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

January 18, 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 (RAI 13)
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 1 of this letter provides the response to RAI 13.

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NRR

P.O. Box 128
San Clemente, CA 92672

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,

Enclosure:

1. Response to RAI 13

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

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 RAI 13

RAI 13

The installation of new steam generators involved changes to the steam generator heat transfer characteristics, which could affect the performance of the plant under postulated loss of coolant accident conditions. Please explain how the existing ECCS analysis accounts for these changes, and how considerable steam generator tube plugging has been addressed in the ECCS evaluation. Provide the ECCS evaluation that will apply to the planned operating cycle.

RESPONSE

Note: Response (2) below includes information requested in RAI 14 associated with the Emergency Core Cooling System (ECCS) evaluation. RAI 14 states: "Provide a summary disposition of the U2C17 calculations relative to the planned reduced-power operation."

(1) Evaluation of Impact of Replacement Steam Generators on Emergency Core Cooling System (ECCS) Performance Analyses

Replacement steam generators (RSGs) were installed in SONGS Units 2 and 3 for Cycle 16. The Cycle 16 ECCS performance for SONGS Units 2 and 3 with the RSGs was evaluated to demonstrate conformance to the ECCS acceptance criteria for light water nuclear power reactors contained in 10 CFR 50.46. The evaluation considered the impact of the RSGs on the Analyses of Record (AORs) for Large Break Loss-of-Coolant Accident (LBLOCA), Small Break Loss-of-Coolant Accident (SBLOCA), and post-Loss-of-Coolant Accident (LOCA) Long-Term Cooling (LTC), which are based on the original steam generators (OSGs).

The impact of the RSGs on the SONGS Units 2 and 3 ECCS performance AORs was evaluated through a two-step process. First, the design data of the RSGs, including thermal hydraulic characteristics, were compared to those of the OSGs as modeled in the ECCS performance AORs. Second, differences in design data, which were identified from the comparison, were evaluated for their impact on ECCS performance. The scope of the comparison considered all design features of the steam generators (SGs) that are modeled in the ECCS performance analysis. The most significant parameters are discussed below.

(i) Rated Thermal Power

The OSGs and the RSGs were evaluated at the same core power level, as there was not a power uprate associated with installation of the RSGs.

(ii) RSG Tube Plugging and RCS Volume

The RSGs have more RCS volume than the OSGs. The amount of assumed tube plugging in the RSGs is less than the OSGs. These factors result in a net increase in the total reactor coolant system (RCS) volume. This is a beneficial feature since, for example, it results in more RCS inventory available to drain into the reactor vessel during a SBLOCA, thereby delaying the time that the core begins to uncover. A larger water volume increases the amount of water available to flow through the core during the blowdown period of a LBLOCA. This increases the amount of stored energy removed from the core during the blowdown period. The increase in water volume has an insignificant impact on the post-LOCA LTC analysis. The maximum number of plugged tubes per SG for the RSG was assumed to be 779 tubes (8%) per SG for the RSG Cycle 16 ECCS evaluation.

(iii) RSG Heat Transfer Characteristics

The maximum assumed number of plugged tubes per SG is used in conjunction with the total number of tubes per SG to establish the minimum number of unplugged tubes per SG This is used to establish SG primary side volume, tube bundle flow area, and tube bundle heat transfer area. The RSGs have more tubes (9,727 versus 9,350) than the OSGs and a smaller value for the maximum number of plugged tubes (779 versus 2,000). RSG tubes have a larger average heated length (729.56 in. versus 680.64 in.) than the OSG tubes. These features result in larger values for the RSG for heat transfer area, tube bundle flow area, and tube bundle water volume. This is beneficial in the short and long term for SBLOCAs, which rely upon the steam generators for RCS heat removal.

The RSG tube bundle material is Inconel 690 whereas the OSG tube bundle material is Inconel 600. While the thermal conductivity of Inconel 690 is less than that of Inconel 600, the impact is not significant in the context of ECCS performance. First, the RSGs have larger heat transfer areas which compensate for the decrease of thermal conductivity. Second, after the subcooled forced convection mode of SG heat transfer early in a LOCA transient, the primary coolant-to-wall resistance, and not the wall resistance, is the limiting resistance for SG heat transfer during a LOCA. Therefore, the difference in thermal conductivity does not have a significant impact on ECCS performance given the overall design of the RSGs relative to the OSGs and the nature of SG heat transfer during a LOCA.

Sensitivity studies have shown that the impact due to SG heat transfer area changes is insignificant for LBLOCAs. Heat transfer characteristic differences have an insignificant impact on post-LOCA LTC.

(iv) RSG Pressure Drop / Flow Resistance

The RSGs have a smaller flow resistance and, consequently, a smaller pressure drop than the OSGs based on the same set of conditions and the maximum number of plugged tubes assumed by the ECCS performance analyses. A smaller total SG pressure drop is beneficial for ECCS performance.

The evaluation of the impact of the RSGs on the SONGS Units 2 and 3 ECCS performance analyses demonstrates that the RSGs have a beneficial impact on ECCS performance. Consequently, the results and conclusions of the SONGS Units 2 and 3 ECCS performance AORs for LBLOCA, SBLOCA, and post-LOCA LTC, performed for the OSGs, are applicable to SONGS Units 2 and 3 for operation with the RSGs.

(2) ECCS performance evaluations for SONGS Unit 2 Cycle 17

An ECCS performance analysis was performed for SONGS Unit 2 Cycle 17 to demonstrate conformance to the ECCS acceptance criteria for light water nuclear power reactors. The major changes evaluated in the Unit 2 Cycle 17 ECCS performance analysis are discussed as follows.

(i) Increase in T_{COLD}

The RCS temperature at the inlet to the core, i.e., T_{COLD}, has increased for Unit 2 Cycle 17 to 550°F from the previous Unit 2 Cycle 16 value of 541°F ("T_{COLD} Restoration"). The effect of the change in T_{COLD} is bounded by the Unit 2 Cycle 17 ECCS performance analysis.

(ii) SG Tube Plugging

The maximum number of plugged tubes per SG for Unit 2 Cycle 17 operation is 3%, which is bounded by the maximum number of plugged tubes per SG (8%) assumed in the RSG ECCS performance evaluation.

(iii) Extended Operation at Power Levels Between 50% and 100%

SONGS Unit 2 Cycle 17 safety analyses and LOCA analyses were evaluated for acceptability of plant operating at power levels between 50% and 100%, which bounds the planned operation at 70% power level. The impact of the extended reduced power operation was evaluated to determine the continued applicability of SONGS Units 2 and 3 ECCS performance AORs. It was concluded that the power operation range between 50% and 100% remains bounded by the current SONGS Units 2 and 3 ECCS performance AORs for LBLOCA, SBLOCA, and post-LOCA LTC.