February 7, 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 3 - RE: THIRD 10-YEAR INSERVICE INSPECTION INTERVAL REQUEST FOR ALTERNATIVE TO THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE (TAC NO. MD1713)

Dear Mr. Rosenblum:

By letter dated May 11, 2006, as supplemented by letter dated November 20, 2006, Southern California Edison (SCE, the licensee) submitted a request for the use of alternatives to certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, requirements at San Onofre Nuclear Generating Station, Unit 3 (SONGS 3). Specifically, Relief Request ISI-3-21 requests approval to use alternatives to the requirements of the ASME Code, Section XI, 1995 Edition through 1996 Addenda, IWA-4000, for repair/replacement activities related to the performance of structural weld overlay repairs at SONGS 3 for the third 10-year inservice inspection interval.

The Nuclear Regulatory Commission (NRC) staff authorizes the alternative proposed by SCE in accordance with 50.55a(a)(3)(i) of Title 10 of *Code of Federal Regulations*, which states that the proposed alternatives may be used when authorized by the Director of the Office of Nuclear Reactor Regulation if the applicant demonstrates that the proposed alternatives would provide an acceptable level of quality and safety.

Therefore, Relief Request ISI-3-21 is authorized for the Operating Cycle 14 for SONGS 3. Due to the immediate need of this relief request, the NRC staff granted the verbal authorization for the use of this relief request on December 1, 2006.

The staff's safety evaluation is enclosed.

Sincerely,

/RA/

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

Docket No. 50-362

Enclosure: Safety Evaluation

cc w/encl: See next page

The staff's safety evaluation is enclosed.

Sincerely,

/RA/

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

Docket No. 50-362

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF ISI-3-21

SOUTHERN CALIFORNIA EDISON

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 3

DOCKET NO. 50-362

1.0 INTRODUCTION

By letter dated May 11, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML061350370), as supplemented by letter dated November 20, 2006 (ADAMS Accession No. ML063280024), Southern California Edison (SCE, the licensee) submitted relief request ISI-3-21 to allow the continued use of the embedded flaw repair process, which was approved by letter dated December 23, 2004 (ADAMS Accession No. ML043620341), for Cycle 13, for the Reactor Vessel Head Penetration (RVPH) Control Element Drive Mechanism (CEDM) No. 56 at San Onofre Nuclear Generation Station, Unit 3 (SONGS 3), during Cycle 14 operation. The licensee requested the relief as an alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) process for the current configuration of penetration.

The inservice inspection (ISI) of the ASME Code Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the ASME Code and applicable edition and addenda, as required by paragraph 50.55a(g) of Title 10 of the *Code of Federal Regulations* (10 CFR). Paragraph 50.55a(a)(3) of 10 CFR states, in part, that alternatives to the requirements of paragraph 50.55(g) may be used, when authorized by the Nuclear Regulatory Commission (NRC), if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and preservice examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components.

The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year ISI interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The third 10-year ISI interval for SONGS 3,

began in August 2003 and will end in August 2013. The ISI ASME Code of record for the SONGS 3, third 10-year ISI interval is the 1995 Edition with 1996 Addenda. The components (including supports) may meet the requirements set forth in subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed therein and subject to Commission approval.

2.0 REGULATORY EVALUATION

2.1 Components for which relief is requested

This relief request applies to SONGS 3 RVHP CEDM No. 56, an ASME Code, Section III, Class 1 component.

2.2 Code Requirements (As stated by the licensee)

ASME XI, IWA-4410(a) states the repair/replacement activities, such as metal removal and welding, shall be performed in accordance with the Owner's Requirements and the original Construction Code of the component or system. The applicable Construction Code is ASME III, 1971 Edition, through the Summer 1971 Addenda.

Base Metal Defect Repairs

ASME III, NB-4131 states that defects in base metals, such as the RPVH penetration tubes, may be eliminated or repaired by welding, provided the defects are removed, repaired and examined in accordance with the requirements of NB-2500.

ASME III, NB-2538 addresses elimination of base material surface defects and specifies defects are to be removed by grinding or machining. Defect removal must be verified by a magnetic particle or liquid penetrant examination using acceptance criteria of NB-2545 or NB-2546. If the removal process reduces the section thickness below the NB-3000 design thickness, then repair welding per NB-2539 is to be performed.

ASME III, NB-2539.1 addresses removal of defects and requires defects be removed or reduced to an acceptable size by suitable mechanical or thermal methods.

ASME III, NB-2539.4 provides the rules for examination of the base material repair welds and specifies they shall be examined by the magnetic particle or liquid penetrant methods with acceptance criteria per NB-2545 and NB-2546. Additionally, if the depth of the repair cavity exceeds the lesser of 3/8 inch or 10 percent of the section thickness, the repair weld shall be examined by the radiographic method using the acceptance criteria of NB-5320.

Weld Metal Defect Repairs

ASME III, NB-4451 states defects in weld metal shall be eliminated and, when necessary, repaired per NB-4452 and NB-4453.

ASME III, NB-4452 addresses elimination of weld metal surface defects and specifies defects are to be removed by grinding or machining. Defect removal must be verified by a magnetic particle or liquid penetrant examination using acceptance criteria of NB-5340 or NB-5350. If the removal process reduces the section thickness below the NB-3000 design thickness, then repair welding per NB-4453 is to be performed.

ASME III, NB-4453.1 addresses removal of defects in welds and requires the defect removal be verified with magnetic particle or liquid penetrant examinations using acceptance criteria of NB-5340 or NB-5350, or in the case of partial penetration welds where the entire thickness of the weld is removed, only a visual examination is required.

2.3 Relief Requested (As stated by the licensee)

Relief is requested from the requirements of ASME Section XI, IWA-4410(a), to perform repairs on the RPVH penetrations per the rules of the Construction Code.

Relief is requested from the requirements in ASME III, NB-4131, NB-2538 and NB-2539.1 to eliminate base material defects prior to repair welding.

- Relief is requested to use substitute examination methods in lieu of those specified in NB-2539.4. For the embedded flaw weld on the outside diameter (OD) surface of the [RVHP] CEDM # 56 penetration tube, surface examinations using the liquid penetrant method will be performed on the overlay repair weld surface.

- Ultrasonic examinations of the penetration volume and OD repair weld will be performed from the inside diameter (ID) surface opposite the overlay repair weld. The ultrasonic method is a different volumetric examination method than is specified in NB-2539.4.

- Surface examinations using the liquid penetrant method will be performed on the J-weld overlay repair weld surface.

Relief is requested from the requirements in ASME III, NB-4451, NB-4452 and NB-4453.1 to eliminate weld metal defects prior to repair welding.

2.4 Licensee's Proposed Alternative and Basis for Use

In its letter dated July 3, 2003, from H. N. Berkow (NRC) to H. A. Sepp (Westinghouse), "Acceptance for Referencing - Topical Report [TR] WCAP-15987-P, Revision 2, 'Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations,' (TAC No. MB8997)" (ADAMS Accession No. ML031840237), NRC indicated the TR has been reviewed and it is acceptable to reference the TR in licensing applications as an alternative to the 1989 Edition of Section III of the ASME Code, NB-4453.1 to the extent specified and under the limitations delineated in the TR and in the associated safety evaluation (SE). The letter also stated that the SE defined the basis for acceptance of the TR and the licensees may reference this SE when requesting an alternative pursuant to 10 CFR 50.55a(a)(3)(i).

In a letter dated October 26, 2004, from A. E. Scherer (SCE) to NRC (ADAMS Accession No. ML043020268), the licensee submitted Relief Request ISI-3-13 to allow the use of the embedded flaw repair process as an alternative to the ASME Code Process for the as-found configuration of RVHP No. 56. In its evaluation of this relief request, the NRC staff concluded that, subject to the conditions of its December 23, 2004, SE (ADAMS Accession No. ML043620341), the proposed embedded flaw process provides an acceptable level of quality and safety.

SCE performed a Code reconciliation to verify that the bases contained in WCAP-15987-P, Revision 2, are applicable to SONGS, Units 2 and 3. The July 3, 2003, SE states that it is acceptable to reference WCAP-15987-P, Revision 2, in licensing applications as an alternative to the 1989 Edition of Section III of the ASME Code, with the limitations noted in the SE. The SONGS Code reconciliation was performed in accordance with the licensee's ASME Code, Section XI Program between the applicable repair requirements of ASME Code, Section III, 1989 Edition and ASME Code, Section III, 1971 Edition through the Summer 1971 Addenda. The differences identified by the licensee were suitably reconciled.

For the OD overlay repair welds, the proposed substitute examination methods have been previously demonstrated to be adequate for flaw detection and sizing as shown in a letter from J. S. Galembush (Westinghouse) to Terence Chan (NRC) and Brian Benney (NRC), "Inspection of Embedded Flaw Repair of a J-Groove Weld," dated October 1, 2003 (ADAMS Accession No. ML032810457).

The embedded flaw repair process is considered a permanent repair that will last through the useful life of the RPVH. As long as a primary water stress-corrosion cracking (PWSCC) flaw remains isolated from the primary water environment, the only known mechanism for any further potential propagation is fatigue. The calculated fatigue usage in this region is very low, because the reactor vessel head region is isolated from the transients that affect the hot-leg or cold-leg piping.

The thickness of the weld used to embed the flaw has been set to provide a permanent embedment of the flaw. The embedded flaw process imparts less residual stresses than weld repair following the complete removal of the flaw.

Since Alloy 52 (690) weldment is considered highly resistant to PWSCC, a new PWSCC flaw should not initiate and grow through the Alloy 52 overlay to reconnect the primary water

environment with the embedded flaw. The resistance of the Alloy 690 material has been demonstrated by laboratory testing, and in approximately 10 years of operational service in steam generator tubes, where no PWSCC has been found.

As previously discussed, an additional analysis was performed using the same methodology as that in WCAP-15987-P to evaluate and analyze RVHP No. 56 for an embedded flaw repair. The results of this analysis demonstrate that an embedded flaw repair on RVHP No. 56 will meet ASME Code, Section XI, requirements for allowable flaw size until the end of the SONGS 3 third 10-year ISI interval (August 17, 2013). A copy of the analysis, "Evaluation of the Acceptability of Embedded Flaw Repair of the Indication in Reactor Vessel Head Penetration No. 56 at SONGS 3," was submitted in the attachment to letter dated October 26, 2004, from A. E. Scherer (SCE) to NRC (ADAMS Accession No. ML043020268), to support Relief Request ISI-3-13.

The Cycle 14 refueling outage inspection of this nozzle will be performed to meet the First Revised NRC Order EA-03-009 (Order) for vessel head penetration nozzle OD repairs below the J-groove weld. The depth of the indication in RVHP No. 56 will be compared to the depth measured during the Cycle 13 refueling outage inspection. If the Cycle 14 refueling outage measurement indicates a change in the indication (i.e., if there is an increase in the measured flaw depth greater than 0.020 inch), repairs will be made in accordance with the approved ASME Code and a separately approved relief request.

Therefore, unless a flaw is confirmed, the staff considers the embedded flaw repair process to be an acceptable alternative to ASME Code requirements that provides an acceptable level of quality and safety, as required by 10 CFR 50.55a(a)(3)(i).

3.0 TECHNICAL EVALUATION

In letter dated May 11, 2006, the licensee requested NRC approval to extend the relief request from Cycle 13 operation to Cycle 14 for the repaired RVHP No. 56 at SONGS 3, if an inspection reveals no growth of a previously repaired crack. The flaw is in the penetration nozzle base material on the OD of the nozzle at and below the J-groove weld level. The measured length and depth of the flaw during the Cycle 13 outage are 1.96 inches and 0.513 inch, respectively. The ultrasonic (UT) measurement uncertainty in the through-wall depth was stated to be 0.02 inch. The total wall thickness of the nozzle is 0.661 inch. The flaw was originally identified in the Cycle 12 refueling outage as a weld defect having no surface breaking indications with a through-wall depth of 0.44 inch. In the Cycle 13 outage inspection, the flaw was investigated with improved UT equipment for greater flaw definition. This flaw was determined to have grown 0.07 inch in one operating cycle under the PWSCC environment. As a result, it was repaired using an embedded flaw process in accordance with that described in WCAP-15987-P, Revision 2. The SE on this TR was issued on July 3, 2003.

The licensee performed an embedded flaw repair to RVHP No. 56 during the Cycle 13 outage to provide a protective layer of material between the primary water environment and the susceptible material. For RVHP No. 56, the protective layer of PWSCC resistant weld material Alloy 52 covers the entire wetted surface of the J-groove weld and butter as well as the entire OD wetted surface of the nozzle. This repair thereby eliminates contact between the environment and the flaw and should prevent growth of the flaw.

The Cycle 13 outage inspection confirmed that PWSCC caused the growth of the original flaw to 77.6 percent through-wall, which exceeds the applicability limit of 75 percent specified in WCAP-15987-P, Revision 2. As a result, the licensee used the methodology of ASME Code, Section XI, Appendix C (henceforth referred to as only Appendix C) to calculate the critical flaw size for continued operation through SONGS 3 third 10-year ISI interval. As discussed in the December 23, 2004, SE, the application of Appendix C is limited to a flaw size not greater than 75-percent through-wall thickness. Therefore, the staff determined that the licensee's technical basis to use the embedded flaw repair process on RVHP No. 56 was not sufficient for the remainder of the 10-year ISI interval, but was sufficient for one operational cycle.

The approval of Relief Request ISI-3-13 in 2004 was based on the SE determination:

> [S]ufficient margin remains in the remaining ligament of 0.128 inch to provide reasonable assurance of the structural integrity of the reactor coolant pressure boundary and an acceptable level of quality and safety, for one operational cycle. The NRC staff bases this conclusion on the following factors: the previously measured crack growth in one operational cycle with measurement uncertainty was 0.09 inch, and the embedded flaw repair method used on RVHP No. 56 effectively eliminates potential crack growth due to PWSCC. This mitigative action limits the crack growth rate to fatigue alone, which is expected to be very small.

This basis applies to the current relief request, ISI-3-21. In this application, a flaw of 77.6 percent through wall would still meet the ASME Code required margins for the crack stability evaluation of the flaw in the repaired RVHP No. 56. Hence, the staff concludes that the issue to be considered here is whether the embedded flaw repair process, which was completed in accordance with WCAP-15987-P, Revision 2, would achieve its objective of isolating the crack from the PWSCC environment.

The licensee reported its UT inspection results in a letter dated November 20, 2006, which indicate that the crack depth growth for the subject flaw is less than 0.02 inch (the UT measurement resolution capability). Based on this, the staff determines that the flaw has been isolated from the PWSCC environment, and the licensee's relief request to perform no additional repair beyond the existing weld overlay on the J-weld and penetration OD is justified. This staff determination also relieves the licensee from executing its commitment quoted in the December 23, 2004, SE:

> Prior to the end of the next 3 operating cycle [the Cycle 14 outage] SCE will identify a long-term repair method and implement that repair on [RVHP] Nozzle 56 during the next 3 refueling outage.

In summary, Relief Request ISI-3-21 is acceptable because the 2006 UT examination demonstrates that the subject crack has no growth and, therefore, has been isolated from the PWSCC environment. The licensee's fatigue crack growth analysis, which demonstrates that the repaired SONGS 3 RVHP No. 56 can be operated for 10 years, also supports this determination.

4.0 CONCLUSION

The NRC staff has reviewed the licensee's proposal to allow for the continued use of embedded flaw repair as an alternative to the ASME Code requirements for the as-found configuration of the SONGS 3 RVHP No. 56, in accordance with 10 CFR 50.55a(a)(3)(i). Based on its review, the NRC staff finds that the licensee's proposal provides an acceptable level of quality and safety for the requested duration of Cycle 14 operation. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternative to the flaw repair requirements of IWA-4410(a) and related requirements listed in Section 2.2 of this SE, of ASME Code, Sections III and XI, at SONGS 3 for Cycle 14 operation.

Due to the immediate need of this relief request, the NRC staff granted the verbal authorization for the use of this relief request on December 1, 2006.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: S. Sheng

Date: February 7, 2007

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