



*Southern California Edison Company*

SAN ONOFRE NUCLEAR GENERATING STATION

P. O. BOX 128

SAN CLEMENTE, CALIFORNIA 92674-0128

R. W. KRIEGER  
STATION MANAGER

October 10, 1991

TELEPHONE  
(714) 368-6295

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

Subject: Docket No. 50-361  
Voluntary Report  
Licensee Event Report No. 91-014  
San Onofre Nuclear Generating Station, Unit 2

Pursuant to NUREG-1022, Supplement 1, "Licensee Event Report System," this submittal provides a voluntary Licensee Event Report (LER) for an occurrence involving the failure of a check valve in the turbine-driven auxiliary feedwater pump steam supply system. Upon completion of our investigation into this failure, a supplement to this report will be submitted providing further discussion of the cause(s) and safety significance. Neither the health nor the 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. 91-014

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) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION	DOCKET NUMBER	LER NUMBER	PAGE
UNIT 2	05000361	91-014-00	2 of 7

Plant: San Onofre Nuclear Generating Station  
 Unit: Two  
 Reactor Vendor: Combustion Engineering  
 Event Date: 9/10/91  
 Time: 1629

## A. CONDITIONS AT TIME OF THE EVENT:

Mode: 6, Refueling (Defueled)

## B. BACKGROUND INFORMATION:

### 1. Auxiliary Feedwater (AFW) System (AFWS):

The AFWS [BA] provides a source of feedwater to steam generators (SGs) [SG] E-088 and E-089. The AFWS is manually controlled to provide SG makeup during normal plant startup and shutdown, and is automatically initiated in response to an emergency feedwater actuation signal (EFAS) [JE], which in turn is initiated by low SG level. The AFWS is comprised of electrically-driven pump [P] P-141, which is normally aligned to supply only E-089, electrically-driven pump P-504, which is normally aligned to supply only E-088, steam turbine-driven pump P-140, which can supply either SG, and associated valves and piping. AFW pump turbine (AFWPT) K-007 [TRB] provides the motive power for AFW pump (AFWP) P-140 (refer to Figure 1).

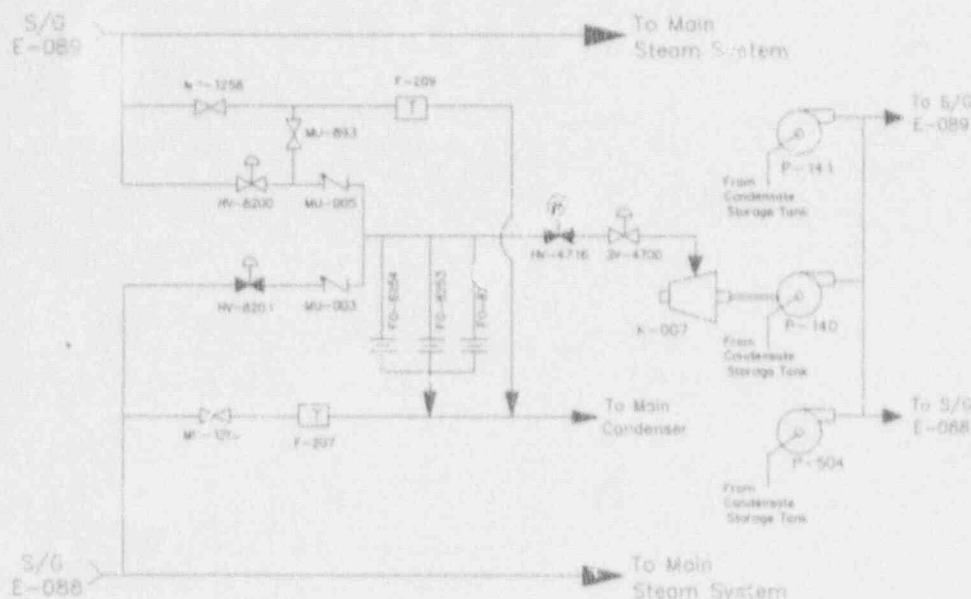


Figure 1: AFWPT Steam Supply & Drain System

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION	DOCKET NUMBER	LER NUMBER	PAGE
UNIT 2	05000361	91-014-00	3 of 7

AFWPT P-140 can be supplied steam from either E-088 via isolation valve HV-8201 [ISV] and check valve MU-003 [V] or from E-089 via isolation valve HV-8200 and check valve MU-005. The steam lines from these two sources are combined into a common line downstream of the check valves. Steam is then directed to the AFWPT via trip/throttle valve HV-4716 and governor valve SV-4700. HV-8201 is normally maintained closed when P-140 is in the standby mode of operation, and HV-8200 is left open to minimize wear damage from flow induced pressure oscillations to check valves MU-003 and MU-005. During surveillance and normal starts, both HV-8200 and HV-8201 are opened.

The AFWPT steam supply lines are provided with traps and orifices which are intended to provide a means for continuously extracting condensed steam and to keep the piping hot (refer to Figure 1 for details).

2. Inservice Testing (IST):

Steam supply check valves MU-003 and MU-005 are partially stroked in the open direction once per quarter in accordance with Procedure SO23-V-3.5.4, "Inservice Testing of Check Valves (Quarterly Frequency)." Each check valve is verified open by running P-140 on miniflow using steam supplied by a single SG (i.e., check valve MU-005 is tested with isolation valve HV-8200 open and HV-8201 shut, and MU-003 is tested with the isolation valves in the opposite configuration) while monitoring AFWP discharge pressure. The absence of a significant decrease in AFWP discharge pressure verifies that the check valve being tested is open. This is normally performed during the pump IST which is done on a monthly frequency per Procedure SO23-V-3.4.1, "Auxiliary Feedwater Inservice Pump Test."

Check valves MU-003 and MU-005 are disassembled and hand stroked during refueling on a rotating basis to verify full valve opening and closure per Procedure SO23-I-6.160, "Anchor-Boring Pressure Seal Tilting Disc Check Valves."

3. Technical Specification (TS) requirements:

TS 3.7.1.2, "Auxiliary Feedwater System", requires that all three AFW pumps be operable in Modes 1 through 3. With one AFW pump inoperable, the required AFW pump must be restored to operable status within 72 hours or the plant must be shutdown to Mode 3 within the next 6 hours and Mode 4 within the following 6 hours.

TS 3.8.1.1, "A.C. Sources". Action c.2 requires that in Modes 1-3, with one emergency diesel generator (EDG) [EK] inoperable, AFWP P-140 must be operable or returned to operable status within 2 hours. Otherwise, the plant must be shutdown to Mode 3 within the next 6 hours and Mode 5 within the following 30 hours.

LICENSEE EVENT REPORT (ER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION	DOCKET NUMBER	LER NUMBER	PAGE
UNIT 2	05000351	91-014-00	4 of 7

C. DESCRIPTION OF THE EVENT:

1. Event:

On 9/10/91, with Unit 2 in Mode 6 and defueled, turbine-driven AFWP P-140 steam-supply-check valve MU-005 was found to be damaged (refer to Figure 2). The check valve hinge pins were found to be failed such that the disc was separated from the pins and carried downstream to become lodged in the valve outlet piping. The west hinge pin was found bent about 15 to 20 degrees in the direction of normal steam flow. The east hinge pin was slightly bent and sheared off at the step down area at the end. A subsequent inspection of the valve internals revealed a flow area equal to approximately 15% of the normal maximum flow area. The observed damage was indicative of the disc being subjected to a large impact force, such as might be generated by a mass of water entrained in the steam flow through the piping.

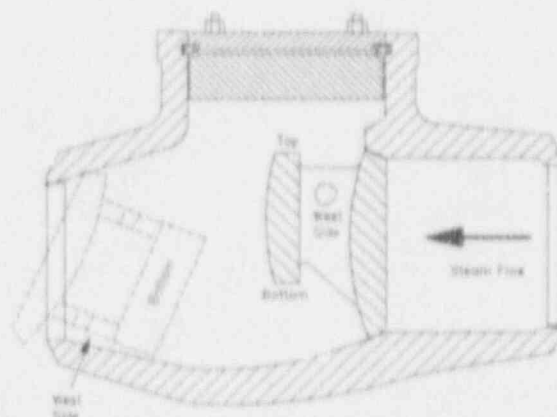


Figure 2: Check Valve MU-005

Further evaluation, with the check valve in the observed condition, is necessary in order to determine the overall effect on AFWP operability. Thus, this occurrence is being reported as a voluntary LER pending completion of our evaluation. In addition to this, the evaluation is attempting to determine the circumstances resulting in the damage, including the time that it occurred. The results of this effort will be provided in a supplement to this report.

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

None.

3. Sequence of Events:

Not applicable.

4. Method of Discovery:

The failure was discovered during a routine disassembly of check valve MU-005 in accordance with the IST program to verify full valve opening and closure.

5. Personnel Actions and Analysis of Actions:

Not applicable.

6. Safety System Responses:

Not applicable.



LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION	DOCKET NUMBER	LER NUMBER	PAGE
UNIT 2	05000361	91-014-00	5 of 7

D. CAUSE OF THE EVENT:

Our preliminary investigation indicates that water (condensed steam), entrained in the steam flow, could impose sufficient impulse force as it impacts the disc and hinge pins to cause the damage observed in check valve MU-005. At this point in our investigation, we have not yet determined when the event occurred or the circumstances that may have led to the accumulation of condensation in the steam piping. The investigation is continuing, and the results will be provided in a supplement to this report.

E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

- a. Prior to performing the Unit 2 disassembly inspection of check valve MU-005, AFWPT steam-supply-check valve MU-003 had been inspected, and found to be in proper operating condition.
- b. Check valve MU-005 was removed and replaced in-kind. Flow testing of the valve in the as-found condition is planned such that the effect of the observed damage can be better characterized. This is considered necessary to properly evaluate the safety significance of this event.
- c. The Unit 3 AFWPT steam-supply-check valves MU-003 and MU-005 were radiographed, and verified to be operating normally.
- d. The AFWPT steam supply lines for Units 2 and 3 were inspected for potential damage resulting from entrained water in the steam supply. No damage resulting from a water intrusion transient was apparent.
- e. As a result of the overspeed trip occurrence reported in LER 90-012 (Docket No. 50-361), Operating Procedures had previously been modified in order to minimize the potential for the formation of condensate in the AFWPT steam supply line.

2. Planned Corrective Actions:

- a. Devices (e.g., striker plates which provide indication of relative pipe movement) which provide external evidence of unusual pipe movement (indicative of a system transient) will be installed prior to returning Unit 2 to service from the current outage. Similar devices will be installed on Unit 3 during the upcoming Cycle 6 outage.
- b. Additional corrective actions resulting from the root cause evaluation will be evaluated as appropriate.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION	DOCKET NUMBER	LER NUMBER	PAGE
UNIT 2	05000361	91-014-00	6 of 7

F. SAFETY SIGNIFICANCE OF THE EVENT:

The AFWPT steam-supply-check valves MU-003 and MU-005 provide the following safety functions:

- o Each valve is required to open to provide steam to AFWPT K-007 from its respective SG during events requiring the initiation of AFW.
- o Each valve is required to close in the event of a main steam or feedwater line break associated with the SG to which it is aligned. This function serves two purposes: 1) proper closure of the valve prevents diversion of steam from the intact SG to the break, thus ensuring sufficient steam flow to drive the turbine, and 2) proper closure prevents blowdown of an intact SG which could adversely affect primary plant cooldown and the containment environment.

To date, the capability of check valve MU-005 to perform its safety functions in the as-found condition has not been determined. It will be necessary to perform flow testing to properly establish the performance of the damaged valve. Upon completion of this testing, the impact of the damaged check valve on system operability and safety significance will be provided in a supplement to this report.

G. ADDITIONAL INFORMATION:

1. Component Failure Information:

Manufacturer: Anchor/Darling Industries (A391)

Model: 3408-3

Type: Tilt disc check valve

Size: 4 inch

2. Previous LERs for Similar Events:

LER 85-017 (Docket 50-362):

This LER reported an event occurring on 4/16/85 at Unit 3 involving a failed snubber on the main steam line to the AFWPT. The failure was attributed to a hydraulic transient. It was postulated that condensation resulted in a water slug which passed through the main steam inlet lines to the AFWPT during turbine startup because of incomplete draining during system heatups. Corrective actions included replacement of existing steam traps with orifices to allow continuous removal of condensation and to maintain a more constant temperature in the system. Damage to other components was not observed.

LER 86-009 (Docket 50-361) & LER 86-009 (Docket 50-362):

These voluntary LERs reported events identified on 4/16/86 and 7/1/86, respectively, in which hinge pin damage occurred at both Units 2 and 3. Check valve MU-005 at Unit 2 was found in a similar condition to that identified on 9/10/91. However, the disc in valve MU-005 was found stuck approximately one-half inch from the full close position - it was still held in place by the west hinge pin with the east pin sheared off. The damage was attributed to

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

SAN ONOFRE NUCLEAR GENERATION STATION	DOCKET NUMBER	LER NUMBER	PAGE
UNIT 2	05000361	91-014-00	7 of 7

water, which had condensed in the line and entrained in the steam flow, impacting the valve disc when the AFWPT started. Subsequent modifications were made to improve valve design. Also, containment isolation valve TS changes were implemented to allow the steam trap isolation valves to be open continuously, thereby permitting the traps to perform their intended functions.

LER 90-012 (Docket 50-361):

This LER reported an event identified on 10/21/90 at Unit 2 where steam traps F-207 and F-209 upstream of check valves MU-003 and MU-005 were discovered isolated in the main steam line to the AFWPT. The isolated steam traps resulted in subsequent AFWPT overspeed trips due to steam supply line condensation accumulation. Corrective actions included: e.g., 1) procedural changes in order to minimize water intrusion in the steam supply lines, and 2) an evaluation of system design enhancements to address water entrainment. Since the exact cause and time of the event being reported here in LER 91-014 has not yet been determined, it is unknown as to whether or not the corrective actions for LER 90-012 would have prevented the event that was discovered on 9/10/91.