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PG&E Letter DCL-04-056

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 1-2004-001-00
Steam Generator Tube Plugging Due to Stress Corrosion Cracking

Dear Commissioners and Staff:

In accordance with Technical Specification (TS) 5.6.10.c and 10 CFR 50.73(a)(2)(ii), 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 twelfth refueling outage. TS 5.6.10.c requires a special report since more than one percent of the tubes inspected in SG 1-1 and SG 1-4 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/A0605274

Enclosure

cc: Bruce S. Mallett
David L. Proulx
Girija S. Shukla
Diablo Distribution
INPO
State of California, Pressure Vessel Unit

JE22

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Diablo Canyon Unit 1					DOCKET NUMBER (2) 0 5 0 0 0 2 7 5					PAGE (3) 1 OF 7	
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TITLE (4)

Steam Generator Tube Plugging Due to Stress Corrosion Cracking

EVENT DATE (5)			LER NUMBER (6)				REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)								
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MO	DAY	YEAR	FACILITY NAME					DOCKET NUMBER				
04	08	2004	2004	- 0 0 1	- 0 0	05	10	2004										

OPERATING MODE (9) 6	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11) <div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> <input checked="" type="checkbox"/> 10 CFR <input checked="" type="checkbox"/> OTHER </div> <div style="text-align: center;"> 50.73(a)(2)(ii)(B) Special Report per TS 5.6.10.a and c <small>(SPECIFY IN ABSTRACT BELOW AND IN TEXT, NRC FORM 366A)</small> </div> </div>		
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
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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)					EXPECTED SUBMISSION DATE (15)			MON	DAY	YR
<input type="checkbox"/> YES (If yes, complete EXPECTED SUBMISSION DATE)					<input checked="" type="checkbox"/> NO					

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines.) (16)

On April 8, 2004, with Unit 1 in no Mode (Defueled), analysis of eddy current testing on Steam Generator (SG) 1-4 indicated that greater than one percent of the tubes were defective. 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," at 1402 PDT.

On April 14, 2004, PG&E discussed the preliminary results of the SG eddy current inspection during a phone conference with the NRC. PG&E notified the NRC that primary water stress corrosion cracking (PWSCC) and circumferential indications were detected at tube support plate intersections, per TS 5.6.10 paragraph d.

On April 20, 2004, analysis of eddy current testing on SG 1-1 also indicated that greater than one percent of the tubes were defective. PG&E made a nonemergency report required by TS Table 5.5.9-2, at 2026 PDT.

The majority of the tube defects in SG 1-4 were attributed to circumferential PWSCC in the U-bend region. The majority of the tube defects in SG 1-1 were attributed to axial outside diameter stress corrosion cracking at tube support plate intersections.

PG&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 condition-monitoring requirements at the end of Cycle 12. PG&E maintains a comprehensive program to minimize SG tube degradation.

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TEXT

I. Plant Conditions

Unit 1 was in no Mode (Defueled) in its twelfth refueling outage (1R12).

II. Description of Problem

A. 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 one 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 Report," paragraph a, requires the number of tubes plugged in each SG [AB][TBG] 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 TS Table 5.5.9-2, "Steam Generator (SG) Tube Inspection," 10 CFR 50.72(b)(3)(ii), and submittal of a special report is required in accordance with TS 5.6.10.c.

B. Event Description

On April 8, 2004, final analysis of eddy current testing on SG 1-4 indicated that greater than one percent of the active tubes inspected were defective, therefore classifying SG 1-4 as Category C-3, per TS 5.5.9. Defects in 92 active tubes in SG 1-4 were removed from service by tube plugging during 1R12.

On April 8, 2004, at 1402 PDT, a nonemergency report was made in accordance with TS Table 5.5.9-2 and 10 CFR 50.72(b)(3)(ii)(B).

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TEXT

On April 14, 2004, PG&E discussed the preliminary results of the inspection during a scheduled phone conference with the NRC. 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 April 20, 2004, final analysis of eddy current testing on SG 1-1 indicated that greater than one percent of the active tubes inspected were defective, therefore classifying SG 1-1 as Category C-3, per TS 5.5.9. Defects in 40 active tubes in SG 1-1 were removed from service by tube plugging in 1R12

On April 20, 2004, at 2026 PDT, a nonemergency report was made in accordance with TS Table 5.5.9-2 and 10 CFR 50.72(b)(3)(ii)(B).

In SGs 1-2 and 1-3, the number of defective tubes plugged in 1R12 was 28 and 27, respectively, thus classifying these SG inspection results as Category C-2, per TS 5.5.9. Six tubes in SG 1-2 were also preventively plugged (permeability variation) so a total of 34 tubes were plugged in SG 1-2. Preventively plugged tubes do not apply to categories.

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 routine scheduled eddy current testing of Unit 1 SG tubing performed during 1R12.

F. Operator Actions

None.

G. Safety System Responses

None.

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TEXT

III. Cause of the Problem

A. The number of defective tubes in SG 1-1 and SG 1-4 identified during 1R12 exceeded one percent of the total tubes inspected, placing the SGs in Category C-3, per TS 5.5.9.

B. Root Cause

The majority of the tube defects are attributed to axial outside diameter stress corrosion cracking (ODSCC) at hot leg TSP intersections (SG 1-1) and circumferential PWSCC in the U-bend region (SG 1-4).

C. Contributory Cause

None.

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 1R12, 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 1 SGs.

SG NO.	Active Tubes Plugged in 1R12	Total Tubes Plugged to Date	Total Percentage of Tubes Plugged
1-1	40	194	5.7
1-2	34	272	8.0
1-3	27	76	2.2
1-4	92	167	4.9

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 12.

Also, 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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TEXT

V. Corrective Actions

A. Immediate Corrective Actions

All Unit 1 SG tubes classified as defective during 1R12 have been plugged in accordance with Diablo Canyon Power Plant (DCPP) TS 5.5.9.

B. Corrective Actions to Prevent Recurrence

PG&E has initiated several programs to minimize SG tube degradation and implemented alternate repair criteria to extend the SG service life.

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 during each refueling outage to minimize ODSCC at the tube sheet.
3. DCPP has an upgraded plant makeup water system to minimize SG contaminate levels.
4. SG blowdown is maintained at approximately one 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. DCPP has condensate polishers and emergency (plant curtailment) procedures to protect against seawater condenser tube leaks.
7. The Unit 1 SGs were chemically cleaned in 2004 (1R12).

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TEXT

Primary side initiatives to minimize tube degradation:

1. Rows 1 and 2 U-bends were 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 starting in Cycle 9 to inhibit PWSCC in SG tubes.

Alternate repair criteria (ARC):

1. Voltage-based ARC for axial ODSACC at TSPs was implemented starting in Unit 2 eighth refueling outage and Unit 1 ninth refueling outage (1R9).
2. W* ARC for axial PWSCC contained in the WEXTEx tube sheet was implemented starting in 1R9 and Unit 2 ninth refueling outage.
3. PWSCC ARC for axial PWSCC at dented TSPs was implemented starting in Unit 1 eleventh refueling outage (1R11) and Unit 2 eleventh refueling outage.
4. License Amendment Request (LAR) 03-16, submitted in PG&E letter DCL-03-174, dated December 19, 2003, requests a revision to the SG wedge region exclusion zones for SG tube ARC.
5. LAR 03-18, submitted in PG&E letter DCL-03-183, dated January 7, 2004, requests a revision to TS 5.5.9, and TS 5.6.10, to use the 4-volt ARC for SG tube repair.
6. LAR 04-01, submitted in PG&E letter DCL-04-028, dated March 18, 2004, requests the use of a bobbin probability of prior cycle detection (PODCD) methodology for both Units 1 and 2, as was previously approved in the NRC License Amendment No. 164 for use in DCP Unit 2 Cycle 12.

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TEXT

Tube repair techniques:

LAR 03-15, submitted in PG&E Letter DCL-03-132, dated October 22, 2003, requested a revision to TS 5.5.9, Table 5.5.9-2, for the use of Alloy 800 tube sleeves for SG tube repair.

VI. Additional Information

A. Failed Components

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

B. Previous Similar Events

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

LER 1-2000-010-00 reported that greater than one percent of the tubes inspected in SG 1-2, during the Unit 1 tenth refueling outage, were defective.

LER 1-2002-002-00 reported that greater than one percent of the tubes inspected in SG 1-2, during 1R11, were defective.