July 13, 2007

Mr. Richard M. Rosenblum
Senior Vice President and Chief Nuclear Officer
Southern California Edison Company
San Onofre Nuclear Generating Station
P.O. Box 128
San Clemente, CA 92674-0128

SUBJECT: SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 2 - EVALUATION OF 2006 (CYCLE 14) STEAM GENERATOR TUBE INSPECTIONS (TAC NO. MD3205)

Dear Mr. Rosenblum:

By letters dated February 7 and October 26, 2006, and January 19, 2007, Southern California Edison (the licensee), submitted information summarizing the results of the 2006 steam generator (SG) tube inspections performed at San Onofre Nuclear Generating Station, Unit 2 (SONGS 2). These inspections were performed following Cycle 14 of Unit 2 (U2C14).

In addition to these reports, the U.S. Nuclear Regulatory Commission (NRC) staff summarized additional information concerning the 2006 SG tube inspections at SONGS 2 in a letter dated April 3, 2006.

The NRC staff has completed its review of these reports and concludes that the licensee provided the information required by their technical specifications and that no additional follow-up is required at this time. The staff's review of the reports is enclosed.

Sincerely,

/RA/

N. Kalyanam, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-361

cc w/encl: See next page

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ADAMS **Accession No.: ML071860655 NRR-106** ***Tech Staff Input**

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SUMMARY OF REVIEW BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 2

2006 STEAM GENERATOR TUBE INSPECTIONS

TAC NO. MD3205

DOCKET NO. 50-361

By letters dated February 7 and October 26, 2006, and January 19, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML060400103, ML063040307, and ML070230128, respectively), Southern California Edison (the licensee), submitted information summarizing the results of the 2006 steam generator (SG) tube inspections performed at San Onofre Nuclear Generating Station, Unit 2 (SONGS 2). These inspections were performed following Cycle 14 of Unit 2 (U2C14). In addition to these reports, the U.S. Nuclear Regulatory Commission (NRC) staff summarized additional information concerning the 2006 SG tube inspections at SONGS 2 in a letter dated April 3, 2006 (ADAMS Accession No. ML060950305).

SONGS 2 has two Combustion Engineering Model 3410 SGs, E-088 and E-089. Each SG has 9350 tubes fabricated from mill-annealed Alloy 600. Each tube has a nominal outside diameter of 0.75 inches and a nominal wall thickness of 0.048 inches, and was explosively expanded into the full thickness of the tubesheet. The SGs were inspected during the Cycle 14 refueling outage (U2C14) in January 2006.

The plant Technical Specifications allow tube repair using Asea Brown Boveri, Combustion Engineering tungsten inert gas (TiG) welded sleeves. Alloy 690 sleeves were installed at SONGS 2 during the 1999 (U2C10), 2000 (U2C11), 2002 (U2C12), and 2004 (U2C13) outages. All of the sleeves were installed to repair defects within or just above the hot-leg tubesheet.

The licensee provided the scope, extent, methods, and results of their SG tube inspections in the documents referenced above. In addition, the licensee described corrective actions (i.e., tube plugging) taken in response to the inspection findings.

As a result of the review of the reports, the NRC staff has the following comments/observations:

> The inside diameter of approximately 100 inservice sleeves was found to be reduced during the 2006 outage. Most of the affected sleeves were installed during the 2002 (U2C12) and 2004 (U2C13) outages. As a result, all tubes with sleeves installed during the 2002 and 2004 outages were plugged. At the conclusion of the 2006 outage, there were 159 sleeved tubes in service in SG E-088, and 97 sleeved tubes in service in SG E-089. All of these sleeves were installed during 1999 or 2000. No new sleeves were installed during the 2006 outage. Additional information concerning the cause for

the reduced sleeve diameter is contained in a letter dated November 30, 2004 (ADAMS Accession No. ML043350123).

With respect to the ability to detect degradation in the parent tube behind the nickel band of the sleeves and the implications of any flaws that may exist in this region, the licensee provided a letter dated July 14, 2006 (ADAMS Accession No. ML061990069). This letter is currently being reviewed by the NRC staff.

Migration of nickel within the tube-to-sleeve crevice region was observed in 26 tubes/sleeves in SG E-088 and 14 tubes/sleeves in SG E-089. All tubes were sleeved using the TiG process. This phenomenon has been observed at other plants. For example, in 1999, eddy current indications suggestive of axial or circumferential degradation of the parent tube were reported on 13 sleeved tubes at one plant. The sleeve and a portion of the parent tube of two of these tubes were pulled for destructive examination. Destructive examination showed no degradation of the tube or sleeve. The source of the signals was attributed to areas of deposition of mainly pure nickel and pure chromium with traces of iron, sulfur, silicon, and aluminum. The nickel deposit was adjacent to the sleeve outside surface while the chromium deposit was adjacent to the tube inside diameter surface. In both pulled sleeved tubes, small, discontinuous subsurface inclusions were found in the weld. These inclusions did not affect the structural integrity or leak tightness of the weld. The nickel deposit signals are primarily located in the upper-joint region of the sleeve at the bottom of the hydraulically expanded area, just below the weld. These deposits do not appear to extend to the weld. All of the nickel deposit signals are well above the tube/sleeve lower hardroll joint. Based on these findings, the licensee assessed whether the signals from these nickel deposit signals could affect flaw detectability. The licensee concluded that the signal amplitude associated with the nickel deposits in the sleeve inspection frequency would have a negligible impact upon detecting postulated degradation that could affect the integrity of the sleeved tube. Although the staff did not review the licensee's assessment in detail, it is not expected that safety significant degradation would occur in the area of the sleeve affected by these deposits given the enhanced corrosion resistance of Alloy 690 (compared to Alloy 600) and the limited time these sleeves are expected to remain in service (given the planned replacement of SGs).

The effective percentage (number) of tubes plugged in SG E-088 is 13.5 percent, and the effective percentage of tubes plugged in SG E-089 is 12.1 percent. The currently approved safety analyses assumes that a maximum of approximately 21 percent of the tubes are plugged.

During the 2006 inspections, no cracks were associated with dings, and no cracks were detected during the rotating probe inspections near the hot-leg scallop bar supports. Approximately seven crack-like indications were associated with dents at tube supports.

No degradation of the U-bend support structure (as discussed in NRC Information Notice 2005-29, "Steam Generator Tube and Support Configuration") was observed at SONGS 2 during the 2006 inspections.

In the NRC's summary of a conference call held to discuss the results of the 2006 SG tube inspections, there was a reference to inspection findings at Catawba Unit 2. Although the call

summary indicated that the Catawba findings related to inspection of the tie rods and the tubes surrounding all new and previously identified loose parts, the findings at Catawba related to cracking in the portion of the tube located within the tubesheet region. In response to the findings at Catawba, the rotating probe inspections in the cold leg were expanded to include 30 percent of the tubes from 2 inches above to 13 inches below the top of the secondary face of the cold-leg tubesheet.

> The 13-inch lower inspection bound is based on a methodology referred to as C-star. The staff's review of the C-star methodology is documented in a license amendment dated November 9, 2006 (ADAMS Accession No. ML062970441).

Based on a review of the information provided, the staff concludes that the licensee provided the information required by their technical specifications. In addition, the staff concludes that there are no technical issues that warrant follow-up action at this time since the inspections appear to be consistent with the objective of detecting potential tube degradation and the inspection results appear to be consistent with industry operating experience at similarly designed and operated units.

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