OFFICE OF NUCLEAR REACTOR REGULATION
REQUEST FOR ADDITIONAL INFORMATION
SOUTHERN CALIFORNIA EDISON
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 2
RESPONSE TO MARCH 27, 2012, NRC CONFIRMATORY ACTION LETTER
DOCKET NO. 50-361
TAC NO. ME9727

On March 27, 2012, the NRC issued a Confirmatory Action Letter (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12087A323) to Southern California Edison (SCE) for the San Onofre Nuclear Generating Station (SONGS), Units 2 and 3. The Confirmatory Action Letter (CAL) confirmed the commitments made in SCE's March 23, 2012, letter entitled, "Steam Generator Return-to-Service Action Plan" (RTS Action Plan; ADAMS Accession No. ML12086A182). Commitment 2 of the RTS Action Plan states in part that SCE will determine the cause(s) of the tube-to-tube interactions that resulted in steam generator (SG) tube wear in Unit 3, and will implement actions to prevent loss of integrity due to these causes in the Unit 2 steam generator tubes. Commitment 3 of the RTS Action Plan states in part that, prior to entry of Unit 2 into Mode 2, SCE will provide to the NRC the results of SCE's assessment of Unit 2 steam generators, and the basis for SCE 's conclusion that there is reasonable assurance, as required by NRC regulations, that Unit 2 will operate safely.

By letter dated October 3, 2012 (ADAMS Accession No. ML122850320), SCE submitted its response to the NRC Confirmatory Action Letter (CAL), for SONGS Unit 2. By letter dated November 28, 2012 (ADAMS Accession No. ML12348A287), SCE submitted proprietary versions of several reports enclosed with the October 3, 2012 CAL response, along with affidavits supporting SCE’s request for withholding the proprietary information under 10 CFR 2.390.

Steam generator tubes are an integral part of the reactor coolant pressure boundary and are relied on to maintain primary system pressure and inventory. The operating licenses for SONGS Units 2 and 3 require SCE to conduct a Steam Generator Program (Technical Specification (TS) 5.5.2.11), to ensure that steam generator tube integrity is maintained. TS 5.5.2.11 specifies performance criteria for maintaining SG tube integrity. The processes used to meet the SG performance criteria are defined by NEI 97-06, "Steam Generator Program Guidelines." These processes include performing detailed technical evaluations, called operational assessments, to demonstrate that tube structural integrity will be maintained under normal and accident conditions for the proposed operating cycle.

The NRC staff is continuing its detailed review of the information provided by SCE in support of SCE’s conclusion that SG tube integrity will be maintained, and that there is reasonable assurance, as required by NRC regulations, that Unit 2 will operate safely. To complete this review, the staff has determined that additional information is needed regarding the operational assessments discussed in your CAL response.

The staff's latest request for additional information (RAI) is attached. Please note that although the NRC staff has determined that the attached questions are not proprietary, many of the questions refer to information that SCE has requested be withheld in its letter dated November 28, 2012. If the responses to these questions include proprietary information, SCE should provide additional requests for withholding under 10 CFR 2.390, as necessary. (Note: The NRC staff previously provided an RAI regarding the CAL response to SCE in the form of 32 initial questions, which were sent by letter dated December 26, 2012 (ADAMS Accession No. ML12361A065). The staff also transmitted two additional RAIs containing proprietary information via electronic mail to SCE on February 1, 2013 (5 questions), and February 20, 2013 (15 questions). For continuity, the numbering scheme for the additional questions below begins where the NRC's previous RAI questions ended.)

53. In Reference 1, Section 4.6.2, "[Tube-to-Tube (TTW)] Growth Model," was the regression fit slope and intercept uncertainty modeled (e.g., as was done for the burst pressure versus voltage model in NRC Generic Letter 95-05)? If not, why is this conservative? Was the data scatter about the regression fit modeled as normally distributed? If so, provide justification for the adequacy of this assumption (i.e., normal distribution) to fully capture the upper tail of the distribution as shown in Figure 4-12 on page 4-25.

54. In Reference 1, Figures 4-11 and 4-13, the maximum depths in Figure 4-11 have been divided by the Unit 3 cycle length of 0.926 years to yield the growth rates in Figure 4-13. The staff understands that Figure 4-13 should be simply a scaled version of Figure 4-11. Please explain why some of the data in Figure 4-11 are not shown in Figure 4-13; for example, the three flaws shown in Figure 4-11 with maximum depths ranging from 89 to 100% (AREVA resized).

55. In Reference 2, page 107 of 129, second to last paragraph, did total gap also include wear of the anti-vibration bars (AVBs) themselves? If not, explain why the approach is conservative. If so, how was wear of the AVBs determined? (This question is a follow-up on RAI No. 26 from the NRC's December 26, 2012, letter).

56. For Reference 2, Figure 8-3, provide an assessment of the robustness of the Figure 8-3 predictions of the probability of instability versus time in terms of how well it accommodates uncertainty in these predictions for purposes of ensuring acceptable tube integrity margins during the planned 5-month inspection interval for Unit 2. Robustness refers in part to accommodating increases or decreases in the rate at which instability increases with time and the calculated value of the probability of instability at the beginning of cycle (BOC) 16 for Units 2 and 3 and BOC 17 for Unit 2. Robustness also considers the time interval between onset of instability and the loss of acceptable tube integrity margins.

57. In Reference 3, Appendix 9, Table 6.2-1, why is tube support plate (TSP) hole mis-location not included in the table headings? If not accounted for in the analysis, explain

why the approach is conservative. If used in the analysis, provide an updated table that includes the TSP hole mis-location parameter.

58. In Reference 3, Appendix 9, Table 6.2-1, which parameters are sampled randomly at each tube/AVB intersection? Why is this appropriate in lieu of assuming a functional relationship for each given parameter from tube to tube in a given column of tubes? For parameters (e.g., AVB twist) assumed to follow a functional relationship from tube to tube in the same column, provide the basis for the assumed relationship. For AVB twist, how does the assumed relationship relate to Figure 6.2-2?

59. In Reference 3, Appendix 9, Attachment 9-1; define the statistical distributions which were actually sampled for Unit 2 and Unit 3. What is the technical justification for the assumed distributions compared to the actual distribution of the data?

60. In Reference 3, Appendix 9, Figures 7.2-3 and 7.2-5 apply to Unit 3. Please provide similar figures for Unit 2.

61. Reference 3, Appendix 9, Attachment 9-3, Figure 4.1.2-3. Discuss the pedigree of the data in this figure and how it differs from Reference 2, Figure 6-19 and 6-20. Please explain the differences between the Reference 3 versus the Reference 2 figures for dings exceeding 0.5 volts?

62. In Reference 2, Figure 8-3, the staff understands that the stability ratio (SR) in the context of Figure 8-3 is a 95% upper bound estimate, both for the last operating period for both Units 2 and 3 and for the next operating period for Unit 2. Why wasn't a best estimate SR used for benchmarking the probability of SR>1 at the conclusion of the last operating period for both Units 2 and 3? (Benchmarking refers to selecting a contact force criterion for effective AVB support such as to produce probabilities of SR>1 at the end of the last operating period consistent with what was actually observed.) How would a best estimate SR have affected the curves presented for the last operating period? Discuss whether the use of a 95% upper bound estimate for benchmarking purposes essentially negates the conservatism of using 95% upper bound SR estimates for future operation of Unit 2?

63. In Reference 3, Page 66, the last sentence on this page states, "Therefore, the difference of the contact forces between Unit-2 and Unit-3 is caused by the difference of the manufacturing dimensional tolerances other than the outer-most tube-to-AVB gaps." Explain the basis for this conclusion in light of the omission of the measured tube-to-AVB gaps at the outer tubes as a boundary condition in the contact force model described in Appendix 9 of Reference 3.

64. In Reference 3, Appendix 9, page 9-6 (355 of 474), it is stated, "Especially for AVB twist, AVB twist factor in consideration of torsion stiffness is defined as a decrease function of distance from AVB bending peak, because the more contact points leave from AVB nose, the less AVB torsion stiffness is." Please clarify the meaning of this

sentence by answering the following questions: What is the "AVB twist factor?" What is meant by "AVB twist factor in consideration of torsion stiffness?" What parameter is decreasing as a function of distance from the AVB nose, AVB twist or AVB torsional stiffness? Why does torsional stiffness vary as function of distance from the AVB nose? Describe the specific variation of torsional stiffness with distance from nose function that was used in the analysis. How was this variation determined?

65. In Reference 3, Appendix 9, Figure 6.2.2 shows AVB twist factor as a function of distance from AVB nose tip. Is this the function that was used in the contact force analysis? For all AVBs? If not, what twist factor functions were used for the other AVBs? How were these twist factor functions determined? Explain the relationship between twist factors shown in this figure versus those shown in Table 6.2-1.

66. In Reference 3, Appendix 9, page 9-6 (355 of 474) it is also stated, "In AVB nose area, the factor is always 1, because increased twist from nose tip and decreased stiffness from nose tip cancel each other." Please provide a detailed clarification of this sentence. The staff further notes that "twist" and "stiffness" have different units. How can they cancel each other out?

67. Reference 3, Appendix 9, Attachment 9-3; describe in detail any "tuning" of the contact force model that was performed to replicate the ding signals observed during pre-service inspection.

REFERENCES

1. Letter from Peter T. Dietrich, SCE, to Elmo E. Collins, USNRC, "Docket No. 50-361, Confirmatory Action Letter – Actions to Address Steam Generator Tube Degradation, San Onofre Nuclear Generating Station, Unit 2," October 3, 2012; **Enclosure 2**, "San Onofre Nuclear Generating Station Unit 2 Return to Service Report, Revision 0." **Attachment 6**, "SONGS U2C17 Steam Generator Operational Assessment," **Appendix C**, "Operational Assessment for SONGS Unit 2 Steam Generators for Upper Bundle Tube-to-Tube Wear Degradation at End of Cycle 16," prepared by Intertek APTECH for Areva, Report No. AES 12068150-2Q-1, Revision 0, September 2012. (ADAMS Accession No. ML12285A269)

2. Letter from Richard J. St. Onge, SCE, to Document Control Desk, USNRC, "Docket No. 50-361, Confirmatory Action Letter Response – Proprietary Documents, San Onofre Nuclear Generating Station, Unit 2," November 28, 2012. (ADAMS Accession No. ML12348A287); Enclosure 6, "SONGS U2C17 Steam Generator Operational Assessment for Tube-to-Tube Wear," prepared by Areva NP Inc. Document No. 51-9187230-000, Revision 0), October 2012. **[Proprietary]** [Note: a non-proprietary version of this report was provided as Enclosure 2, Attachment 6, Appendix B, to SCE's letter dated October 3, 2012. See ADAMS Accession Nos. ML12285A267, ML12285A268, and ML12285A269]

3. Letter from Richard J. St. Onge, SCE, to Document Control Desk, USNRC, “Docket No. 50-361, Confirmatory Action Letter Response – Proprietary Documents, San Onofre Nuclear Generating Station, Unit 2,” November 28, 2012. (ADAMS Accession No. ML12348A287); Enclosure 3, MHI Document L5-04GA564 Rev. 9, “Tube Wear of Unit-3 RSG – Technical Evaluation Report.” **[Proprietary]** [Note: a non-proprietary version of this report was provided as Enclosure 2, Attachment 4, to SCE’s letter dated October 3, 2012. See ADAMS Accession Nos. ML12285A265, ML12285A266, andML12285A267]