December 23, 2004

Mr. Harold B. Ray
Executive Vice President
Southern California Edison Company
San Onofre Nuclear Generating Station
P.O. Box 128, Mail Stop: D-3-F
San Clemente, CA 92674-0128

SUBJECT: SAN ONOFRE NUCLEAR GENERATING STATION (SONGS) UNIT 3- RE: REQUEST FOR RELIEF FROM REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) BOILER AND PRESSURE VESSEL CODE (CODE) CONCERNING REACTOR VESSEL HEAD PENETRATION (RVHP) REPAIRS (TAC NO. MC4969)

Dear Mr. Ray:

By letter dated October 26, 2004, as supplemented by letter dated December 2, 2004, Southern California Edison Company (the licensee or SCE) requested relief ISI-3-13 to allow for the use of the embedded flaw repair process as an alternative to requirements of the ASME Code for the as-found configuration of RVHP No. 56 at SONGS Unit 3. Specifically, the licensee requests to deviate from the NRC approved methodology described and referenced in Westinghouse Topical Report WCAP-15987-P, Revision 2, "Technical Basis of the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations."

The Nuclear Regulatory Commission (NRC) staff concludes that the licensee's proposed use of the embedded flaw repair process on RVHP No. 56 provides an acceptable level of quality and safety for one operational cycle. Therefore, pursuant to 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations*, the NRC staff authorizes relief request ISI-3-13 to the flaw repair requirements of the ASME Code, as listed in Section 2.2 of the enclosed safety evaluation, at SONGS Unit 3 for one operational cycle, with the following commitment from the licensee:

> Prior to the end of the next Unit 3 operating cycle SCE will identify a long-term repair method and implement that repair on CEDM [control rod drive mechanism] Nozzle 56 during the next Unit 3 refueling outage.

Sincerely,

/RA/

Robert A. Gramm, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
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-3-13

SOUTHERN CALIFORNIA EDISON

SAN ONOFRE NUCLEAR GENERATING STATION (SONGS) UNIT 3

DOCKET NO. 50-362

1.0 INTRODUCTION

The inservice inspection (ISI) of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by 50.55a(g) of Title 10 of the *Code of Federal Regulations* (10 CFR), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 55a(a)(3) of 10 CFR Part 50 states in part that alternatives to the requirements of paragraph (g) may be used, when authorized by the 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, "Rules for Inservice Inspection (ISI) of Nuclear Power Plant Components," 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) twelve 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 San Onofre Nuclear Generation Station (SONGS) Unit 3, began in August 2003 and will end in August 2013. The ISI Code of record for the SONGS, Unit 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.

By letter dated October 26, 2004, as supplemented by letter dated December 2, 2004, Southern California Edison (SCE or the licensee) submitted relief request ISI-3-13 to allow for use of the embedded flaw repair process as an alternative to the ASME Code requirements for the as-found configuration of Reactor Vessel Head Penetration (RVHP) No. 56 at SONGS Unit 3.

2.0 REGULATORY EVALUATION

2.1 Components for which Relief is Requested

This relief request applies to SONGS Unit 3 RVHP No. 56.

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" or 10% of the section thickness, the repair weld shall be examined by the radiographic method using the acceptance criteria of NB-5320.

WELD 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 XI, IWA-4410(a), to perform repairs on the RPVH penetrations per the rules of 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 following cases:

- In the case of embedded flaw welds on the ID [inside diameter] surface of the penetration tubes, eddy current and ultrasonic examinations will be performed on the overlay repair welds which are surface and volumetric examination but are different methods than specified in NB-2539.4.

- In the case of embedded flaw welds on the OD [outside diameter] surface of the penetration tubes, surface examinations using the liquid penetrant method will be performed on the overlay repair weld surface. Additionally, ultrasonic examinations of the repair weld volume will be performed from the ID surface opposite the overlay repair weld. The ultrasonic method is a different volumetric examination method than is specified in NB-2539.4.

Relief is requested from the Construction Code 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 Basis

By letter dated July 3, 2003, from H. N. Berkow (NRC) to H. A. Sepp (Westinghouse), "Acceptance for Referencing - Topical Report WCAP 15987-P, Revision 2, 'Technical Basis of the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations,' (TAC No. MB8997)," the NRC staff concluded that, subject to the conditions of its safety evaluation (SE), the embedded flaw process proposed provides an acceptable level of quality and safety.

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

In both cases of the ID and 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 Bryan Benney (NRC), "Inspection of Embedded Flaw Repair of a J-groove Weld," dated October 1, 2003.

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 Unit 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 Unit 3," was submitted to the NRC to support this relief request.

Future inspections of this nozzle will be performed to meet the First Revised NRC Order EA-03-009 (Order) and will be consistent with the requirements specified in Section IV of the Order for vessel head penetration nozzle OD repairs below the J-groove weld. Inspections will be performed each refueling outage and the results will be included in the 60-day post refueling outage report required by the Order.

Therefore, the embedded flaw repair process is considered to be an alternative to 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

By letter dated May 5, 2004 (Accession No. ML041260459), the NRC granted Relief Request ISI-3-8 to SONGS Unit 3 to use the embedded flaw repair process in accordance with Westinghouse Topical Report WCAP-15987-P for the third 10-year ISI interval, with the following limitations:

1. Licensees must follow the NRC flaw evaluation guidelines provided in the R. J. Barrett (NRC) letter to A. Marion (Nuclear Energy Institute), "Flaw Evaluation Guidelines," April 11, 2003. (Accession No. ML030980322)

2. The crack growth rate referenced in WCAP-15987-P, Revision 2 is not applicable to Alloy 600 or Alloy 690 weld material, i.e., Alloy 52, 82, 152, and 182 filler material.

3. The nondestructive examination (NDE) requirements listed in the table below must be implemented for examinations of repairs made using the embedded flaw process.

Repair Location	Flaw Orientation	Repair Weld	Repair NDE	ISI NDE of the repair, Note 2
VHP Nozzle ID	Axial	Seal	UT and Surface	UT or Surface
VHP Nozzle ID	Circumferential	Note 1	Note 1	Note 1
VHP Nozzle OD above J-groove weld	Axial or Circumferential	Note 1	Note 1	Note 1
VHP Nozzle OD below J-groove weld	Axial or Circumferential	Seal	UT or Surface	UT or Surface
J-groove weld	Axial	Seal	UT and Surface, Note 3	UT and Surface, Note 3
J-groove weld	Circumferential	Seal	UT and Surface, Note 3	UT and Surface, Note 3

Notes: 1. Repairs must be reviewed and approved separately by the NRC.

2. Inspect consistent with the NRC Order EA-03-009 dated February 11, 2003, and any subsequent changes.

3. Inspect with personnel and procedures qualified with ultrasonic test (UT) performance-based criteria. Examine the accessible portion of the repaired region. The UT coverage plus surface coverage must equal 100 percent.

The NRC staff found the use of the RVHP repair methodology as described in WCAP-15987-P, Revision 2, to be acceptable for the SONGS Unit 3 third 10-year ISI interval. However, WCAP-15987-P uses an equation bounded by a flaw depth of 75 percent wall thickness. By its relief request submittal dated October 26, 2004, the licensee requested relief to use the same previously approved embedded flaw repair process in relief request ISI-3-8 for the SONGS Unit 3 RVHP No. 56 which has a flaw with a measured depth of 77.6 percent through-wall thickness.

The SONGS Unit 3 RVHP No. 56 has a flaw in the penetration nozzle base material on the OD of the nozzle at and below the J-groove weld level. The total length of the flaw is 1.96-inch and measured flaw depth is 0.513-inch. Measurement through-wall depth uncertainty was 0.02-inch. The flaw was identified in the previous outage as a weld defect having no surface breaking indications with a through-wall depth of 0.44-inch. In the current outage inspection, the flaw was investigated with improved ultrasonic equipment for greater flaw definition. This flaw was determined to have grown 0.07-inch in one operational cycle and therefore reclassified as a PWSCC. The total wall thickness of the nozzle is 0.661-inch. The remaining ligament is 0.128-inch with measurement uncertainty included.

The SONGS Unit 3 is currently in its refueling outage. The licensee has performed an embedded flaw repair to RVHP No. 56. The purpose of the embedded flaw repair is 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 removes the environment from the PWSCC flaw and

should prevent growth of the flaw due to PWSCC. The flaw may grow, but at a very limited rate due to fatigue only. The licensee used the methodology of ASME Code, Section XI, Appendix C to calculate critical flaw size for continued operation through SONGS Unit 3 third 10-year ISI interval.

Enclosure A of the licensee's submittal, "Evaluation of the Acceptability of Embedded Flaw Repair of the Indication in Reactor Vessel Head Penetration No. 56 at SONGS Unit 3," presents the licensee's basis for applicability of the embedded flaw repair on RVHP No. 56 in the as-found condition. Section 4.1 of this submittal provided a technical basis for this relief request based on the use of ASME Code, Section XI, Appendix C for flaw analysis. The NRC staff found that the use of Appendix C is limited to a flaw size not greater than 75 percent through-wall thickness. Therefore, Appendix C is not applicable to the flaw in RVHP No. 56 as the reported flaw size has a depth of 78 percent through-wall thickness. As such, 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. However, there is sufficient technical basis for relief for one operational cycle.

The NRC staff finds that sufficient 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 operating 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. Further, if a 100 percent through-wall flaw does develop, in order for pressure boundary leakage to occur, the flaw must continue to grow through the J-groove weld or through base material to a level higher than the root of the J-groove weld. Furthermore, if leakage does occur, in accordance with the requirements of the Order, the licensee will perform effective examinations of the reactor pressure vessel upper head and all associated penetration nozzles during the next outage to identify any pressure boundary leakage or other degradation.

However, because the ASME Section XI, Appendix C requirements limit its applicability to flaws with through-wall depths less than or equal to 75 percent, and is not applicable to the licensee's request, this relief is only authorized for one cycle of operation. As such, the licensee has committed, in a letter dated December 2, 2004, to repair the nozzle during the next refueling outage as follows:

> This letter revises Section 6.0 "Duration of the Proposed Alternative" from the "third in-service inspection interval" to "one Unit 3 operating cycle, which is expected to begin in December of 2004 and end in the third quarter of 2006.
>
> Prior to the end of the next Unit 3 operating cycle SCE will identify a long-term repair method and implement that repair on CEDM Nozzle 56 during the next Unit 3 refueling outage.

4.0 CONCLUSION

The NRC staff has reviewed the licensee's proposal to allow for the use of embedded flaw repair as an alternative to the ASME Code requirements for the as-found configuration of the SONGS Unit 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 one operational cycle. 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 Unit 3 for one operational cycle, with the following commitment by the licensee:

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

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: J. Collins

Date: December 23, 2004

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