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Richard J. St. Onge
Director, Nuclear Regulatory Affairs and Emergency Planning

Proprietary Information
Withhold from Public Disclosure

February 6, 2013 10 CFR 50.4

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: **Docket No. 50-361**
Response to Request for Additional Information (RAIs 20, 21, 22, 23, 24, 26 & 31)
Regarding Confirmatory Action Letter Response
(TAC No. ME 9727)
San Onofre Nuclear Generating Station, Unit 2

References:
1. Letter from Mr. Elmo E. Collins (USNRC) to Mr. Peter T. Dietrich (SCE), dated March 27, 2012, Confirmatory Action Letter 4-12-001, San Onofre Nuclear Generating Station, Units 2 and 3, Commitments to Address Steam Generator Tube Degradation

2. Letter from Mr. Peter T. Dietrich (SCE) to Mr. Elmo E. Collins (USNRC), dated October 3, 2012, Confirmatory Action Letter – Actions to Address Steam Generator Tube Degradation, San Onofre Nuclear Generating Station, Unit 2

3. Letter from Mr. James R. Hall (USNRC) to Mr. Peter T. Dietrich (SCE), dated December 26, 2012, Request for Additional Information Regarding Response to Confirmatory Action Letter, San Onofre Nuclear Generating Station, Unit 2

Dear Sir or Madam,

On March 27, 2012, the Nuclear Regulatory Commission (NRC) issued a Confirmatory Action Letter (CAL) (Reference 1) to Southern California Edison (SCE) describing actions that the NRC and SCE agreed would be completed to address issues identified in the steam generator tubes of San Onofre Nuclear Generating Station (SONGS) Units 2 and 3. In a letter to the NRC dated October 3, 2012 (Reference 2), SCE reported completion of the Unit 2 CAL actions and included a Return to Service Report (RTSR) that provided details of their completion.

By letter dated December 26, 2012 (Reference 3), the NRC issued Requests for Additional Information (RAIs) regarding the CAL response. Enclosure 2 of this letter provides the response to RAIs 20, 21, 22, 23, 24, 26 and 31.

Enclosure 2 of this submittal contains proprietary information. SCE requests that this proprietary enclosure be withheld from public disclosure in accordance with 10 CFR 2.390(a)(4). Enclosure 1 provides a notarized affidavit from AREVA NP Inc., which sets forth the basis on

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which the information in Enclosure 2 may be withheld from public disclosure by the NRC and addresses with specificity the considerations listed by paragraph (b)(4) of 10 CFR 2.390. Proprietary information identified in Enclosure 2 was extracted from AREVA document 51-9197672, SONGS Probability of FEI Operational Assessment RAI Responses, which is addressed in the affidavit. Enclosure 3 provides the non-proprietary version of Enclosure 2.

There are no new regulatory commitments contained in this letter. If you have any questions or require additional information, please call me at (949) 368-6240.

Sincerely,

for

Enclosures:

1. Notarized Affidavit
2. Response to RAI 20, 21, 22, 23, 24, 26 and 31 (Proprietary)
3. Response to RAI 20, 21, 22, 23, 24, 26 and 31 (Non-Proprietary)

cc: E. E. Collins, Regional Administrator, NRC Region IV
J. R. Hall, NRC Project Manager, SONGS Units 2 and 3
G. G. Warnick, NRC Senior Resident Inspector, SONGS Units 2 and 3
R. E. Lantz, Branch Chief, Division of Reactor Projects, NRC Region IV

ENCLOSURE 1

Notarized Affidavits

AFFIDAVIT

COMMONWEALTH OF VIRGINIA)
) ss.
CITY OF LYNCHBURG)

1. My name is Gayle F. Elliott. I am Manager, Product Licensing, for AREVA NP Inc. (AREVA NP) and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by AREVA NP to determine whether certain AREVA NP information is proprietary. I am familiar with the policies established by AREVA NP to ensure the proper application of these criteria.

3. I am familiar with the AREVA NP information contained in Engineering Information Record 51-9197672-000 entitled, "SONGS Unit 2 Probability of FEI Operational Assessment RAI Responses," dated January 2013 and referred to herein as "Document." Information contained in this Document has been classified by AREVA NP as proprietary in accordance with the policies established by AREVA NP for the control and protection of proprietary and confidential information. The proprietary information is identified by its enclosure within pairs of brackets ("[ ]").

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by AREVA NP and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document be withheld from public disclosure. The request for withholding of proprietary information is made in

accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information":

6. The following criteria are customarily applied by AREVA NP to determine whether information should be classified as proprietary:

(a) The information reveals details of AREVA NP's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for AREVA NP.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for AREVA NP in product optimization or marketability.

(e) The information is vital to a competitive advantage held by AREVA NP, would be helpful to competitors to AREVA NP, and would likely cause substantial harm to the competitive position of AREVA NP.

(f) The document contains identification information, the disclosure of which could reasonably be expected to constitute an unwarranted invasion of personal privacy.

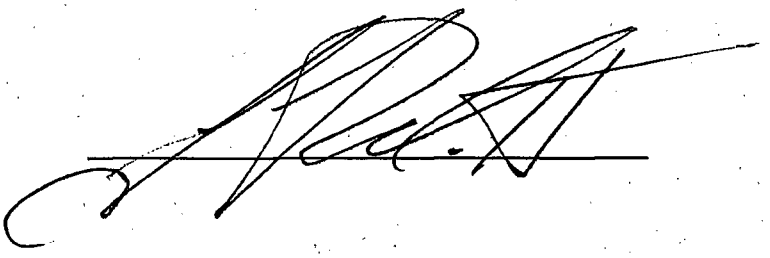
The information in the Document is considered proprietary for the reasons set forth in paragraphs 6(f).

7. In accordance with AREVA NP's policies governing the protection and control of information, proprietary information contained in this Document have been made available,

on a limited basis, to others outside AREVA NP only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. AREVA NP policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.



SUBSCRIBED before me this 1st
day of February 2013.

Sherry L. McFaden
NOTARY PUBLIC, COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES: 10/31/14
Reg. # 7079129

SHERRY L. MCFADEN
Notary Public
Commonwealth of Virginia
7079129
My Commission Expires Oct 31, 2014

ENCLOSURE 3

SOUTHERN CALIFORNIA EDISON

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

REGARDING RESPONSE TO CONFIRMATORY ACTION LETTER

DOCKET NO. 50-361

TAC NO. ME 9727

Response to RAIs 20, 21, 22, 23, 24, 26 and 31

(NON-PROPRIETARY)

RAI 20

Reference 3, page 17 of 129, refers to tube-to-support design clearance of 2 mils diametral. Confirm that this is the nominal diametral clearance under ambient conditions, or clarify the statement otherwise.

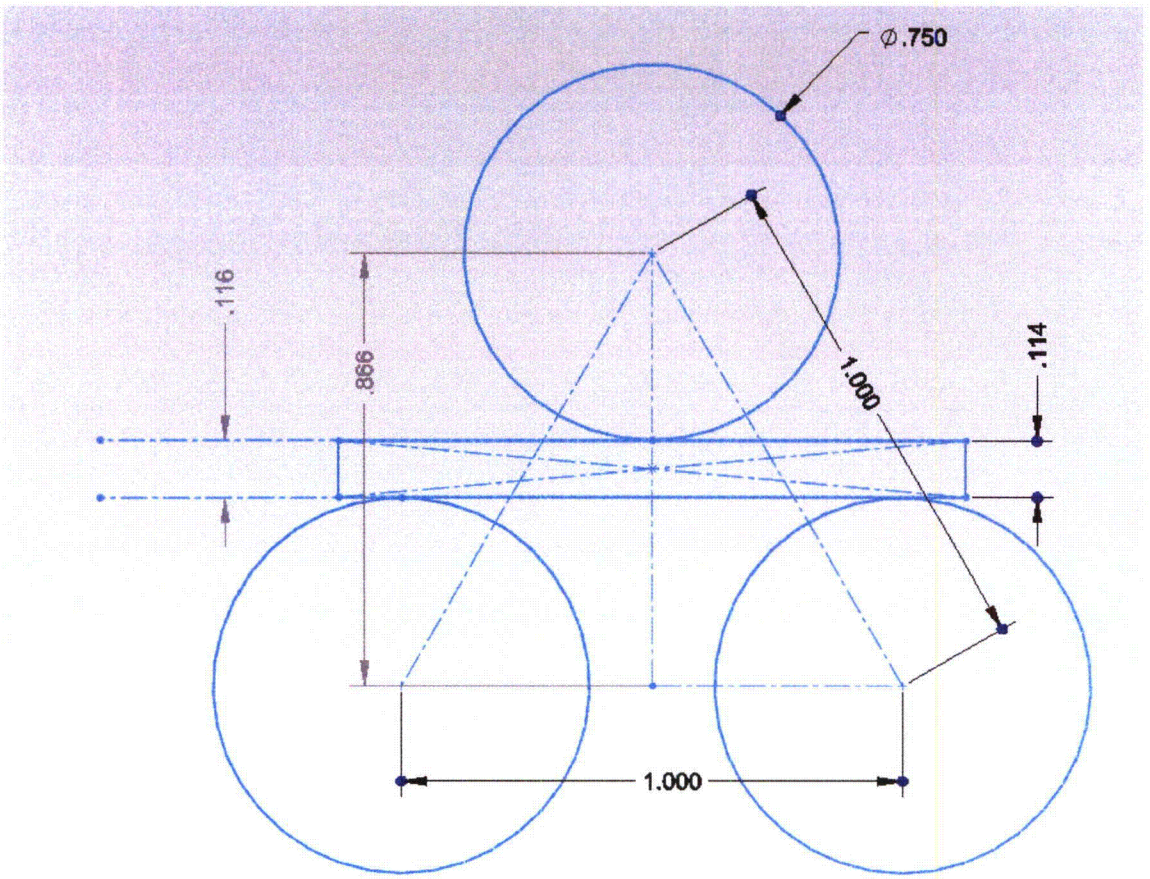
RESPONSE

Note: Request for Additional Information (RAI) Reference 3 is "SONGS U2C17 Steam Generator Operational Assessment for Tube-to-Tube Wear," prepared by Areva NP Inc. Document No. 51-9187230-000 (NP), Revision 0, October 2012.

The nominal design values for dimensions needed to determine the tube to anti vibration bar (AVB) clearance are summarized below.

Tube outside diameter = 0.750 in.
AVB thickness = 0.114 in.
Tube-to-tube spacing = 1.000 in.

As shown in the figure below, the nominal clearance between the adjacent tube columns is 0.116 in. Therefore, the nominal tube to AVB clearance is 1 mil. The total clearance is twice this value or 2 mils. This is the nominal design clearance at ambient conditions.



Nominal AVB Clearance

RAI 21

Reference 3, page 44 of 129, states that the plugged tubes have an effect on local thermal/hydraulic conditions upon returning to power and have been included in the stability ratio calculations. The staff interprets this to mean the effect of the plugged tubes on the calculated thermal/hydraulic conditions were considered in the stability ratio calculations and that the stability ratio calculations included the plugged (and stabilized) tubes. Is this correct? Clarify, if not.

RESPONSE

The RAI Reference 3 is the AREVA SONGS U2C17 Steam Generator Operational Assessment (OA) for Tube-to-Tube Wear. As indicated above, the OA states that the plugged tubes have an effect on local thermal-hydraulic conditions upon returning to power and have been included in the stability ratio calculations.

The AREVA OA considered the effect of the plugged and stabilized tubes on the calculated thermal/hydraulic conditions. In addition, the stability ratio calculations included the plugged tubes with J-type stabilizers installed.

RAI 22

Reference 3, page 57 of 129, first full paragraph beginning with the words "Figure 6-1"The third sentence states, " ... it is not practical to use an individual run of the quarter model as a single Monte Carlo trial for contact forces." However, the staff was unable to ascertain from the subsequent discussion exactly what was done as an alternative? Nor was the staff able to discern this from Reference 6, Appendix 9. Provide or cite by reference a more complete description of how the cumulative distributions of contact forces were determined. For example, what is a "run?" What does it mean to "combine runs?" How were zones employed in order to provide a more practical approach? Are all tubes in a given zone assumed to have the same initial clearances, final clearances, and contact forces? Do all AVB #5 in a zone have the same cumulative distribution of contact forces? Is a Monte Carlo performed for each zone?

RESPONSE

Summary of Response

This introduction provides a roadmap to finding answers to specific RAI 22 questions and requests. These answers are embedded in the section labeled Response.

Request: Provide or cite by reference a more complete description of how the cumulative distributions of contact forces were determined.

Answer: Provided by the Response section below.

Question: What is a "run"?

Answer: Provided in paragraph 3 of the Response section.

Question: What does it mean to "combine runs"?

Answer: Provided in paragraph 6 of the Response section.

Question: How were zones employed in order to provide a more practical approach?

Answer: Provided by paragraphs 4, 5 and 6 of the Response section.

Question: Are all tubes in a given zone assumed to have the same initial clearances, final clearances, and contact forces?

Answer: Provided by paragraphs 4, 6 and 7 of the Response section.

Question: Do all AVB #5 in a zone have the same cumulative distribution of contact forces?

Answer: Provided in paragraph 7 of the Response section.

Question: Is a Monte Carlo performed for each zone?

Answer: Provided by paragraphs 4, 5 and 6 of the Response section.

Response

1. Gaps and contact forces between tubes and AVBs were calculated using the ABAQUS finite element analysis (FEA) program. Tubes, AVBs and support structures were explicitly modeled. From symmetry considerations only one quarter of the bundle was modeled.

2. The input to the model consists of different initial gap sizes for 48,730 gap elements in the quarter model. Each gap input is a random selection from a gap distribution. This gap distribution is based on variations in the following factors: tube diameter, AVB thickness, top tube support plate (TSP) hole mislocation, AVB twist, AVB flatness and tube flatness.

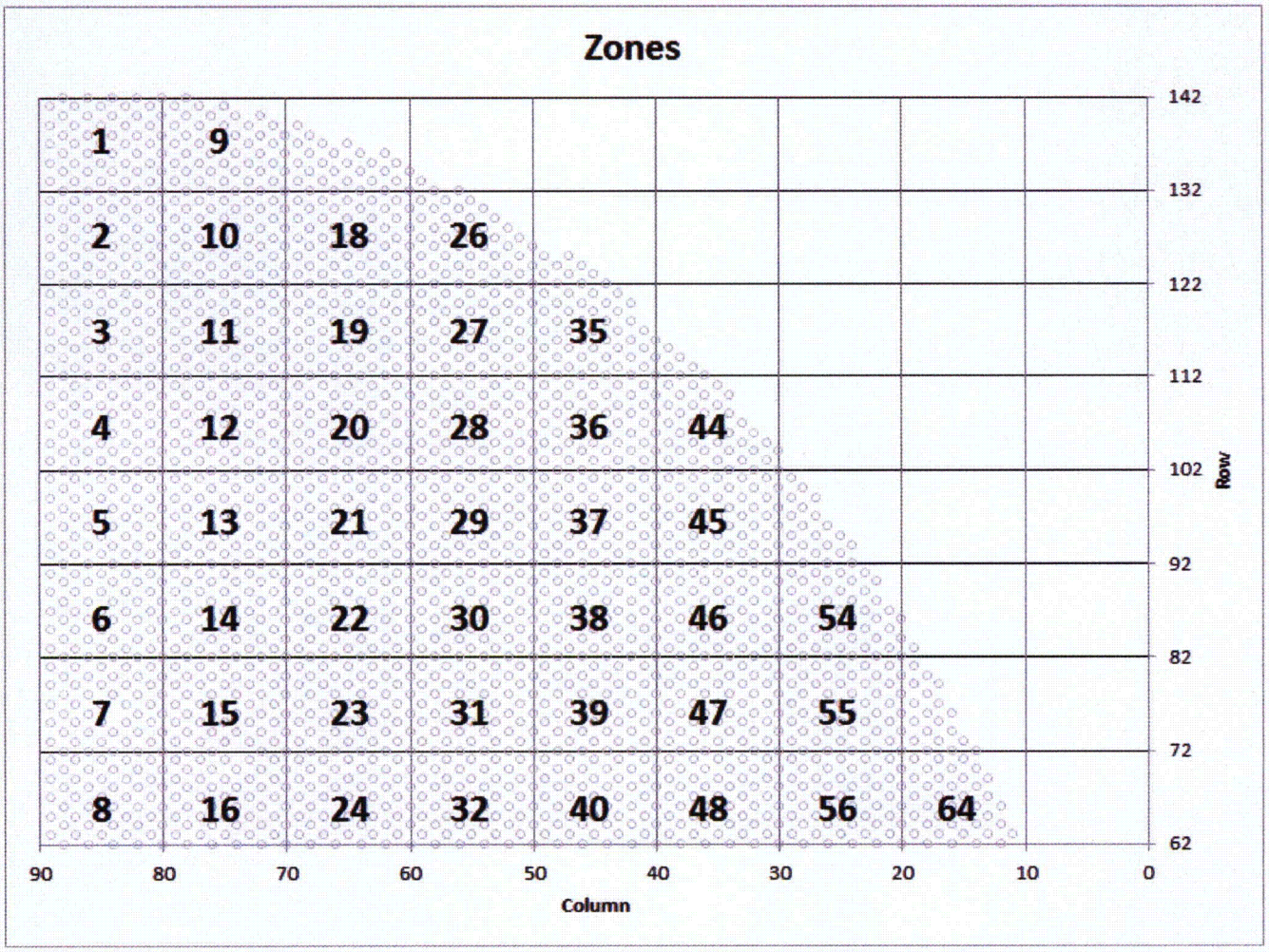
3. The finite element program redistributes the gaps as the tubes, AVBs and support structures interact and attain a state of static equilibrium. This large, highly nonlinear FEA problem requires 6 to 8 hours of computer processing time. The resulting output is the gaps and contact forces for each tube with its neighboring AVBs. This resulting solution for a given selection of input gaps is termed one run. Other runs are simply solutions to different random selections of input gaps. The OA was prepared using the results from four runs.

4. For each AVB to tube location in the bundle the gap/contact force changes from one run to the next. In a typical Monte Carlo simulation the cumulative distributions of gap/contact forces for each AVB to tube location in the bundle could be obtained from thousands or perhaps hundreds of computer runs. This is impractical given the computing time requirements. Instead the gaps and contact forces for a given AVB in a small region of the bundle are considered to be from characteristic distributions that define the small local region which is approximately 10 inches by 10 inches by 10 inches in size.

5. These small local regions are called zones. The zones are typically 10 rows by 10 columns in extent as shown in RAI Reference 3, Figure 6-2 (reproduced below). Because of the triangular pitch any given column contains only even numbered or odd numbered rows. Thus the typical zone contains 50 tubes. In the periphery, some zones have slightly smaller or slightly larger numbers of tubes as shown on the figure. All tubes in a given zone do not have the same initial clearances.

6. Combining runs is just adding the results of four computer runs which leads to 200 different contact forces (and gaps) for a given AVB in a given zone. This provides the characteristic cumulative distribution of contact forces for a given AVB in a given zone. In probabilistic calculations of support effectiveness the contact force (or gap size if desired) for a particular tube to AVB intersection is a random selection from the characteristic cumulative distribution of that AVB in the zone of interest.

7. Cumulative distributions vary from one AVB to another within a given zone. These distributions also vary from one zone to another. Section 6 of RAI Reference 3 provides 16 example plots of cumulative distributions of contact forces for various zones and discusses the systematic variations in cumulative distributions as affected by different locations in the bundle and wear of both tubes and AVBs themselves. As discussed in RAI Reference 3, the effect of wear at AVB locations on contact force distributions is dramatically different between Unit 2 and Unit 3.



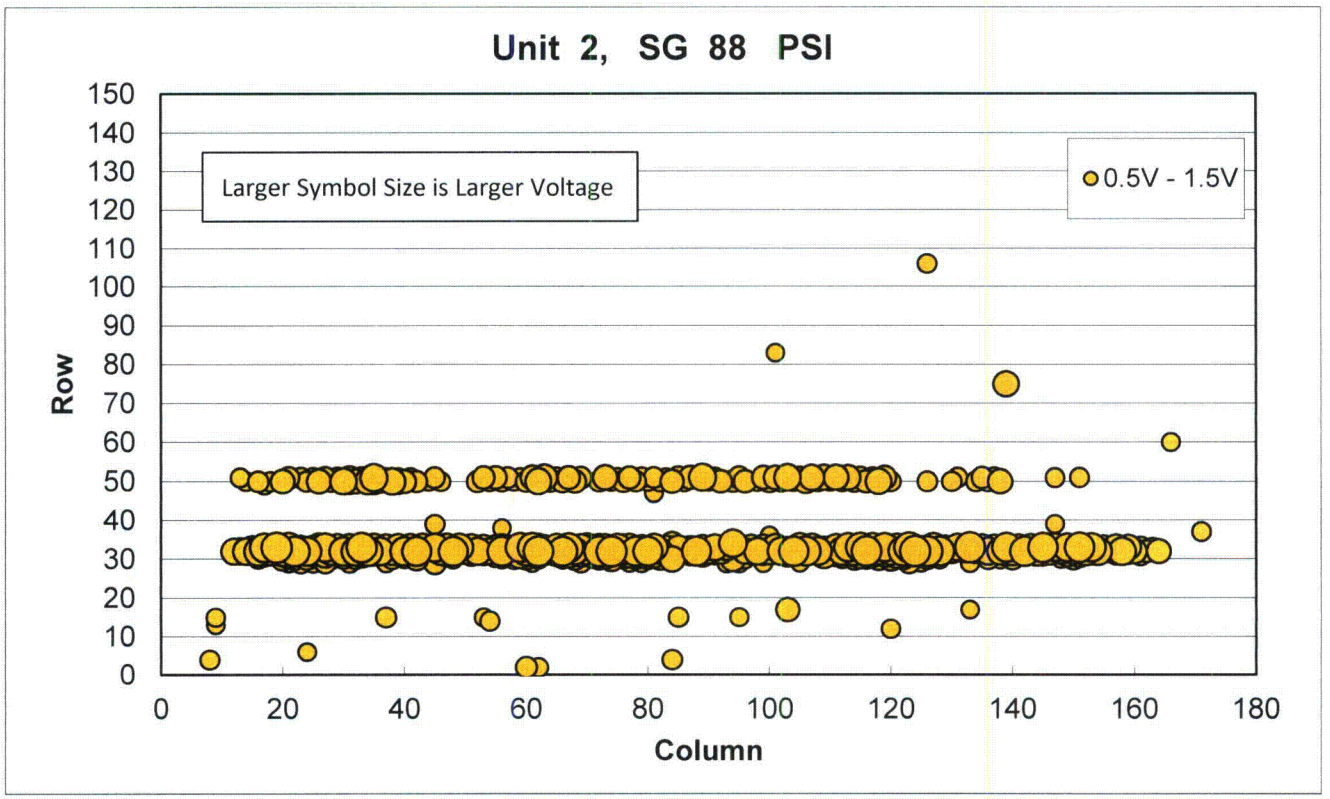
Reference 3, Figure 6-2: Zones Used to Develop Characteristic Distributions of Contact Forces for Each AVB in the Zone

RAI 23

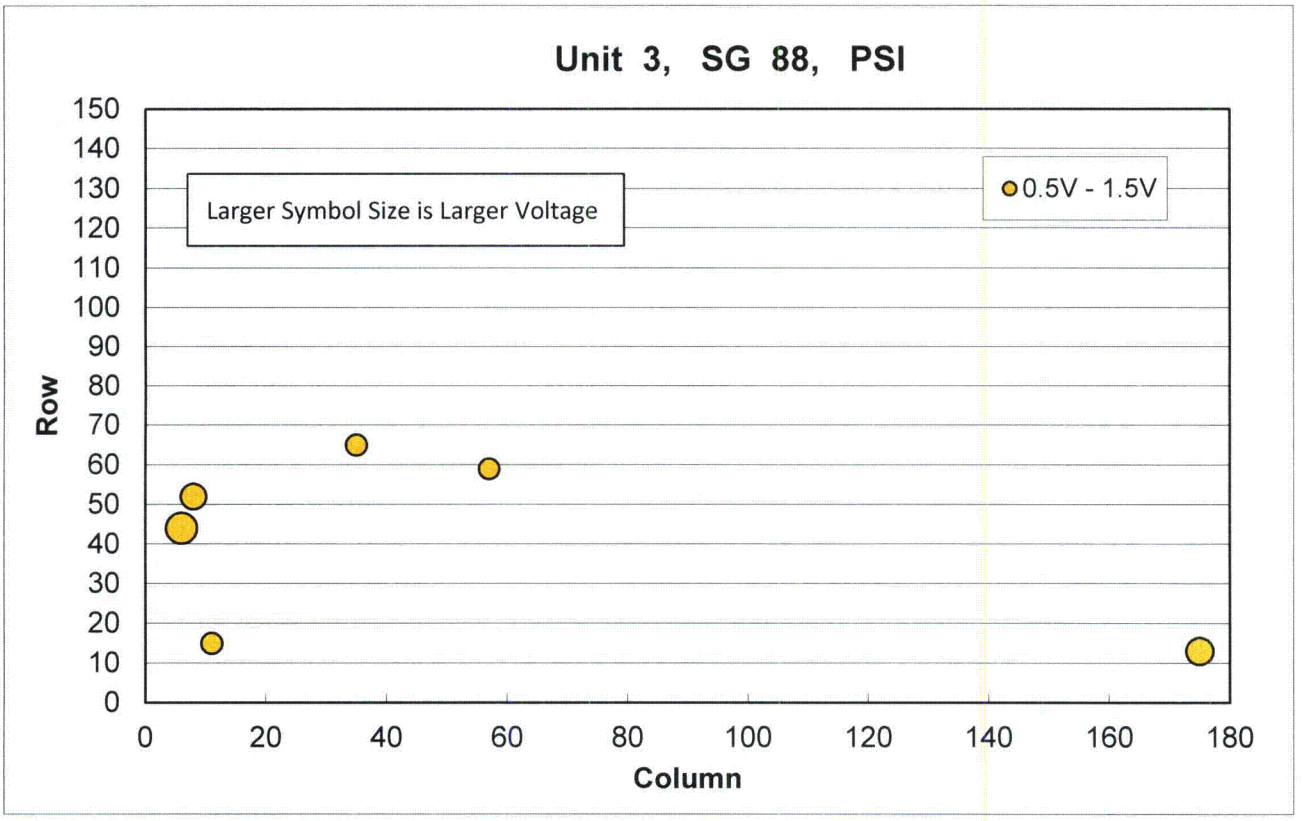
Reference 3 - Provide figures similar to Figures 6-19 and 6-20 for Unit 3, SG E-088, and Unit 2, SG E-088.

RESPONSE

The requested plots are attached for steam generator (SG) 2E-088 and SG 3E-088. The 4 plots (Figures 6-19, 6-20 and the two below) were prepared by Mitsubishi Heavy Industries, LTD (MHI) based on pre-service inspection (PSI) data.



Tubesheet Map of Dents Found in Pre-Service Inspection, SG 2E-088



Tubesheet Map of Dents Found in Pre-Service Inspection, SG 3E-088

RAI 24

Reference 3, page 59 of 129, last paragraph -The sentence, "AVBs 2, 3, 11 and 10 near row 27 have sporadic dents in the vicinity of the noses of AVBs 1. 4. 9 and 12" does not appear to make sense. Provide further clarification relative to the discussion of Figure 6-20.

RESPONSE

The referenced sentence should read as follows:

> "In stark contrast, Figure 6-20 shows that there are very many locations of 0.5 volts dents and high loads in SG 2E-089. These dents occur primarily at the noses of anti vibration bar (AVB) pairs 6 and 7 near Row 48 and at the noses of AVB pairs 2, 3, 10 and 11 near Row 27. Occasional denting is noted near the noses of AVB pairs 5 and 8 near Row 17. There are sporadic dents at the noses of AVB pairs 1, 4, 9 and 12 in low rows."

Note that the patterns and magnitudes of denting will be discussed further in the response to RAI 25 requesting evidence supporting the contention that: "Patterns of dents and high contact forces are in good agreement with the final quarter model calculations."

RAI 26

Reference 3, page 107 of 129, second to last paragraph -Provide additional details of the wear growth model at the tube supports. Were cumulative probability functions of observed wear rates constructed and randomly sampled when developing the contact force probability distributions at each intersection? Was total gap at each intersection (prior to applying temperature and allowing the model to settle, leading to the development of contact forces) assumed to be the sum of the manufacturing gap and the maximum wear depth?

RESPONSE

Summary of Response

Direct answers to the two questions from RAI 26 are provided first followed by additional details of the incorporation of wear induced gaps at tube support locations.

Question

Were cumulative probability functions of observed wear rates constructed and randomly sampled when developing the contact force probability distributions at each intersection?

Answer

No. The gaps from maximum wear depths were taken from the worst case steam generators for Unit 2 and Unit 3 respectively and added to the sum of the manufacturing gap. Wear induced gaps were placed at the same locations as found in eddy current inspections.

Question

Was the total gap at each intersection (prior to applying temperature and allowing the model to settle, leading to the development of contact forces) assumed to be the sum of the manufacturing gap and the maximum wear depth?

Answer

Yes.

Response

Wear at tube to AVB intersections was included in the MHI calculations of gaps and contact forces. Both wear of the tube and wear of the AVB were included. Based on MHI wear test data the wear volume of the AVB is [ ] of the corresponding wear volume of the tube. Increased gaps due to wear were added to the ABAQUS quarter model input in addition to the random selection of gaps from the manufacturing gap distributions.

The sizes of wear induced gaps were based on eddy current inspection data for the worst case steam generators, SG 2E-089 and SG 3E-089. The wear gaps were placed at the same locations as found in the eddy current inspection.

The wear level at any given location was adjusted for different time periods using the assumption that the work rate at that location was constant over time. Thus the wear volume loss rate is constant over time at a given location. The wear volume loss rate at different locations is calculated from the eddy current inspection wear depth and the total operating time at the end of the operating cycle. Results from multiple inspections of other wear challenged replacement steam generators show this assumption to be conservative.

For Unit 2 the wear volume loss rates after restart at 70% power are conservatively assumed to be the same wear rate as observed at 100% power operation in SG 2E-089.

RAI 31

In References 7 and 8 (specifically, in Section 7.2 of Reference 7 and in Section 8.0 of Reference 8), AREVA used Revision 3 of the Electric Power Research Institute "Steam Generator Management Program: Steam Generator Integrity Assessment Guidelines," in part, to assess the most limiting structural integrity performance criteria (e.g., the more limiting structural limit determined from (a) the three times the normal operating differential pressure criterion or (b) the safety factor of 1.2 on combined primary loads and 1.0 on axial secondary load criterion). In some cases, it appears that the limits in the Integrity Assessment Guidelines may have been based on specific tests and plant data. Please discuss whether you have confirmed the applicability of the limits in the Integrity Assessment Guidelines (in particular, those related to when non-pressure loads need to be considered) to the SONGS replacement steam generators.

RESPONSE

Note: RAI Reference 7 is "SONGS 2C17 Steam Generator Condition Monitoring Report," prepared by AREVA NP Inc. Document No. 51-9182368-003 (NP), and RAI Reference 8 is "SONGS Unit 3 February 2012 Leaker Outage – Steam Generator Condition Monitoring Report," prepared by AREVA NP Inc. Document No. 61-9180143-001 (NP).

The following are the results of an independent QA review of the limiting structural integrity performance criteria (SIPC) of the replacement steam generators. The results of Electric Power Research Institute (EPRI) sponsored test programs and resulting formulas for the evaluation of the effects of contributing loads on the burst pressure of degraded tubing were confirmed as being applicable to the replacement steam generators. A quantitative analysis was performed which is more rigorous than application of general guidance observations that can be found in EPRI documents.

The SIPC was evaluated considering pressure, bending and axial force loading with the appropriate safety factors. A bounding type of analysis was performed. The bounding assumptions were:

1. both in plane and out of plane bending moments for accident loads were considered as primary loads
2. largest radius U-bend in bundle considered
3. worst case circumferential location of degradation assumed
4. worst case moments used regardless of location in bundle.

The three times normal operating pressure differential (3xNOPD) value of 4290 psid applied to the Unit 2 condition monitoring evaluation was found to be limiting for all forms of degradation. Using formulas in EPRI Report 1019037, Rev. 1, the severity of pressure loading that is equivalent to bounding accident pressure plus contributing loads with safety factors of 1.2 applied is 3893 psi. Hence any 3xNOPD value larger than 3893 psi is limiting. Without bounding assumptions a lower 3xNOPD value can be limiting for some locations and types of degradation.