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SUBJECT: Provides response to NRC requests for addl info re GL 95-03, "Circumferential Cracking Of SG Tubes."

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October 2, 1995

PG&E Letter DCL-95-218

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Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Response to NRC Requests for Additional Information Related to Generic Letter 95-03, "Circumferential Cracking of Steam Generator Tubes"

Gentlemen:

NRC Letters dated August 31 and September 20, 1995, "Request for Additional Information - Generic Letter (GL) 95-03 - Diablo Canyon Nuclear Power Plant, Units 1 and 2," requested that PG&E respond within 30 days of receipt to the additional requests for information. PG&E's response to these NRC Letters is enclosed.

Sincerely,

Gregory M. Rueger

Subscribed and sworn to before me
this 2nd day of October 1995

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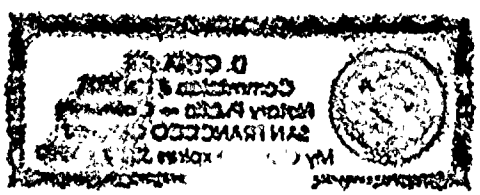

ENCLOSURE

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION RELATED TO GENERIC LETTER 95-03, "CIRCUMFERENTIAL CRACKING OF STEAM GENERATOR TUBES"

PG&E Letter DCL-95-137, dated June 29, 1995, responded to NRC Generic Letter (GL) 95-03. NRC Letter dated August 31, 1995, submitted four additional questions related to GL 95-03, and NRC Letter dated September 20, 1995 submitted one additional question. The NRC Letters requested that PG&E respond to the questions within 30 days of their receipt. The NRC questions and PG&E's responses are provided below.

1. ***"The following areas have been identified as being susceptible to circumferential cracking:***

   a. Expansion transition circumferential cracking
   b. Small-radius U-bend circumferential cracking
   c. Dented location (including dented tube support plate (TSP)) circumferential cracking
   d. Sleeve joint circumferential cracking

   In your response, area d was not specifically addressed. Please submit the information requested in GL 95-03 per the guidance contained in the GL for this area (and any other area susceptible to circumferential cracking). The staff realizes that some of the above areas may not have been addressed since they may not be applicable to your plant; however, the staff requests that you clarify this (e.g., no sleeves are installed; therefore, the plant is not susceptible to sleeve joint circumferential cracking)." (NRC Letter dated August 31, 1995)

PG&E Response

GL 95-03 requested a safety assessment based, in part, on an evaluation of recent operating experience. Sleeve joint circumferential cracking was not addressed in PG&E's safety assessment in response to GL 95-03 because sleeves have not been used to repair any steam generator (SG) tubes at Diablo Canyon.

While PG&E has not repaired any SG tubes using sleeves, 16 tubes in Diablo Canyon Unit 1 SG 1-1 contain "sleeve-like" inserts associated with 16 implant tubes that were installed during initial SG fabrication. The implant tubes were installed to field test advanced SG tubing materials, and Diablo Canyon Unit 1 is one of the few

Westinghouse Model 51 SG plants to have had these implants installed. To install the implant tubes, approximately 30 inches of tubing from the hot leg side of 16 SG tubes was removed, and the 30-inch implant tubes were installed and joined to the respective parent tubes by a 1-inch "sleeve-like" insert, which was then welded.

The inserts for implant tubes have not been identified to be susceptible to circumferential cracking. PG&E inspected the insert region of the implant tubes with rotating pancake coil (RPC) probes during the Unit 1 sixth refueling outage (1R6) and no indications in the insert regions were identified. To be consistent with EPRI "full-tube length" inspection recommendations, PG&E intends to inspect the insert regions of the implant tubes using RPC probes at least once every 5 fuel cycles.

2. ***"In your response it was indicated that the use of c-scan plots for analysis of rotating pancake coil (RPC) data was proceduralized as a result of recent industry experience. Were RPC c-scans analyzed during the past steam generator tube inspections? If not, were the data reanalyzed to ensure that indications were not missed?" (NRC Letter dated August 31, 1995)***

PG&E Response

In previous outages, use of C-scan plotting was not specifically required by PG&E's Data Analysis Guidelines. C-scan plotting, however, was considered a good practice by PG&E. Further, the data analysts were specifically trained regarding the use and benefits of C-scan plotting. Also, the Data Analysis Guidelines included C-scan examples. Lastly, use of C-scans by the analysts is much easier and faster than scrolling through the strip chart. Based on the foregoing, PG&E is confident that most analysts routinely used C-scans when analyzing the RPC data. Accordingly, PG&E does not believe that reanalysis of the RPC data using C-scan plotting is necessary to verify whether or not indications were missed. As noted in PG&E Letter DCL-95-137, as a result of recent industry experience, C-scan plotting will be required in the Data Analysis Guidelines that will be used for SG tube inspections beginning with the Unit 1 seventh refueling outage (1R7), which began September 30, 1995.

3. ***"In your response to Generic Letter GL 95-03, you indicated that dents greater than 5.0 volts had been and would be inspected with a technique capable of detecting circumferential cracking. Provide a detailed description of the procedure used for sizing the dents (i.e., 4.0 volts on 4 20-percent through-wall ASME holes at 550/130 mix). If the procedure is identical to the procedure for the voltage-based repair criteria, a detailed description is not necessary.***

   It was indicated that the sample plan for dents may be limited to the lowest TSP. Clarify if the 20 percent sample will be determined from the number of dents greater than 5.0 volts at all TSPs or from the number of dents greater than 5.0 volts at the lowest hot-leg TSPs. A large dent at an upper TSP may

be more significant in terms of corrosion susceptibility as a result of higher stresses than a small dent at a lower TSP even though the temperature is lower at the upper TSP. Given this, discuss the basis for the proposed sample strategy given that cracking depends on many factors including temperature and stress levels." (NRC Letter dated August 31, 1995)

PG&E Response

Dent Sizing

The PG&E procedure currently used for sizing dents in Units 1 and 2 is consistent with the methodology used for voltage-based repair criteria by plants using alternate tube plugging criteria. Starting in the Unit 2 sixth refueling outage (2R6), PG&E used actual volts that were calibrated to the EPRI lab standard (e.g., 2.75 volts) on four 20-percent through-wall ASME holes at 400/100 kHz mix. (Prior to 2R6, PG&E used 4 volts on four 20 percent through-wall ASME holes at 400 kHz.) To identify the dents that are greater than or equal to 5 volts, the Unit 1 1R6 data were reanalyzed manually using this new volt scale, while the Unit 2 data were reanalyzed using auto analysis methods.

Basis for Dent Inspection Sampling

For the upcoming Units 1 and 2 seventh refueling outages (1R7 and 2R7), PG&E's inspection criteria for dented tube support plate (TSP) intersections are as follows:

- Inspect at least 20 percent of all hot leg dents in each SG (dent signal amplitude greater than or equal to 5 volts).
- Focus the inspections on those dents located at the lower hot leg TSPs.

Specifically, during the upcoming 1R7 outage, PG&E will inspect 100 percent of the dents (dent signal amplitude greater than or equal to 5 volts) at the 1st, 2nd, and 3rd hot leg TSPs (i.e., 1H, 2H, and 3H) in each SG. If necessary, additional dents may be inspected above 3H to ensure that at least 20 percent of the total hot leg dented TSP intersections in each SG are inspected.

PG&E plans to focus its dented TSP inspection plan on the lower hot leg TSPs because, for the Diablo Canyon Power Plant (DCPP) Units 1 and 2 SGs, we have concluded that temperature is a greater contributor to dented TSP cracking than high stress level. Our conclusions are based on the scope and results of past inspections.

Scope of Past Inspections

Unit 1: In 1R6, PG&E inspected 20 percent of the hot leg dented TSP intersections in the Unit 1 SGs using RPC probes. PG&E's dent selection criteria included the following:

- Dents were selected for inspection from 1H (higher temperature) through 7H (lower temperature) to provide a representative distribution of dents.

- Dents with higher voltages (i.e., larger dents with potentially higher stress levels) were selected for inspection over those with lower voltages.

Unit 2: In 2R5, PG&E inspected 100 percent of the hot leg dented TSP intersections up to 6H in the Unit 2 SGs. In 2R6, PG&E inspected 100 percent of all the hot leg dents (i.e., up to 7H) in the Unit 2 SGs.

Results of Past Inspections

The results of these inspections for both units show that no circumferential indications at hot leg dented TSPs were found. Of the 42 axial indications found, 40 indications were at either 1H or 2H; 1 indication was at 3H and 1 indication was at 4H. As such, PG&E believes that temperature is the dominant contributor to dented TSP cracking.

4. ***"During the last Unit 2 steam generator tube inspection outage, a circumferential indication was detected at the expansion transition region in one tube. Provide the expansion criteria used for the WEXTEX region during the previous steam generator tube inspections at Unit 2, and provide the expansion criteria to be used during the upcoming Unit 1 and 2 outages." (NRC Letter dated August 31, 1995)***

PG&E Response

The expansion criteria used for the previous WEXTEX region tube inspections are defined in the WOG/WEXTEX expansion guidelines. These expansion guidelines will continue to be used during the upcoming 1R7 and 2R7 outages. The WOG/WEXTEX expansion criteria are only applicable to (a) circumferential indications found in the WEXTEX transition region and (b) axial indications found in the WEXTEX transition region that exceed their structural limit. (Note: The WEXTEX transition region is defined as the area from the bottom of the WEXTEX transition (BWT) to 0.5 inches above the BWT. The BWT is the first point of contact between the tube and the tubesheet.) The DCPP Technical Specifications govern all other types of expansions.

The WOG/WEXTEX expansion criteria are based on the number of indications found in the WEXTEX transition region and their extent. The expansion criteria are:

- An 8 percent increase in the sample size in the affected SG for the first indication identified, and then a step increase in the sample size of at least 10 percent in the affected SG for each subsequent circumferential indication found; and,

- An increase to 100 percent (in the affected SG) if (a) more than seven circumferential indications are found as summed over all inspected tubes in the initial or expanded sample, or (b) any circumferential or axial indication exceeds its structural limit.

As noted in DCL-95-137, one circumferential indication was identified in the WEXTEX transition region in each of the last Unit 2 refueling outages (2R5 and 2R6). As described below, the expansions that were performed met the WOG/WEXTEX expansion criteria.

2R5 WEXTEX Inspection

In 2R5, over 50 percent of the tubes in the WEXTEX Zone 4 region were initially inspected with RPC probes to identify defects in the WEXTEX transition region. During the initial WEXTEX Zone 4 RPC inspection, the following indications were reported:

- Axial indications were reported in each SG below the BWT. The axial indications did not exceed their structural limit. As a result, the expansion requirements were governed by the DCPP Technical Specifications, which require that 204 additional tubes (selected randomly across WEXTEX Zones 1, 2, 3, and 4) be inspected in each SG. Additional axial indications were reported in each SG in this expansion, prompting an additional expansion of 408 tubes (selected randomly across WEXTEX Zones 1, 2, 3, and 4) in each SG to be consistent with DCPP Technical Specification requirements. Following this second expansion, no further expansions were required. Therefore, a total of 612 tubes in WEXTEX Zones 1, 2, 3, and 4 were inspected as part of the expansion program.

- In SG 2-2, a circumferential indication was identified in the WEXTEX transition region in Tube R12C46. The indication had a small arc length of 44 degrees, well within its structural limit. Since it was a circumferential indication, the expansion requirements were governed by the WOG/WEXTEX expansion criteria, which require that 274 additional tubes in Zone 4 be randomly inspected. These 274 tubes in Zone 4 were inspected as part of the 612 tube inspection described above.

PG&E performed pressure pulse cleaning (PPC) in 2R5 and, as a result, Westinghouse recommended that RPC inspection be performed on 10 additional tubes in the WEXTEX region around the periphery of the PPC nozzle to ensure that any PPC-propagated cracks would be detected. These 10 additional tubes constitute WEXTEX Zone 5. This inspection scope was in addition to that required by the WOG/WEXTEX guidelines and the DCPP Technical Specifications. All tubes in WEXTEX Zone 5 in each SG were inspected and no circumferential cracking was identified. Westinghouse further recommended an inspection of 30 additional tubes surrounding the tubes in Zone 5 if a circumferential indication was identified anywhere in the WEXTEX transition region. These 30 tubes constitute WEXTEX Zone 6. However, following confirmation and characterization of the circumferential indication in SG 2-2 Tube R12C46,

discussions were held with Westinghouse and it was decided that no expansion into SG 2-2 WEXTEX Zone 6 was necessary because of the small arc length of the indication.

2R6 WEXTEX Inspection

The 2R6 initial WEXTEX inspection was identical to 2R5; i.e., over 50 percent of the tubes in WEXTEX Zone 4 were initially inspected with RPC probes to identify defects in the WEXTEX transition region. During the initial WEXTEX Zone 4 RPC inspection, the following indications were reported:

- Axial indications were reported in SG 2-4 below the BWT. The axial indications did not exceed their structural limit. As a result, the expansion requirements were governed by the DCPP Technical Specifications, which require that 204 additional tubes (selected randomly across WEXTEX Zones 1, 2, 3, and 4) be inspected in SG 2-4. As part of this 204 tube expansion, 87 tubes in Zone 4 were inspected. No further indications were reported. Therefore, no further expansions were required.

- In SG 2-4, a circumferential indication was identified in the WEXTEX transition region in Tube R17C44. The indication had an arc length of 100 degrees, well within its structural limit. Since it was a circumferential indication, the expansion requirements were governed by the WOG/WEXTEX expansion criteria, which require that 274 additional tubes in Zone 4 be randomly inspected. To meet this WOG/WEXTEX requirement, 187 additional tubes in Zone 4 were inspected. Credit was taken for the 87 tubes inspected in Zone 4 (see previous bullet), yielding a total Zone 4 inspection of 274 tubes.

5. ***"During the Maine Yankee outage in July/August 1994, several weaknesses were identified in their eddy current program as detailed in NRC Information Notice (IN) 94-88, "Inservice Inspection Deficiencies Result in Severely Degraded Steam Generator Tubes." In IN 94-88, the staff observed that several circumferential indications could be traced back to earlier inspections when the data was reanalyzed using terrain plots. These terrain plots had not been generated as part of the original field analysis for these tubes. For the rotating pancake coil (RPC) examinations performed at your plant at locations susceptible to circumferential cracking during the previous inspection (i.e., previous inspection per your Generic Letter 95-03 response), discuss the extent to which terrain plots were used to analyze the eddy current data. If terrain plots were not routinely used at locations susceptible to circumferential cracking, discuss whether or not the RPC eddy current data has been reanalyzed using terrain mapping of the data. If terrain plots were not routinely used during the outage and your data has not been reanalyzed with terrain***

mapping of the data, discuss your basis for not reanalyzing your previous RPC data in light of the findings at Maine Yankee.

Discuss whether terrain plots will be used to analyze the RPC eddy current data at locations susceptible to circumferential cracking during your next steam generator tube inspection (i.e., the next inspection per your Generic Letter 95-03 response)." (NRC Letter dated September 20, 1995)

PG&E Response

The term "terrain plot" is synonymous in industry with the term "C-scan plot." As discussed above in response to Question 2, PG&E has routinely used C-scan plots in past outages as a good practice and has proceduralized their use for future SG tube inspections in response to industry events such as that noted in IN 94-88.