



**Pacific Gas and
Electric Company**

David H. Oatley
Vice President and
General Manager

Diablo Canyon Power Plant
PO Box 56
Avila Beach, CA 93424

805 545 4350
Fax 805 545 4234

March 14, 2003

PG&E Letter DCL-03-031

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Docket No. 50-323, OL-DPR-82
Diablo Canyon Unit 2
Licensee Event Report 2-2003-001-00
Steam Generator Tube Plugging Due to Stress Corrosion Cracking

Dear Commissioners and Staff:

In accordance with Technical Specification (TS) 5.6.10.c, PG&E is submitting the enclosed special report in the form of a licensee event report regarding steam generator (SG) tube plugging due to stress corrosion cracking identified during the Unit 2 eleventh refueling outage. TS 5.6.10.c requires a special report since more than one percent of the active tubes inspected in SG 2-4 were identified as defective and TS 5.6.10.a requires reporting of the number of tubes plugged in each SG.

This event did not adversely affect the health and safety of the public.

Sincerely,

David H. Oatley

ddm/2246/N0002155

Enclosure

cc: Ellis W. Merschoff
David L. Proulx
Girija S. Shukla
Diablo Distribution
INPO

IE22

LICENSEE EVENT REPORT (LER)

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TITLE (4)
Steam Generator Tube Plugging Due to Stress Corrosion Cracking

EVENT DATE (5) 02 13 2003			LER NUMBER (6) 2003 - 0 0 1 - 0 0				REPORT DATE (7) 03 14 2003			OTHER FACILITIES INVOLVED (8)					
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MO	DAY	YEAR	FACILITY NAME					DOCKET NUMBER	

OPERATING MODE (9) 6	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR (11) <input checked="" type="checkbox"/> 10 CFR <u>50.73(a)(2)(ii)(A)</u> <input checked="" type="checkbox"/> OTHER <u>Special Report per TS 5.6.10.a and c</u> (SPECIFY IN ABSTRACT BELOW AND IN TEXT, NRC FORM 366A)
POWER LEVEL (10) 0 0 0	
LICENSEE CONTACT FOR THIS LER (12) Lawrence M. Parker - Senior Regulatory Services Engineer	

TELEPHONE NUMBER	
AREA CODE 805	NUMBER 545-3386

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
B	A B	S G	W 1 2 0	N					

SUPPLEMENTAL REPORT EXPECTED (14) <input type="checkbox"/> YES (If yes, complete EXPECTED SUBMISSION DATE)	<input checked="" type="checkbox"/> NO	EXPECTED SUBMISSION DATE (15)	MON	DAY	YR
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ABSTRACT (Limit to 1400 spaces i.e., approximately 15 single-spaced typewritten lines) (16)

During the Unit 2 eleventh refueling outage with the unit defueled, analysis of Steam Generator (SG) eddy current test results indicated that greater than one percent of the active tubes were defective. On February 13, 2002, at 1645 PST, PG&E made a nonemergency report to the NRC as required by Technical Specification (TS) Table 5.5.9-2, "Steam Generator (SG) Tube Inspection," and 10 CFR 50.72(b)(3)(ii)(A), "Degraded Condition."

On February 13, 2002, PG&E notified the NRC of the preliminary results of the eddy current inspection findings in accordance with TS 5.6.10.d.5. PG&E informed the NRC that outside diameter stress corrosion cracking (ODSCC) at the tube support plate (TSP) intersections exceeded the conditional burst probability reporting threshold of 0.01. PG&E also informed the NRC that circumferential indications were detected in a row 5 tube U-bend.

The U-bend defects are due to primary water stress corrosion cracking (PWSCC). The TSP defects are due to ODSCC.

PG&E inspected 100 percent of the SG tube U-bend region with a rotating coil (plus point) probe to ensure all circumferential PWSCC was detected. PG&E also plus point inspected 100 percent of greater than 1 volt distorted bobbin outside diameter indications at TSPs. On March 4, 2003, PG&E presented an assessment of the safety significance of exceeding a probability of burst of 0.01 to the NRC that concluded the safety significance of the inspection results is low.

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I. Plant Conditions

Unit 2 was in Mode 6 (Refueling) in its eleventh refueling outage (2R11).

II. Description of Problem

A. Background

Technical Specification (TS) 5.5.9, "Steam Generator (SG) Tube Surveillance Program," Table 5.5.9-2, requires that the results of each SG [AB][TBG] tube inspection be classified as Category C-3 if more than one percent of the total tubes inspected are defective. Defective tubes must be repaired or removed from service by plugging. Results of SG tube inspections that are classified as Category C-3, require NRC notification in accordance with 10 CFR 50.72(b)(2).

TS 5.6.10.a, "Steam Generator (SG) Tube Inspection Report," requires the number of tubes plugged in each SG to be reported within 15 days following the completion of each inservice inspection.

TS 5.6.10.c, requires the results of SG tube inspections, which fall into Category C-3, to be reported in a special report to the Commission within 30 days and prior to resumption of plant operation. "This report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence."

TS 5.6.10.d, requires that for implementation of voltage-based repair criteria to tube support plate intersections that the NRC be notified prior to returning the SG to service if any of five conditions are identified. Condition 2 addresses circumferential indications at the TSP intersections and condition 4 addresses primary water stress corrosion cracking (PWSCC) at tube support plate (TSP) intersections. Condition 5 requires "if the calculated conditional burst probability based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds 0.01, notify the NRC and provide an assessment of the safety significance of the occurrence"

This special report documents TS 5.6.10.a and 5.6.10.c reporting, and TS 5.6.10.d notification requirements for Unit 2 SG inspections in 2R11.

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B. Event Description

During operating cycle 11, a low level primary to secondary leak rate was identified in SG 2-4 that started at approximately 1 gallon per day (gpd), increased throughout the cycle, to approximately 6 gpd, and decreased to less than 4 gpd prior to 2R11. PG&E made plans to perform a secondary pressure test in which the secondary side of the steam generator is pressurized with water with the primary side drained such that visual monitoring of the primary face of the tube sheet could identify any SG tube or plug leakage.

On February 9, 2003, a visual inspection during a secondary side pressure test of SG 2-4, identified 15 tubes that exhibited potential leakage characteristics. Additional bobbin and rotating coil (plus point) probe inspections identified large voltage outside diameter stress corrosion cracking (ODSCC) indications at several tube support plate (TSP) intersections and a potential through wall circumferential indication in a row 5 SG tube U-bend.

On February 13, 2003, at 1000 PST, PG&E notified the NRC that the probability of burst (POB) reporting threshold was exceeded in SG 2-4 due to a large voltage indication in SG 2-4 (R44C45 TSP 2H), in accordance with TS 5.6.10.d.5. During this phone conference, PG&E also notified the NRC that circumferential indications were detected in the U-bend region of SG 2-4 (R5C62).

On February 13, 2003, initial analysis of eddy current testing on SG 2-4 indicated that greater than one percent of the active tubes inspected were defective; therefore, classifying SG 2-4 as Category C-3, in accordance with TS 5.5.9. An Emergency Notification System nonemergency report in accordance with TS Table 5.5.9-2 and 10 CFR 50.72(b)(3)(ii)(A) was made at 1645 PST as Event Notification #39584.

PG&E identified seven circumferential indications at TSP intersections in SG 2-2 that were repaired by plugging. PG&E also identified axial PWSCC indications at TSP intersections in SG 2-2, 2-3, and 2-4 that are managed under the PWSCC ARC program.

In a meeting with NRC NRR and Region IV representatives on March 4, 2003, PG&E provided an assessment of the safety significance of exceeding the 0.01 POB reporting threshold requirement. A risk assessment was presented that concluded the safety significance, as measured by the change in the large early release frequency (LERF)

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TEXT

figure of merit, associated with leaving tubes with ODSCC flaws in service for the full cycle 12 is low. This assessment of the safety significance and NRC notification satisfies TS 5.6.10.d.5 requirements.

C. Status of Inoperable Structures, Systems, or Components that Contributed to the Event

None.

D. Other Systems or Secondary Functions Affected

None.

E. Method of Discovery

The defective tubes were found during scheduled testing of Unit 2 SG tubing performed during 2R11 in accordance with TS requirements. PG&E initially identified suspect leaking tubes by performing a secondary side pressure test to determine the source of low-level tube leakage. The extent of tube degradation was further determined by eddy current inspections utilizing a rotating coil (plus point) probe.

F. Operator Actions

None.

G. Safety System Responses

None.

III. Cause of the Problem

A. Root Cause

1. Circumferential indications were identified in 12 tubes in row 3 through row 10 U-bend regions. The U-bend defects are due to PWSCC.
2. Indications at the tube to TSP intersections are due to axial ODSCC. Voltage-based alternate repair criteria is used to manage axial ODSCC at the TSP intersections.

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IV. Assessment of Safety Consequences

The licensing-basis, large-break, loss-of-coolant accident analysis assumes a tube-plugging limit of 15 percent per SG. Including the tubes plugged during 2R11, the following table presents the number of tubes (out of a total of 3,388 tubes for each SG) that are currently plugged in each of the four Unit 2 SGs.

SG No.	Defective Tubes Plugged (includes >2.0 Volt bobbin OD TSP indications per GL 95-05)	Tubes Plugged Preventively, (including >1.2 Volt bobbin OD TSP indications and non-service induced flaws)	Total Plugged Tubes to Date	Total Percentage of Tubes Plugged
2-1	22	25	109	3.2%
2-2	29	18	226	6.7%
2-3	22	22	119	3.5%
2-4	88	114	315	9.3%
Totals	161	179	769	5.7%

The plugging percentage for each Unit 2 SG remains within the current allowable limit of 15 percent.

Insitu pressure testing of 15 tubes with U-bend PWSCC indications (3 in row 1 and 12 in rows 3 through 10) was performed. Only one tube (largest U-bend indication, SG 2-4 R5C62) exhibited leakage during the insitu test, with a steam line break differential pressure leak rate of about 0.003 gpm at room temperature. The tube did not burst at 3 times normal operating differential pressure. Therefore, leakage and structural integrity was confirmed for the U-bend indications.

PG&E provided the NRC an assessment of the safety significance of the occurrence of exceeding a POB of 0.01 as required by TS 5.6.10.d.5 via a risk assessment which concluded that the safety significance, as measured by the change in the LERF figure of merit, associated with leaving tubes with ODSCC flaws in service for the duration of cycle 12 is low.

The condition is not considered a Safety System Functional Failure.

Therefore, the event is not considered risk significant and it did not adversely affect the health and safety of the public.

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V. Corrective Actions

A. Immediate Corrective Actions

1. Secondary side pressure tests were performed for all four Unit 2 SGs by pressurizing the secondary side while observing the primary face of the tube sheet to identify tube leaks.
2. The U-bend regions of all active SG tubes were inspected with the plus point probe.
3. TSP intersections with greater than 1 volt distorted bobbin outside diameter (OD) indications were inspected by plus point.
4. All defective SG tubes were removed from service by tube plugging in 2R11. Defective tubes include tubes with U-bend circumferential indications and tubes with distorted bobbin OD indications at TSPs that were greater than 2 volts.
5. SG tubes with distorted bobbin OD indications at TSPs with less than or equal to 2 volts but greater than 1.2 volts were preventively plugged.
6. Insitu pressure testing of 15 tubes with U-bend PWSCC indications (3 in row 1 and 12 in rows 3 through 10) was performed to confirm their leakage and structural capability.
7. Two SG tubes with axial ODSCC at TSP 2H intersections in SG 2-4 (R44C45 and R35C57) were pulled for laboratory leakage and burst testing. Results of this testing will be reported in the 90-day SG inspection report in accordance with TS 5.6.10.e and TS 5.6.10.f.

B. Corrective Actions to Prevent Recurrence

1. The critical area for U-bend circumferential PWSCC will be defined in the Degradation Assessment for the next refueling outage, and plus point inspections of 100 percent of the defined critical area will be performed.
2. Additional actions for axial ODSCC at TSP intersections will be determined after completion of destructive examination of the tubes that were pulled in 2R11.

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VI. Additional Information

A. Failed Components

Component: SG tubes (Series 51 SG)
 Manufacturer: Westinghouse

B. Previous Similar Events

LER 2-96-003, submitted via DCL-96-105 dated March 13, 1996, reported that greater than one percent of the tubes inspected in SG 2-1, 2-2, and 2-4, during the Unit 2 seventh refueling outage, were defective.

LER 2-1998-002-00, submitted via DCL-98-041 dated March 19, reported that greater than one percent of the tubes inspected in SGs 2-2, during the Unit 2 eighth refueling outage, were defective.