February 8, 2006

Mr. Richard M. Rosenblum
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, UNITS 2 AND 3 - RE: INSERVICE INSPECTION PROGRAM RELIEF REQUEST ISI-3-15 (TAC NOS. MC7977 AND MC7978)

Dear Mr. Rosenblum:

By letter dated July 22, 2005, Southern California Edison Company requested approval of an alternative to an American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) inservice inspection (ISI) requirement in Relief Request ISI-3-15 for the San Onofre Nuclear Generating Station (SONGS), Units 2 and 3. The request for relief is from ASME Code Case 1361-2, "Socket Welds, Section III," to allow a slightly larger diametric clearance between the replacement pressurizer heater sleeves and the heater sheaths. The request is associated with the replacement of the pressurizer heater sleeves scheduled for the Unit 2 Cycle 14 refueling outage and for future Unit 3 replacement activities.

Based on its review of Relief Request ISI-3-15, as discussed in the enclosed safety evaluation, the Nuclear Regulatory Commission staff concludes that the proposed alternative to ASME Code Case 1361-2 provides an acceptable level of quality and safety for a 40-year plant operating life. Based on this, pursuant to paragraph 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations*, Relief Request ISI-3-15 is authorized for the remainder of the current operating licenses for SONGS, Units 2 and 3.

Sincerely,

/RA/

David Terao, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-361 and 50-362

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO INSERVICE INSPECTION (ISI) PROGRAM RELIEF REQUEST ISI-3-15

SOUTHERN CALIFORNIA EDISON COMPANY

SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3

DOCKET NOS. 50-361 AND 50-362

1.0 INTRODUCTION

By letter dated July 22, 2005, Southern California Edison Company (the licensee) submitted Relief Request ISI-3-15, requesting approval of an alternative to an American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) ISI requirement for the San Onofre Nuclear Generating Station (SONGS), Units 2 and 3. The request for relief is from Code Case 1361-2, "Socket Welds, Section III," to allow a slightly larger diametric clearance between the replacement pressurizer heater sleeves and the heater sheaths. The request is associated with the replacement of the pressurizer heater sleeves scheduled for the Unit 2 Cycle 14 refueling outage and for future Unit 3 replacement activities.

2.0 BACKGROUND

The heater sleeves are attached to the bottom head of the pressurizer. The heater sheaths are inserted through the sleeves and welded to the sleeves. The pressurizer in each unit contains 30 heater sleeves. The original sleeves are made from Alloy 600 material, a nickel-based alloy, which has been found to be susceptible to primary water stress corrosion cracking (PWSCC). The replacement sleeves are made from Alloy 690 material which is less susceptible to PWSCC. The licensee replaced 29 sleeves with Alloy 690 heater sleeves in the last Unit 3 refueling outage. One heater sleeve had been previously replaced with an Alloy 690 heater sleeve. The licensee plans to replace the Unit 2 heater sleeves at the next scheduled outage.

The licensee indicated that the relatively tight clearance between the heater sheath and the heater sleeve caused challenges in the sleeve alignment and subsequent installation of the Unit 3 heaters. Similar difficulties had been encountered at the Palo Verde Nuclear Generating Station (PVNGS) during the Unit 2 pressurizer repair outage. PVNGS used an increased clearance between the heater sheath and the heater sleeve for the Unit 3 pressurizer repair outage which resolved the heater installation difficulty. The licensee proposed to use a similar increased clearance for the SONGS, Unit 2, heater sleeve replacements.

The allowable clearance is controlled by ASME Code requirements for the weld joint between the heater sheath and the heater sleeve. Code Case 1361-2 specifies requirements for this type of joint design for ASME Code, Section III vessels. The Code Case specifies the maximum clearance between the connecting parts. The clearance between the heater sheath and the heater sleeve must satisfy this requirement. Relief from this ASME Code requirement

was authorized for PVNGS by the Nuclear Regulatory Commission (NRC) staff letter dated November 19, 2004. The licensee requested similar relief for SONGS, Units 2 and 3.

3.0 REGULATORY REQUIREMENTS

General Design Criterion (GDC) 1, "Quality standards and records," of Appendix A to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR), states that "structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function."

The ISI of ASME Code Class 1, 2, and 3 components in nuclear plants is to be performed in accordance with the ASME Code, Section XI, and applicable edition and addenda as required by Paragraph 50.55a(g) of 10 CFR, except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The regulation at 10 CFR 50.55a(a)(3) states: "Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that: (i) The proposed alternatives would provide an acceptable level of quality and safety, or (ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety." The third 10-year ISI interval code for SONGS, Units 2 and 3, is the ASME Code, Section XI, 1995 Edition, 1996 Addenda.

The 1995 Edition, 1996 Addenda, of the ASME Code, Section XI, IWA-4120(a) states: "Repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later Editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and [ASME] Code Cases may be used." The construction code for the SONGS, Units 2 and 3, pressurizer vessels is ASME Code, Section III, 1971 Edition, Summer 1971 Addenda.

Code cases provide alternatives developed and approved by ASME or explain the intent of existing ASME Code requirements. Regulatory Guide (RG) 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," identifies the ASME Section III Code Cases acceptable to the NRC for the design and construction of light-water-cooled nuclear power plants. Code cases approved by the NRC provide an acceptable alternative to the ASME Code requirements. RG 1.84 is incorporated by reference in 10 CFR 50.55a.

4.0 LICENSEE'S BASIS FOR THE PROPOSED ALTERNATIVE

The joint design used to attach the heater sleeve to the heater sheath connection is not explicitly authorized by Section III of the ASME Code. SONGS Updated Final Safety Analysis Report (UFSAR), Section 5.2.1.2 identifies that Code Case 1361-2 was used for the original pressurizer assembly (heater sleeve to heater sheath fillet weld). At the time of plant construction, Code Case 1361-2 was acceptable to the NRC for application in the design and construction of the SONGS pressurizer assembly. Code Case 1361-2 has been replaced by Code Case N-405-1, "Socket Welds Section III, Division 1," which is endorsed by the current version of RG 1.84.

Code Case 1361-2 lists several requirements associated with this type of joint design, and the design parameter relevant to this relief request is the maximum diametral clearance between connecting parts (cMAX) noted on Figure 1 of this Code Case. Figure 1 of Code Case 1361-2 specifies cMAX to be 0.045 of an inch. It should be noted that Code Case N-405-1, which is very similar to Code Case 1361-2, has essentially the same figure and also specifies that cMAX be 0.045 of an inch.

The licensee is requesting relief from Code Case 1361-2 because this Code Case is identified in the UFSAR as the regulatory basis for the original pressurizer assembly (heater sleeve to heater sheath fillet weld). The proposed relief request applies to all 30 heater sleeves in each of the Unit 2 and 3 pressurizers and is requested for the remainder of plant life at the two units.

The licensee proposes to use a maximum 0.060 of an inch cMAX between the pressurizer heater sleeve and pressurizer heater sheath as an alternative to the code case requirement of 0.045 of an inch. The licensee states that this proposed alternative will provide an acceptable level of quality and safety and, thus, will meet the requirements of 10 CFR 50.55a(a)(3)(i). The licensee based this conclusion on a revised analysis of the reconfigured weld joint to demonstrate compliance with ASME Code, Section III, Paragraph NB-3220 allowable limits for primary membrane, primary membrane plus bending, primary plus secondary, and fatigue stresses.

The original construction for the heater sleeve was Alloy 600. The original construction for the heater sheath was Type 316 stainless steel. The materials of construction for the replacement sleeve are Alloy 690. The materials for the heater sheath have not changed. The original fillet weld connected a sleeve with an inner diameter (ID) of 1.273 inches and an outer diameter (OD) of 1.66 inches, and a heater sheath with an OD of 1.245 inches. The resulting fillet weld had a leg of 0.1875 of an inch with a nominal diametral clearance between parts of 0.028 of an inch.

The new design replacement for the Unit 2 heater sleeve has an ID of 1.298 inches and an OD of 1.66 inches, with the same heater sheath OD of 1.245 inches. The fillet weld size connecting these parts is the same as the original construction, namely a 0.1875-inch leg. However, the cMAX is increased to 0.060 of an inch (0.053-inch nominal). The increased diametral clearance should make installation of the heaters easier.

The original stress reports modeled the fillet weld with a nominal design clearance between the parts of 0.028 of an inch using finite element analysis techniques. The revised analysis performed in support of this relief request evaluates the same fillet weld with a cMAX of 0.060 of an inch. The revised analysis utilizes the results from the original stress report to determine acceptability of the replacement heater sleeve/sheath weld configuration. In the revised analysis, the loads and weld cross-sectional properties are modified by a ratio factor that takes into account the change in diametral clearance between the parts. The licensee states that the results of the revised analysis demonstrate compliance with the ASME Code NB-3220 allowable limits for primary membrane, primary membrane plus bending, primary plus secondary, and fatigue stresses.

Code Case 1361-2 was approved in March of 1972. At that time, the ASME Code did not prepare a basis document for their Code Case assumptions as is being done currently. Thus, the basis for the cMAX of 0.045 of an inch in Code Case 1361-2 is not specified. However, the

licensee believes that, by maintaining a relatively small diametral clearance between the parts, the amount of bending stresses that can be imparted on the fillet weld due to deflection of the parts is negligible. The manner in which the SONGS pressurizer heaters are held in place, fixed at one end by the fillet weld and supported at the other end by two consecutive heater support plates satisfies these criteria (i.e., minimizes bending stresses at the fillet weld). The clearance between the heater and heater support plates is nominally 0.037 of an inch (1.282 inches minus 1.245 inches).

Based on the above discussion, the licensee concludes that the reconfigured weld joint is acceptable from a stress/fatigue perspective for remaining plant life.

5.0 NRC STAFF EVALUATION

RG 1.84 lists the ASME Section III Code Cases found to be acceptable by the NRC staff for the design and construction of pressure-retaining ASME Code, Section III, Class 1, components within the reactor coolant pressure boundary (Quality Group A). The NRC staff concludes that compliance with the requirements of these code cases will result in a quality level that is commensurate with the importance of the safety function of the reactor coolant pressure boundary and constitutes an acceptable basis for satisfying the requirements of GDC 1 and is, therefore, acceptable.

At the time of plant licensing, Code Case 1361-2 was listed in RG 1.84 as an acceptable code case and the current referenced version of RG 1.84, Revision 33, lists Code Case N-405-1 as an acceptable code case. Because Code Case N-405-1 is a replacement for Code Case 1361-2, the NRC staff's evaluation, of the licensee's proposed relief request to slightly increase the diametral clearance between the heater sleeve and heater sheath, focused on the new stresses that would be seen by the connecting joints.

Code Case 1361-2 and Code Case N-405-1 both contain the same relevant requirements:

(1) The design of the joint shall be such that stresses will not exceed the limits described in NB-3220 and tabulated in Tables I-1.1 and I-1.2.

(2) A fatigue strength reduction factor of not less than 4 shall be used in the fatigue analysis of the joints.

(3) The finished welds shall be examined by a magnetic particle or by a liquid penetrant method in accordance with Section V and the Acceptance Standards of NB-5000.

The specific value of cMAX that is contained in both code cases maintains a relatively small diametral clearance between the parts, limiting the amount of bending stresses that can be imparted on the fillet weld due to deflection of the parts. However, the primary assurance of safety is demonstrated by satisfying the ASME Code stress limits and by proper examination of the finished welds. Therefore, the NRC staff’s acceptance of the proposed increase in cMAX will be based on whether the three requirements stated above are met for the new design. ASME Code, Section III, NB-3220, specifies loading conditions that need to be considered and specifies the stress limits that must be satisfied for these load conditions. The specific stresses to be considered for the sleeve-to-sheath weld are general primary stress, primary membrane

plus bending stress, primary plus secondary stress, and primary plus secondary plus peak stress, which are used in the fatigue evaluation. The licensee accounted for the increased cMAX by reducing the weld throat area used to calculate the stresses. The NRC staff concludes that this analysis was satisfactorily performed, and that all resultant stresses were within the acceptance criteria required by NB-3220. Therefore, the NRC staff finds that requirement (1) has been satisfied.

The fatigue strength reduction factor used in the licensee's analysis was set at 5, in compliance with requirement (2) above. The resulting cumulative usage factor, considering a 40-year plant operating life (stated in the licensee's application), which is within the current operating licenses of the SONGS units, is significantly less than the allowable value of 1.0. Based on this, the NRC staff finds that requirement (2) has been satisfied.

The licensee must still examine the finished welds for both Units 2 and 3 in accordance with ASME Code, Section III, Class 1 requirements (which are located in Section V and the Acceptance Standards of NB-5000 of the ASME Code), and must examine the finished welds after the repair activities are conducted. Requirement (3) of Code Case 1361-2 must be satisfied after the repair activities are complete.

Based on the above discussion regarding compliance with the three primary requirements of both Code Case 1361-2 and, its replacement, Code Case N-405-1, the NRC staff concludes that the proposed alternative value to use a cMAX of 0.060 of an inch between the pressurizer heater sleeve and pressurizer heater sheath, as an alternative to the code case requirement of 0.045 of an inch, provides an acceptable level of quality and safety.

6.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that the proposed alternative value of cMAX, as discussed in the licensee's request for relief, provides an acceptable level of quality and safety. Therefore, the proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the duration of the current operating licenses for the SONGS, Units 2 and 3.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable.

Principal Contributor: John Fair

Date: February 8, 2006

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