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PG&E Letter DCL-00-138

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

Docket No. 50-275, OL-DPR-80  
Diablo Canyon Unit 1  
Licensee Event Report 1-2000-010-00  
Steam Generator Tube Plugging Due to Stress Corrosion Cracking

Dear Commissioners and Staff:

PG&E is submitting the enclosed licensee event report regarding steam generator (SG) tube plugging due to stress corrosion cracking identified during the Unit 1 tenth refueling outage. Technical Specification (TS) 5.6.10.c requires a special report since more than 1 percent of the tubes inspected in SG 1-2 were identified as defective, and TS 5.6.10.a requires reporting of the number of tubes plugged in each SG.

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

Sincerely,

*R.A. Walter*  
for  
David H. Oatley

cc: Ellis W. Merschoff  
David L. Proulx  
Lakshminaras Raghavan  
Diablo Distribution  
INPO

Enclosure

DDM/2246/A0516883

*IE22*

# LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) <b>Diablo Canyon Unit 1</b>	DOCKET NUMBER (2) <b>0 5 0 0 0 2 7 5</b>	PAGE (3) <b>1 OF 7</b>
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TITLE (4) <b>Steam Generator Tube Plugging Due to Stress Corrosion Cracking</b>
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EVENT DATE (5)	LER NUMBER (6)	REPORT DATE (7)	OTHER FACILITIES INVOLVED (8)
MO DAY YEAR	SEQUENTIAL NUMBER REVISION NUMBER	MO DAY YEAR	FACILITY NAME DOCKET NUMBER
10 28 2000	2000 - 0 1 0 - 0 0	11 03 2000	

OPERATING MODE (9) <b>6</b>	POWER LEVEL (10) <b>0 0 0</b>	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)	
		<input checked="" type="checkbox"/> 10 CFR	<b>50.73(a)(2)(v)(c)</b>
		<input type="checkbox"/> OTHER	<b>Special Report per TS 5.6.10.a and c</b>
(SPECIFY IN ABSTRACT BELOW AND IN TEXT, NRC FORM 366A)			

LICENSEE CONTACT FOR THIS LER (12)		TELEPHONE NUMBER
<b>Roger L. Russell - Senior Regulatory Services Engineer</b>		AREA CODE: <b>805</b> NUMBER: <b>545-4327</b>

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 NRPDS
B	A B	S G	W 1 2 0	N					

SUPPLEMENTAL REPORT EXPECTED (14)	EXPECTED SUBMISSION DATE (15)	MON DAY YR
<input type="checkbox"/> YES (If yes, complete EXPECTED SUBMISSION DATE)	<input checked="" type="checkbox"/> NO	

<p><b>ABSTRACT (16)</b></p> <p>On October 28, 2000, with Unit 1 in Mode 6 (Refueling), analysis of eddy current testing on Steam Generator (SG) 1-2 indicated that greater than 1 percent of the total tubes inspected were defective. On October 28, 2000, at 1336 PDT, PG&amp;E made a 4-hour, nonemergency report to the NRC pursuant to 10 CFR 50.72(b)(2)(iii)(C), to report this condition as required by Technical Specification (TS) 5.5.9, "Steam Generator (SG) Tube Surveillance Program," Table 5.5.9-2.</p> <p>On October 24, 2000, PG&amp;E discussed the preliminary results of the eddy current inspection with the NRC during a phone conference as requested in NRC letter to PG&amp;E dated October 12, 2000. During this phone conference, PG&amp;E also notified the NRC that PWSCC and circumferential indications were detected at tube support plate (TSP) intersections, satisfying TS 5.6.10 paragraph d.</p> <p>The majority of the tube defects were attributed to primary water stress corrosion cracking and outside diameter stress corrosion cracking at TSP intersections.</p> <p>PG&amp;E has plugged all defective Unit 1 tubes identified during the current refueling outage in accordance with TS 5.5.9. All defective tubes met the criteria of Regulatory Guide 1.121 for structural integrity at the end of Cycle 10. PG&amp;E maintains a comprehensive program to minimize SG tube degradation.</p>
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# LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

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TEXT

**I. Plant Conditions**

Unit 1 was in Mode 6 (Refueling) in its tenth refueling outage (1R10).

**II. Description of Problem**

**A. Summary**

On October 28, 2000, with Unit 1 in Mode 6 (Refueling), analysis of eddy current testing on Steam Generator (SG) 1-2 indicated that greater than 1 percent of the total tubes inspected were defective. On October 28, 2000, at 1336 PDT, PG&E made a 4-hour, nonemergency report to the NRC pursuant to 10 CFR 50.72(b)(2)(iii)(C), to report this condition as required by Technical Specification 5.5.9, "Steam Generator (SG) Tube Surveillance Program," Table 5.5.9-2.

**B. Background**

Technical Specification (TS) 5.5.9, "Steam Generator (SG) Tube Surveillance Program," requires that the results of each SG tube inspection be classified as Category C-3 if more than 1 percent of the total tubes inspected are defective. Defective tubes must be repaired or removed from service by plugging.

TS 5.6.10, "Steam Generator (SG) Tube Inspection Program," paragraph a, 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, paragraph 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. TS 5.6.10, paragraph d, requires NRC notification prior to returning the SG to service if circumferential crack-like indications are detected at tube support plate (TSP) intersections, or if indications are identified at TSP intersections that are attributable to primary water stress corrosion cracking (PWSCC).

If the results of the SG tube inspections are classified as Category C-3, then NRC notification is required in accordance with 10 CFR 50.72(b)(2) and submittal of a special report is required in accordance with TS 5.6.10.

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TEXT

### C. Event Description

On October 24, 2000, after the majority of SG tubes had been inspected with eddy current techniques, PG&E discussed the preliminary results of the inspection with the NRC during a phone conference as requested in NRC letter to PG&E dated October 12, 2000. During this phone conference, PG&E also notified the NRC that PWSCC and circumferential indications were detected at TSP intersections, satisfying TS 5.6.10 paragraph d.

On October 28, 2000, final analysis of eddy current testing on SG 1-2 indicated that greater than 1 percent of the total tubes inspected were defective, thus classifying SG 1-2 as Category C-3. Defects in 38 active tubes in SG 1-2 were removed from service by tube plugging in 1R10.

On October 28, 2000, at 1336 PDT, a 4-hour nonemergency report was made in accordance with 10 CFR 50.72(b)(2)(iii)(C).

In SGs 1-1, 1-3, and 1-4, the number of defective tubes plugged in 1R10 was 19, 10, and 10, respectively, thus classifying these SGs as Category C-2.

### D. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

### E. Other Systems or Secondary Functions Affected

None.

### F. Method of Discovery

The defective tubes were found during routine scheduled eddy current testing of Unit 1 SG tubing performed during 1R10.

### G. Operator Actions

None required.



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## H. Safety System Responses

None required.

## III. Cause of the Problem

### A. Immediate Cause

The number of defective tubes in SG 1-2 identified during 1R10 exceeded 1 percent of the total tubes inspected, placing the SG in Category C-3 per TS 5.5.9, Table 5.5.9-2.

### B. Cause

The majority of the tube defects are attributed to primary water stress corrosion cracking (PWSCC) and outside diameter stress corrosion cracking (ODSCC) at hot leg TSP intersections.

## IV. Analysis of the Event

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 1R10, the following number of tubes (out of a total of 3,388 tubes for each SG) are currently plugged in each of the four Unit 1 SGs:

SG No.	Defective Tubes Plugged in 1R10	Total Tubes Plugged to Date	Total Percentage of Tubes Plugged
1-1	19	125	3.7
1-2	38	297	8.8
1-3	10	39	1.2
1-4	10	65	1.9

The plugging percentage for each Unit 1 SG remains within the current allowable limit of 15 percent.

There were no actual safety consequences involved in this event since all defective tubes met the criteria of Regulatory Guide 1.121, "Bases For Plugging Degraded PWR Steam Generator Tubes," for structural integrity at the end of Cycle 10.

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TEXT

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

Also, the condition is not considered a Safety System Functional Failure.

### V. Corrective Actions

#### A. Immediate Corrective Actions

All Unit 1 SG tubes classified as defective during 1R10 have been plugged in accordance with DCPD TS 5.5.9.

#### B. Corrective Actions to Prevent Recurrence

PG&E has initiated several programs to minimize SG tube degradation, license alternate repair criteria, and license tube repair techniques.

Secondary side initiatives to minimize tube degradation:

1. Electric Power Research Institute secondary chemistry recommendations were implemented to minimize ODSCC at TSPs (e.g., hydrazine levels were increased in 1992, the secondary side pH treatment was converted from ammonia to ethanol amine in 1993/1994, and a molar ratio control program was implemented in 1993).
2. Tube sheets are sludge lanced at each outage to minimize ODSCC at the tube sheet.
3. Diablo Canyon Power Plant (DCPP) has an upgraded plant makeup water system to minimize SG contaminate levels.
4. SG blowdown is maintained at approximately 1 percent of the main steaming rate to minimize SG contaminate levels.
5. A boric acid addition program is in effect, including boric acid soaks at startup to mitigate denting and ODSCC at TSPs.
6. DCPD has condensate polishers and emergency (plant curtailment) procedures to protect against seawater condenser tube leaks.

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Primary side initiatives to minimize tube degradation:

1. Rows 1 and 2 U-bends have been heat treated in 1987/1988 to prevent PWSCC.
2. The tubes in the hot leg tube sheet region were shot peened in 1992/1993 to minimize PWSCC.
3. Reactor coolant system (RCS) contaminants are maintained at low levels in accordance with EPRI guidelines.
4. Lithium and boron concentrations are coordinated to minimize pH swings in the RCS.
5. Zinc addition to the RCS was implemented in Units 1 and 2 during Cycles 9 and 10 to inhibit PWSCC in SG tubes.

Alternate repair criteria (ARC):

1. Voltage-based ARC for axial ODSCC at TSPs was implemented starting in 2R8 and 1R9.
2. W\* ARC for axial PWSCC contained in the WEXTEx tube sheet was implemented starting in 1R9 and 2R9.
3. Validated techniques for Plus-Point sizing of axial PWSCC at dented TSP intersections were implemented starting in 1R9 and 2R9, allowing axial PWSCC less than 40% maximum depth to remain inservice.
4. PG&E submitted License Amendment Request 00-06, "Alternate Repair Criteria for Axial PWSCC at Dented Intersections in Steam Generator Tubing," in PG&E Letter DCL-00-119 dated June 19, 2000. This ARC is targeted for implementation in 2R10, contingent on NRC approval. 2R10 is currently scheduled to begin May 6, 2001.

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Tube repair techniques:

PG&E is reviewing methods of tube repair and sleeving techniques for application at DCPD.

### VI. Additional Information

#### A. Failed Components

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

#### B. Previous LERs on Similar Problems

LER 1-97-007 reported that greater than 1 percent of the tubes inspected in SG 1-1 and 1-2, during the Unit 1 eighth refueling outage, were defective.