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PG&E Letter DCL-05-138

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 1-2005-001-00
Steam Generator Tube Plugging Due to Stress Corrosion Cracking

Dear Commissioners and Staff:

In accordance with Technical Specification (TS) 5.6.10.a, TS 5.6.10.c, and 10 CFR 50.73(a)(2)(ii), Pacific Gas & Electric Company is submitting the enclosed licensee event report regarding steam generator (SG) tube plugging due to stress corrosion cracking identified during the Unit 1 thirteenth 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 1-2 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/A0650656
Enclosure
cc: Bruce S. Mallett, NRC Region IV
Terry W. Jackson, NRC Senior Resident Inspector
Alan B. Wang, NRR Project Manager
Diablo Distribution
INPO
State of California, Pressure Vessel Unit

IE22

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Diablo Canyon Unit 1	0 5 0 0 0 2 7 5	1 OF 6

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
11	11	2005	2005	- 0 0 1 -	0 0	11	25	2005		

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)		
6	X	10 CFR	50.73(a)(2)(ii)(A)
POWER LEVEL (10)	X	OTHER	Special Report per TS 5.6.10.a and c
0 0 0	(SPECIFY IN ABSTRACT BELOW AND IN TEXT, NRC FORM 366A)		

LICENSEE CONTACT FOR THIS LER (12)

	TELEPHONE NUMBER	
	AREA CODE	
Lawrence M. Parker - Senior Regulatory Services Engineer	805	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)		EXPECTED SUBMISSION DATE (15)	MON	DAY	YR
[ ] YES (If yes, complete EXPECTED SUBMISSION DATE)	[X] NO				

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

On November 11, 2005, at 1200 PST, with Unit 1 in Mode 6 (refueling, with the reactor defueled), analysis of eddy current testing on Steam Generator (SG) 1-1 and SG 1-2 indicated that greater than one percent of the tubes were defective. Pacific Gas & Electric Company (PG&E) made a non-emergency report to the NRC as required by Technical Specification (TS) Table 5.5.9-2, "Steam Generator (SG) Tube Inspection," at 1230 PST, via NRC Event No. 42136.

On November 9, 2005, PG&E discussed the preliminary results of the SG eddy current inspection during a phone conference with the Office of Nuclear Reactor Regulation (NRR). The primary cause of the SG tube cracking was circumferential outside diameter stress corrosion cracking at the hot leg tube support plates and at the hot leg top of tubesheet.

In accordance with TS 5.5.9, "Steam Generator (SG) Tube Surveillance Program," PG&E has plugged all defective Unit 1 tubes identified during the current refueling outage. All defective tubes met condition-monitoring requirements at the end of Cycle 13. PG&E maintains a comprehensive program to minimize SG tube degradation, and plans to replace the SGs at the end of Cycle 15.

I. Plant Conditions

Unit 1 was in Mode 6 (refueling, with the reactor defueled) in its thirteenth refueling outage (1R13).

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 have service induced degradation in excess of TS tube repair limits. Defective tubes must be 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.

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," and submittal of a special report is required in accordance with TS 5.6.10.c.

B. Event Description

On November 9, 2005, PG&E discussed the preliminary results of the inspection during a scheduled phone conference with the NRR.

On November 11, 2005, at 1200 PST, final analysis of eddy current testing on SG 1-1 and SG 1-2 indicated that greater than one percent of the tubes inspected were defective, therefore classifying the SGs as Category C-3, per TS 5.5.9. SG 1-1 had 37 defective tubes and SG 1-2 had 41 defective tubes that were removed from service by tube plugging during 1R13. Additional degraded tubes were also preventively plugged.

On November 11, 2005, a non-emergency report was made in accordance with TS Table 5.5.9-2 and 10 CFR 50.72(b)(3)(ii)(A), at 1230 PST.

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 1R13.

F. Operator Actions

None.

G. Safety System Responses

None.

III. Cause of the Problem

A. The number of defective tubes in SG 1-1 and SG 1-2 identified during 1R13 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 the hot leg tube support plate, and circumferential ODSCC at hot leg tube support plate and at the hot leg top of tubesheet. In addition, axial ODSCC at the hot leg top of tubesheet was identified at Diablo Canyon Power Plant (DCPP) for the first time.

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 1R13, 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.	Tubes Plugged in 1R13	Total Tubes Plugged to Date	Total Percentage of Tubes Plugged
1-1	38	232	6.8
1-2	43	315	9.3
1-3	16	92	2.7
1-4	19	186	5.5

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 performance criteria of the Nuclear Energy Institute (NEI) 97-06, Revision 2, "Steam Generator Program Guidelines."

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.

V. Corrective Actions

A. Immediate Corrective Actions

The Unit 1 SG tubes classified as defective during 1R13 have been plugged in accordance with 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 leave certain indications in service, thus extending the SG service life. Circumferential ODSCC indications are not subject to alternate repair criteria (ARC), and must be plugged upon detection.

PG&E maintains a comprehensive program to minimize SG tube degradation, and plans to replace the SGs at the end of Cycle 15.

TEXT

Secondary side initiatives to minimize tube degradation:

1. EPRI secondary chemistry recommendations were implemented to minimize ODSCC at tube support plates (TSPs) (e.g., hydrazine levels were increased in 1992, the secondary side pH treatment was converted from ammonia to ethanol amine, and a molar ratio control program was implemented in 1993/1994).

2. Tube sheets have been 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.

Primary side initiatives to minimize tube degradation:

1. Rows 1 and 2 U-bends were heat treated in 1987/1988 to prevent primary water stress corrosion cracking (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.

TEXT

Alternate repair criteria (ARC):

1. Voltage-based ARC for axial ODSCC at TSPs was implemented starting in the Unit 2 eighth refueling outage and the Unit 1 ninth refueling outage (1R9).

2. W* ARC for axial PWSCC contained in the WEXTEX tube sheet was implemented starting in 1R9 and the Unit 2 ninth refueling outage.

3. PWSCC ARC for axial PWSCC at dented TSPs was implemented starting in the Unit 1 eleventh refueling outage (1R11) and the Unit 2 eleventh refueling outage.

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.

LER 1-2004-001-00 reported that greater than one percent of the tubes inspected in SG 1-1 and SG 1-4, during Unit 1 twelfth refueling outage, were defective.