies. This PRA demonstrated that the core damage risk due to a possible steam line break in the AFW pump building represented a small contribution (i.e., less than 0.1%) to the total estimated core damage frequency due to internally initiated events. However, SCE has evaluated the consequences of this event assuming a guillotine break in the AFW steam supply pipe did occur.

Background:

The design basis of the plant requires that essential systems and components be protected from the effects of postulated piping failures, including environmental effects. Essential systems and components are those required to mitigate the consequences of a postulated piping failure or to shutdown the plant. The AFW system is considered an essential system because it is used to mitigate the consequences of certain design basis events and normally provide plant cooldown to shutdown cooling conditions.

A break in the 6-inch steam line supplying the TDAFWP is analyzed as part of the plant design basis. The environmental conditions in the AFW pump building are analyzed to demonstrate that required AFW system components located in the AFW pump building are qualified for the duration of exposure to the pipe break environment. Operator action is assumed at 30 minutes post-accident to terminate steam flow to the AFW pump building by closing the isolation valves in the steam supply lines. The AFW pumps and valves in the AFW pump building are qualified to the calculated environment providing assurance that the AFW system will remain operable in a post steam line break environment and available to provide its safe shutdown function.

Additional AFW system components are located in or near the AFW valve room. These components include the four AFW isolation valves and two AFW flow transmitters. These components were not considered to be within the scope of the Environmental Qualification (EQ) program since they were believed to be in mild environments. A break of the steam line to the TDAFWP, however, would result in a harsh environment in the AFW valve room because it is connected by the AFW pipe tunnels to the AFW pump building. If it is assumed that the four AFW isolation valves would fail closed due to the harsh environment, then the AFW flow paths to both steam generators would be rendered inoperable. However, in this case, other available systems or operator action can be relied upon to provide safe shutdown.

Steam Line Break:

A break in the steam line to the TDAFWP with the plant operating at full power results in 2% excess steam flow and will not result in an automatic reactor trip if the feedwater control system (FWCS) is in the automatic mode. A reactor trip on SG low level is unlikely if the FWCS is in the manual mode as the operator has sufficient indication and time (20 minutes) to respond to the event. No engineered safety features (ESF) functions are actuated due to the event (i.e., no Emergency Feedwater Actuation Signal (EFAS)) and hence the AFW system is not required to mitigate the event. Since a reactor trip is not a direct consequence of the pipe break, it is not required to postulate a loss of offsite power.

The heatup of the AFW pump building due to the steam flow from the break causes actuation of the fire protection high temperature alarm in the AFW pump building (and probable actuation of the fire protection sprinklers for the AFW pumps). Additionally, the increase in core power above the licensed power level causes a Core Operating Limit Supervisory System (COLSS) alarm. In response to the alarms and after visual confirmation of a steam line break in the AFW pump building, the operator isolates the steam to the break by closing the steam supply isolation valves HV-8200 and HV-8201. The operator then initiates the emergency ventilation system to return the room environment to ambient conditions.

A small amount of steam flow to the room will continue from the steam traps which provide a bypass path around HV-8200 and HV-8201, until isolated locally by closing the steam trap isolation valves. However, the estimated bypass steam flow (3.3 lb/sec or 5000 CFM) is less than the flow rate from 1 train of the emergency ventilation system and cooldown of the AFW pump building, AFW pipe tunnels, and AFW valve room would be initiated prior to isolation of the bypass flow.

The loss of the TDAFWP would cause entry into a 72-hour TS action statement. If the TDAFWP could not be restored to operable status, plant shutdown would be initiated. At approximately 3% power during a normal plant cooldown from full power, feedwater flow to the SGs is manually transferred from the Main Feedwater (MFW) system to the AFW system.

If the AFW isolation valves are postulated to have failed closed due to the harsh environment in the AFW valve room, the AFW flow paths associated with both the TDAFWP and Motor Driven AFW Pumps (MDAFWP) would be inoperable. This condition causes entry into a TS action statement which requires immediate corrective action to restore at least one AFW pump and its associated flow path to operable status. Feedwater to the SGs would continue to be supplied by the MFW system while corrective action was initiated to locally open at least one AFW isolation valve located in the AFW valve room. Two of the four AFW isolation valves have a handwheel which is accessible at ground elevation in the AFW valve room. Once an AFW system flow path is restored, plant cooldown would be continued using one of the MDAFWPs.

In the highly unlikely event that a loss of MFW occurs concurrent with a break in the steam supply line to the TDAFWP or subsequent to the break while the AFW system is inoperable, a reactor trip would occur with a total loss of feedwater. Assuming availability of offsite power the existing procedural guidance, Emergency Operating Instruction (EOI) SO23-12-9, "Functional Recovery," directs the operator to establish an alternate source of feedwater to the SGs by depressurizing the SGs and using the condensate pumps. The EOI ensures that condensate inventory is maintained via makeup from the Condensate Storage Tank (CST). An evaluation was performed which confirmed that opening both Atmospheric Dump Valves (ADV), at 30 minutes into the event, will reduce SG pressure sufficiently for the condensate pumps to feed the SGs and allow cooldown to shutdown cooling conditions.

In the event that the break in the steam supply line to the TDAFWP occurred in Mode 3 during plant startup or shutdown, the AFW system would be in use and the MFW system may be unavailable due to inadequate steam conditions to operate the Turbine Driven MFW Pump. If the AFW isolation valves are postulated to fail closed due to the harsh environment in the AFW valve room, then a total loss of feedwater occurs. The operators are directed by the EOIs to use the condensate pumps to supply feedwater to the SGs as before. The previous evaluation confirmed the success of this alternative. However, in this case, SG dryout time is predicted to exceed 4 hours, assuming decay heat 1 day after shutdown which would allow ample time to initiate corrective action to locally open one of the AFW isolation valves.

Consequences of Steam Line Break:

The effect of the harsh environment on other components located near the AFW valve room was assessed. The AFW flow transmitters are required to be operable as part of Reg. Guide 1.97, Accident Monitoring Instrumentation. For this event, the AFW system is only used to provide feedwater for plant cooldown to shutdown cooling conditions. During cooldown, the ADVs would be opened to establish the desired cooldown rate and AFW flow would be adjusted to maintain SG level. Alternate indication is available to the operator to monitor AFW flow rate including SG level and AFWP discharge pressure.

The SG blowdown isolation valves are also located in the AFW valve room. These valves are normally open to provide a path for continuous SG blowdown during operation. These valves receive an automatic closure signal on Containment Isolation Actuation Signal (CIAS) or EFAS. However, no ESF actuation signals result from the event. Hence, automatic isolation is not required to mitigate the event. If, as a result of the harsh environment, the SG blowdown isolation valves fail open and MFW is assumed to be unavailable, then SG blowdown can be isolated by closing the control valves at the blowdown tank to prevent unnecessary loss of SG inventory until AFW is restored.

G. ADDITIONAL INFORMATION:

1. Component Failure Information:

Not applicable.

2. Previous LERs for Similar Events:

Similar original plant design and construction problems associated with Units 2 and 3 have been reported in previous LERs, the most recent of which was LER 91-002 (Docket No. 50-361). Corrective actions from those events could not have prevented recurrence since the design errors were associated with original plant design and construction.

3. Other Information:

There is an electrical equipment vault described in SCE's waiver of compliance which could potentially be affected by a harsh environment in the AFW tunnels since the vault has ten small drain holes connecting the vault and one of the tunnels. The purpose of these penetrations is to drain water from the vault to the AFW tunnel in the event of an actuation of the fire suppression system in the vault.

One-way flappers were installed on the ten drain holes prior to returning the TDAFWP steam piping to service. In order to assess the potential for damage to this equipment due to a steam line break in the AFWP room (prior to installation of the flappers), a walkdown was performed by station engineers of the safety equipment building electrical equipment vault. The electrical equipment vault was found to be adequately separated from the AFW pipe tunnels such that the likelihood of steam migration was extremely remote.

The ten, three inch diameter drain holes penetrate a two-foot-thick concrete wall separating one of the AFW pipe tunnels from a large spare equipment room. The only equipment located in this equipment room is a level transmitter which functions to indicate high water level in the event of flooding. The room is otherwise empty. This secondary room is further separated from the electrical vault by a 1.5 hour rated fire door, which is normally closed. The likelihood of steam migration through this pathway and barriers such that equipment in the electrical vault could be affected is considered remote.