

November 20, 2003

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  
Avila Beach, CA 93424

SUBJECT: REVIEW OF DIABLO CANYON NUCLEAR POWER PLANT, UNIT NO. 1 –  
2002 REFUELING OUTAGE 11 STEAM GENERATOR INSPECTION  
90-DAY REPORT (TAC NO. MB6799)

Dear Mr. Rueger:

By letter dated August 22, 2002, and supplemental letters dated May 19 and September 15, 2003, Pacific Gas and Electric Company submitted a report summarizing the steam generator tube inspections performed during the 2002 Diablo Canyon Power Plant Unit 1 eleventh refueling outage (1R11).

As discussed in the enclosed safety evaluation, the staff concludes that the licensee provided the information required by their technical specifications. In addition, the staff did not identify any technical issues that warranted follow-up action at this time.

Sincerely,

**/RA by Stephen Dembek for/**

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

Docket No. 50-275

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 1  
DOCKET NO. 50-275

1.0 INTRODUCTION

By letter dated August 22, 2002, and supplemental letters dated May 19 and September 15, 2003, Pacific Gas and Electric Company (PG&E or licensee) submitted a report summarizing the steam generator tube inspections performed during the 2002 Diablo Canyon Power Plant Unit 1 eleventh refueling outage (1R11).

2.0 STAFF EVALUATION

The scope and results of the licensee's inspections are contained in the documents referenced above. Based on a review of the above documents, the staff concludes that the licensee provided the information required by their technical specifications. In addition, the staff did not identify any technical issues that warranted follow-up action at this time; however, the staff did have the following observations regarding the licensee's inspection and assessments:

1. In question 1 of the staff's request for additional information (RAI) on the W\* alternate repair criteria (ARC), the staff questioned why an axial indication extending into the expansion transition was not postulated to develop during Cycle 12 such that it would be included in the end-of-cycle (EOC) 12 operational assessment. In response to this question, the licensee indicated, in part, that the W\* ARC does not apply to this flaw and indicated that a separate operational assessment could have been performed. The licensee then provided an assessment of whether a similar flaw would challenge the structural and leakage integrity performance criteria if it were found at the end of the following cycle (i.e., the licensee postulated that the size of any flaws found in the transition region during their next outage (scheduled for 2004) would be bounded by the size of this indication). It was concluded that none would be expected.

The purpose of the staff's question was not to assess whether the flaw should have been included in the operational assessment as part of the W\* ARC, but rather whether this indication (or others like it) were being accounted for in the operational assessment. That is, in assessing whether condition monitoring and operational assessment limits are met, all indications must be assessed regardless of whether they are treated as indications associated with an ARC or not. The licensee's analysis provided in support

of the RAI confirmed that no axial primary water stress corrosion cracking (PWSCC) indications in the transition region are expected that would challenge the tube integrity performance criteria.

2. In the staff's safety evaluation approving the W\* ARC, the staff acknowledged that the resistance to leakage increases as flaws are located further into the tubesheet. In addition, it recognized the total leakage rate from tubes repaired by W\* is primarily governed by those flaws that exist near the tubesheet secondary face. However, the safety evaluation also discussed some limitations in the leakage model. Nonetheless, the staff concluded the leakage model was acceptable for several cycles, in part, because the number of steam generator tubes affected by PWSCC should remain low for the period of time for which the ARC was approved. It may be desirable to use the W\* ARC for longer period of times (i.e., beyond which it is currently approved), however, it appears that a methodology for predicting the leakage from flaws below the W\* region should be developed to account for increases in the number of tubes with degradation and the extent of this degradation.

With respect to assessing the leakage from flaws below the W\* region, the staff notes that the plots provided in the supporting Westinghouse Topical Report, WCAP-14797, Revision 1, "Generic W\* Tube Plugging Criteria for 51 Series Steam Generator Tubesheet Region WEXTX Expansions," February 1997, depicting that the number of flaws decreases as the tube extends into the tubesheet (from the top of the secondary face of the tubesheet), were developed in 1997. During this time period, industry practice for inspecting the portion of the tube in the tubesheet region with qualified probes only included inspecting the top several inches of the tube (i.e., the inspections deep within the tubesheet were very limited). As a result, these plots may not provide an accurate depiction of the actual number of flaws occurring below the W\* distance. Many plants have now extended the inspection deeper into the tubesheet and additional data may be available to indicate the adequacy of the data provided in the WCAP. This should be considered in any model that assesses leakage from flaws below the W\* region.

3. The computer code for determining the burst pressure for PWSCC indications at tube support plate intersections only provides the actual burst pressure of the indication when it is estimated to be less than 6100 pounds per square inch (psi). When the burst pressure is estimated to be greater than 6100 psi, the computer code indicates the burst pressure is "greater than" 6100 psi. Assessing whether the burst pressure predictions are conservative, even when the burst pressures are high (e.g., above 6100 psi), may give timely notification that the methodology is not conservative or that additional data is needed to quantify the uncertainties in the various correlations (e.g., in the non-destructive examination uncertainty distributions used in the calculations).
4. A volumetric indication was detected below the top of the tubesheet during refueling outage 1R11. This indication was reported to initiate from the outside diameter of the tube. Assuming that the tube should have been fully expanded in this region, there should be no crevice for the concentration of chemical impurities and, therefore, no driving mechanism for degradation to initiate from the outside diameter of the tube. In the future, if additional outside diameter initiated volumetric indications are detected in

the fully expanded portion of the tube, the licensee may want to provide further assessments to determine the cause of such indications to confirm that the initiation and growth (and therefore the safety implications) of these types of indications are understood.

5. In response to an RAI, the licensee indicated that if they had confirmed volumetric degradation in the cold leg thinning region, then they would have depth sized the indication as cold leg thinning (and presumably left it in service if the depth was less than the plugging/repair limit). Assuming the potential for closely spaced axially oriented outside diameter stress corrosion cracking (ODSCC) indications to display a volumetric indication in the eddy current data, the basis for this practice was not evident to the staff. To support their dispositioning criteria for these volumetric indications, the licensee should consider providing a discussion (in the reports submitted in accordance with their technical specifications) of how they distinguish (from the eddy current data) the various mechanisms that could result in a volumetric indication at a tube support plate intersection.
6. The licensee indicated they use a plant-specific correlation to assign voltages to axial ODSCC indications detected by rotating probe, but not detected by bobbin. Many of these Axial ODSCC not detected by bobbin (AONDB) indications are located at dented tube support plate intersections. Assuming that the databases used to support the voltage-based ARC are industry-wide databases, it is not clear from the material provided by the licensee why a plant-specific correlation relating bobbin and rotating probe voltages is more appropriate than a correlation considering data from all of the plants (i.e., an industry-wide database). The staff notes that an industry-wide database correlating rotating probe and bobbin voltages may provide more confidence in assessing the voltages of AONDB indications. Nonetheless, the licensee provided an analysis of repeat AONDB indications, in part, to demonstrate the adequacy of their approach for addressing AONDB indications. This trending provides useful information in assessing the adequacy of this approach particularly given the effect a dent (at these AONDB locations) may have on the bobbin voltage.
7. The licensee indicated that they plug +Point confirmed axial ODSCC indications or AONDB indications at tube supports with "mix residuals" if the bobbin voltage of the flaw is greater than 1 volt based on a review of the 200 kHz bobbin coil data (or if the inferred bobbin voltage of the flaw is greater than 1 volt for AONDBs). They further indicated that only one indication has met this criteria and was plugged. The staff notes that Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," dated August 3, 1995, indicates that any indications (regardless of voltage) at "large mix residuals" should be plugged. If indications are found at intersections with "large mix residuals," the staff's expectation is that these indications are being plugged.

Principle Contributor: Ken Karwoski

Date: November 20, 2003