

June 24, 2002

Mr. Gregory M. Rueger  
Senior Vice President, Generation and  
Chief Nuclear Officer  
Pacific Gas and Electric Company  
Diablo Canyon Nuclear Power Plant  
P. O. Box 3  
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SUBJECT: REVIEW OF DIABLO CANYON NUCLEAR POWER PLANT, UNIT NO. 2 -  
REFUELING OUTAGE 9 STEAM GENERATOR INSPECTION 90-DAY  
REPORT (TAC NO. MA8224)

Dear Mr. Rueger:

By letter dated January 20, 2000, as supplemented by letter dated January 3, 2002, Pacific Gas and Electric Company (PG&E) submitted its steam generator (SG) tube inspection 90-day report, "Results of Steam Generator Alternate Repair Criteria for Diablo Canyon Unit-2 Ninth Refueling Outage." The report was submitted in accordance with the guidance in Generic Letter (GL) 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking."

As discussed in the report, PG&E assessed the significance of the predominantly axially oriented outside diameter stress corrosion cracking at the tube support plate elevations using an NRC-approved methodology. As discussed in the enclosed safety evaluation, the staff concludes that PG&E has reasonable assurance of tube integrity for this degradation mechanism over the next operating cycle.

Sincerely,

/RA/

Girija S. Shukla, Project Manager, Section 2  
Project Directorate IV  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Docket No. 50-323

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
OF THE STEAM GENERATOR 90-DAY REPORT  
PACIFIC GAS AND ELECTRIC COMPANY  
DIABLO CANYON UNIT 2  
DOCKET NO. 50-323

1.0 INTRODUCTION

By letter dated January 20, 2000, as supplemented by letter dated January 3, 2002, Pacific Gas and Electric Company submitted for staff review its steam generator tube inspection (90-day) report, "Results of Steam Generator Alternate Repair Criteria for Diablo Canyon Unit-2 Ninth Refueling Outage." The report was submitted in accordance with the guidance in Generic Letter (GL) 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking."

The 90-day report also includes the licensee's W\* inspection results. The NRC approved the use of the alternate repair criteria (ARC) on February 19, 1999. Diablo Canyon Unit 2 first implemented the W\* ARC during the ninth refueling outage (RFO).

The subject 90-day report contains the licensee's condition monitoring assessment for Cycle 9 and the operational assessment for Cycle 10 operation. The licensee performed these assessments following an NRC-approved methodology.

2.0 GENERAL PLANT DESCRIPTION

Diablo Canyon Unit 2 has four Westinghouse Model 51 steam generators (SGs) A, B, C, and D. The tubes are 7/8 inch in diameter and were fabricated from mill-annealed Alloy 600. The SGs have carbon steel tube support plates (TSPs) with drilled holes.

The staff approved the licensee's implementation of the 2-volt voltage-based ARC for SG tubes on March 12, 1998. The voltage-based tube repair criteria (1) allows tubes having indications confined within the thickness of the tube support plates and having bobbin voltages less than or equal to 2 volts to remain in service; (2) allows tubes having indications confined within the thickness of the TSPs and having bobbin voltages greater than 2 volts, but less than or equal to the upper voltage repair limit, to remain in service if a motorized rotating pancake coil (RPC) probe or an acceptable inspection alternative does not detect degradation; and (3) requires tubes having indications confined within the thickness of the TSPs and having bobbin voltages greater than the upper voltage limit to be plugged or repaired.

The staff approved the licensee's implementation of the W\* ARC for SG tubes on February 19, 1999. The W\* tube repair criteria allows tubes with defects, predominantly axial oriented primary water stress corrosion cracking (PWSCC) located in tubesheet expansions, specifically, the WEXTEx region, to remain in service provided certain conditions are satisfied to ensure the structural and leakage integrity of the steam generators.

### 3.0 STAFF ASSESSMENT

#### 3.1 Inspection Scope and Results (GL 95-05)

The licensee inspected 100 percent of the inservice tubes full length with a bobbin coil in all four SGs during the end-of-cycle (EOC) 9 inspection outage. Dented intersections were inspected with plus point probes consistent with the methodology described in GL 95-05.

During these inspections, approximately 560 indications of predominantly axially oriented outside diameter stress corrosion cracking (ODSCC) at the TSP elevations were detected. This value includes approximately 80 indications from tubes that were deplugged during the outage (i.e., EOC 9 outage). Of the 560 indications, approximately 60 were greater than 1.0 volt by bobbin coil, including eight indications which had voltages higher than 2.0 volts. There were no indications detected above approximately 3.0 volts, which is below the upper voltage repair limit and the structural limit.

Twenty-six ODSCC TSP indications were removed from service as a result of the steam generator inspections: twenty-two indications were attributed directly to confirmed ODSCC, four indications were removed from service as a result of repairable degradation elsewhere on the tube. No tubes were pulled during the EOC 9 inspection (i.e., 2R9).

#### 3.2 Evaluation of Probabilistic Calculations (GL 95-05)

To demonstrate acceptable tube integrity in accordance with GL 95-05, the licensee determined the conditional probability of tube burst and the tube leak rate during a postulated steam line break. The results from these calculations were below the technical specification reporting thresholds. The licensee's calculations are summarized below.

##### 3.2.1 Projected EOC Voltage Distribution

The projected EOC 10 voltage distribution was obtained by applying a Monte Carlo sampling process to the beginning-of-cycle (BOC) 10 voltage distribution, a voltage-growth distribution, and a non-destructive examination uncertainty distribution. The voltage growth distribution used in the calculations considered the growth rate for degradation in active and previously plugged tubes.

##### 3.2.2 Conditional Probability of Tube Burst During a Main Steam Line Break (MSLB)

The licensee projected the tube burst probabilities for EOC 10 in all four steam generators to be less than the  $1 \times 10^{-2}$  criteria established in GL 95-05.

##### 3.2.3 MSLB Leak Rate Projection

For the operational assessment, the licensee projected the EOC 10 MSLB leak rates to be 0.23, 0.13, 0.15, and 1.24 gpm for SGs A, B, C and D, respectively. The projected MSLB leak rates are below the accident-induced primary-to-secondary allowable leakage of 12.8 gpm. The predicted leakage shows that the leakage integrity of ODSCC indications will be maintained during the Cycle 10 operation.

### 3.3 W\* Inspections and Results

W\* was implemented for the first time during RFO9. During the inspection, the licensee inspected all tubes with bobbin probes from end to end, and 100 percent of the hot leg top of the tubesheet region by plus point probes. The licensee identified fifty-seven tubes as W\* tubes.

In order to validate the leak rate model in WCAP-14797, bases for the W\* amendment, three tubes with W\* indications were in-situ tested for leakage integrity. No leakage was detected from the test.

The licensee calculated W\* leak rate under postulated steam line break conditions in addition to the calculated leak rate from application of GL 95-05 ARC. The rate was well below the 12.8 gpm allowable limit. The licensee concluded that the performance criteria has been satisfied for condition monitoring at EOC 9 and operational assessment at EOC 10.

### 4.0 CONCLUSION

The licensee estimated the conditional tube burst probability at EOC 10 for ODSCC at the tube support plates to be approximately two orders of magnitude below the NRC reporting threshold. In addition, the estimates of the primary-to-secondary tube leak rate from W\* indications and GL 95-05 indications during a postulated MSLB were below the allowable leak rate. As a result of its assessment of the information provided, the staff concludes there is reasonable assurance of tube integrity for the next operating cycle from the applications of W\* and GL 95-05 alternate repair criteria.

Principal Contributor: Bart Fu

Date: June 24, 2002