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Manager of
Nuclear Regulatory Affairs

August 1, 2007

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: **Docket Nos. 50-361 and 50-362**
**Third Ten-Year Inservice Inspection (ISI) Interval Request ISI-3-28**
**48-hour Hold Period**
**San Onofre Nuclear Generating Station, Units 2 and 3**

References: (1) Letter from A. E. Scherer (SCE) to Document Control Desk (NRC), dated July 14, 2006, Subject: Docket Nos. 50-361 and 50-362, Third Ten-Year Inservice Inspection (ISI) Interval Relief Request ISI-3-25, Use of Structural Weld Overlay and Associated Alternative Repair Techniques, San Onofre Nuclear Generating Station, Units 2 and 3.

(2) Letter from A. E. Scherer (SCE) to Document Control Desk (NRC), dated February 21, 2007, Subject: Docket Nos. 50-361 and 50-362, Third Ten-Year Inservice Inspection (ISI) Interval Relief Request, ISI-3-27 Use of Structural Weld Overlay and Associated Alternative Repair Techniques, San Onofre Nuclear Generating Station, Units 2 and 3.

Dear Sir or Madam:

Pursuant to 10 CFR 50.55a(a)(3)(i), Southern California Edison (SCE) requests approval to use alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, 1995 Edition through 1996 Addenda, IWA-4000, for repair/replacement activities related to the performance of structural weld overlays at San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 for the third 10-year inservice inspection (ISI) interval.

SCE is planning to perform a structural weld overlay on the pressurizer surge line nozzle to safe end welds and the adjacent stainless steel welds in both Units 2 and 3 to reduce dependence on the Alloy 82/182 welds as a pressure boundary weld and to mitigate any potential primary water stress corrosion cracking in the future. These structural weld overlays will be performed in accordance with ISI-3-25, submitted to the NRC by letter dated July 14, 2006 (Reference 1), as supplemented by letters dated September 29 and October 23, 2006, and approved by the NRC on June 12, 2007.

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SCE is also planning to perform a structural weld overlay on the Reactor Coolant System (RCS) Hot Leg Surge line, Hot Leg Drain line, and Shutdown Cooling line nozzle to safe end welds and adjacent stainless steel welds in both Units 2 and 3 to reduce dependence on the Alloy 82/182 welds as a pressure boundary weld and to mitigate any potential primary water stress corrosion cracking in the future. Pending NRC approval, these structural weld overlays will be performed in accordance with ISI-3-27, submitted to the NRC by letter dated February 21, 2007 (Reference 2).

SONGS Units 2 and 3 are in their third 10-year ISI interval, which started on August 18, 2003 and is scheduled to end on August 17, 2013. The 1995 Edition through 1996 Addenda of Section XI applies to the ISI program, the Risk Informed ISI (RI-ISI) program, the Repair/Replacement program activities, and the requirements associated with Appendix VIII, Performance Demonstration for Ultrasonic Examination Systems.

Relief Request ISI-3-28 is enclosed with this letter. This relief request proposes to begin the 48-hour hold period required by Code Case N-638-1 following completion of application of the third temperbead layer. This relief request is applicable to the welds described in Relief Requests ISI-3-25 and ISI-3-27 (Note that ISI-3-28 also corrects an editorial error in ISI-3-25 that mis-identified an applicable component). Pending approval of both ISI-3-27 and ISI-3-28, structural weld overlays will be performed on these welds in accordance with Relief Requests ISI-3-25 and ISI-3-27 and this Relief Request ISI-3-28. SCE has determined that this proposed modification to Code Case N-638-1 will provide an acceptable level of quality and safety.

Similar relief requests have been previously approved for Tennessee Valley Authority for its Sequoyah Nuclear Plant, Units 1 and 2, on June 11, 2007; and for Entergy for its Arkansas Nuclear One, Unit 1, on April 6, 2007.

SCE requests approval of this relief request to support the return to service of SONGS Unit 3 from the Cycle 14 mid-cycle outage. SCE currently anticipates that approval would be needed by November 6, 2007, but it could occur earlier.

Should you have any questions, please contact Ms. Linda T. Conklin at (949) 368-9443.

Sincerely,

Enclosure:

cc: B. S. Mallett, Regional Administrator, NRC Region IV
N. Kalyanam, NRC Project Manager, San Onofre Units 2 and 3
C. C. Osterholtz, NRC Senior Resident Inspector, San Onofre Units 2 and 3

Southern California Edison (SCE)

San Onofre Nuclear Generating Station (SONGS), Units 2 and 3

Docket Nos. 50-361 and 50-362

Enclosure

Relief Request ISI-3-28

48-Hour Hold Period Following Application of the Third Temperbead Layer

*Proposed Alternative*
*In Accordance with 10 CFR 50.55a(a)(3)(i)*
*- Alternative Provides Acceptable Level of Quality and Safety -*

## 1.0 REASON FOR THE REQUEST

Southern California Edison (SCE) will be performing full structural weld overlays to reduce dependence on the Alloy 82/182 welds as a pressure boundary weld and to mitigate any potential primary water stress corrosion cracking in the future. SCE has submitted Relief Requests ISI-3-25 and ISI-3-27 by letters dated July 14, 2006 and February 21, 2007, respectively. The NRC issued approval of ISI-3-25 by letter dated June 12, 2007.

Relief Requests ISI-3-25 (as currently approved) and ISI-3-27 (as currently requested) require that the final weld surface be examined using surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours. Research and industry experience show that starting the 48-hour hold period following completion of application of the third temperbead layer provides an acceptable level of quality and safety. Thus, this is the reason for Relief Request ISI-3-28.

## 2.0 CODE COMPONENTS FOR WHICH RELIEF IS REQUESTED

Group: High safety significant (HSS) Class 1 dissimilar metal piping welds with Alloy 82/182 weld metal are susceptible to Pressurized Water Stress Corrosion Cracking (PWSCC).

a) Name of Components:

1. Unit 2 Pressurizer S21201ME087 surge line nozzle to safe end HSS dissimilar metal weld (ISI Designation Number 02-005-031) with Alloy 82/182 weld material subject to PWSCC.

2. The adjacent Unit 2 Pressurizer S21201ME087 stainless steel weld (ISI Designation Number 02-016-001)

3. Unit 3 Pressurizer S31201ME087 surge line nozzle to safe end HSS dissimilar metal weld (ISI Designation Number 03-005-031) with Alloy 82/182 weld material subject to PWSCC.

4. The adjacent Unit 3 Pressurizer S31201ME087* stainless steel weld (ISI Designation Number 03-016-001)

5. Reactor Coolant System Hot Leg surge line nozzle to safe end HSS dissimilar metal welds (ISI Designation Number 02-006-010/03-006-010) with Alloy 82/182 weld material subject to PWSCC.

* Note that this component was erroneously identified in ISI-3-25 as S21201ME087.

6. The adjacent stainless steel welds (ISI Designation Number 02-016-016/03-016-016).

7. Reactor Coolant System Hot Leg drain nozzle to safe end HSS dissimilar metal welds (ISI Designation Number 02-006-011/03-006-011) with Alloy 82/182 weld material subject to PWSCC.

8. The adjacent stainless steel welds (ISI Designation Number 02-030-001/03-030-010).

9. Shutdown Cooling System Hot Leg nozzle to safe end HSS dissimilar metal weld (ISI Designation Number 02-007-009/03-007-009) with Alloy 82/182 weld material subject to PWSCC.

10. The adjacent stainless steel welds (ISI Designation Number 02-021-001/03-021-010).

b) American Society of Mechanical Engineers (ASME) Code Class:

These welds are all ASME Code Class 1 welds located within the reactor coolant pressure boundary.

c) System:

Reactor Coolant System (RCS)

| | |
|---|---|
| d.1) Code Category:<br><br>Examination Category B-F, "Risk-Informed Piping Examinations" | d.2) Code Category:<br><br>Examination Category B-J, "Risk-Informed Piping Examinations" |
| e.1) Code Item No. B5.40<br><br>"Welds subject to PWSCC" (ISI Designation Numbers 02-005-031 and 03-005-031)<br><br>"Welds subject to Thermal Fatigue" (ISI Designation Numbers 02-005-031 and 03-005-031) | e.2) Code Item No. B9.11<br><br>"Welds subject to PWSCC" (ISI Designation Numbers 02-006-010, 02-007-009, 03-006-010, and 03-007-009).<br><br>"Welds subject to Thermal Fatigue" (ISI Designation Numbers 02-016-001, 02-006-010, 02-007-009, 02-016-016, 02-021-001, 03-016-001, 03-006-010, 03-007-009, 03-016-016, and 03-021-010) |

| | |
|---|---|
| N/A | e.2) Code Item No. B9.21<br><br>"Welds subject to PWSCC" (ISI Designation Number 02-006-011 and 03-006-011).<br><br>"Welds subject to Thermal Fatigue" (ISI Designation Numbers 02-006-011, 03-006-011, 02-030-001, and 03-030-010). |

## 3.0 CODE REQUIREMENTS FOR WHICH RELIEF IS REQUESTED

Modification to Code Case N-638-1 (Reference 4).

## 4.0 PROPOSED ALTERNATIVES AND SUPPORTING INFORMATION

Pressurizer Surge Line (ISI-3-25)

A structural weld overlay repair has been approved by the NRC for the pressurizer S2(3)1201ME087 surge line nozzle to safe end HSS dissimilar metal welds (ISI Designation Numbers 02-005-031 and 03-005-031) and the adjacent welds (ISI Designation Numbers 02-016-001 and 03-016-001). The material of the above two nozzles is ferritic steel (P3). The pipe safe ends are austenitic stainless steel (P8). The surge line nozzles material is SA-508 Class 2 and the safe end material is SA-351 CF8M. The existing weld filler material is Alloy 82/182 (F43 equivalent to P43). The surge line pipe is stainless steel SA-376 Grade TP316. As described in NRC-approved Relief Request ISI-3-25, the overlay will be designed as a structural weld overlay in accordance with ASME Section XI Code Case N-504-2 and Nonmandatory Appendix Q (Reference 3). The temper bead welding technique will be implemented in accordance with ASME Section XI Code Case N-638-1 (Reference 4) for that portion of the overlay applied over the ferritic base material for which the Construction Code requires post-weld heat treatment.

Hot Leg Surge/Drain Line, Shutdown Cooling Surge Line (ISI-3-27)

| **Dissimilar Metal Weld Identifier** | **Nozzle Material** | **Safe End Material** |
|---|---|---|
| Hot Leg Surge Line 02-006-010/03-006-010 | SA-105 GR II Forging | SA-351 GR CF8M Stainless Steel Cast |
| Hot Leg Drain 02-006-011/03-006-011 | SA-105 GR II Forging | SA-182 F316 Forging |
| Shutdown Cooling Line 02-007-009/03-007-009 | SA-105 GR II Forging | SA-351 GR CF8M Stainless Steel Cast |
| **Adjacent Stainless Steel Weld Identifier** | **Pipe Material** | |
| Hot Leg Surge Line 02-016-016/03-016-016 | SA-376 Grade TP316 | |
| Hot Leg Drain 02-030-001/03-030-010 | SA-376 Grade TP316 | |
| Shutdown Cooling Line 02-021-001/03-021-010 | SA-403 Grade WP316 | |

As described in Relief Request ISI-3-27, the overlay will be designed as a structural weld overlay in accordance with ASME Section XI Code Case N-504-2 and Nonmandatory Appendix Q (Reference 3). The temper bead welding technique will be implemented in accordance with ASME Section XI Code Case N-638-1 (Reference 4) for that portion of the overlay applied over the ferritic base material for which the Construction Code requires post-weld heat treatment.

Relief Requests ISI-3-25 and ISI-3-27 cite several modifications to Code Case N-638-1 that SCE would apply during weld overlay installation. Specifically, these modifications to the Code Case are found in Table 3, of Enclosure 1, Attachment 1 of SCE's July 14, 2006 and February 21, 2007 submittals. This Relief Request ISI-3-28 proposes an additional modification to Code Case N-638-1.

Paragraph 4.0(b) of Code Case N-638-1 states in part:

> 4.0(b) "The final weld surface and the band around the area defined in para. 1.0(d) shall be examined using surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours...."

Relief Request ISI-3-28 proposes:

> A modification to the above requirement to allow the 48-hour hold time to begin following completion of the third temperbead layer.

Any applicable requirements not addressed by Relief Request ISI-3-28, or by Tables 1, 2, and 3 of ISI-3-25 and ISI-3-27, will be satisfied as described in Section XI, 1995 Edition through 1996 Addenda, IWA-4000 (Reference 1); Appendix VIII, Supplement 11 (Reference 2); Code Case N-504-2 (Reference 3); and Code Case N-638-1 (Reference 4).

This modification to Code Case N-638-1 is based on the following discussion:

In December 2006, the Electric Power Research Institute (EPRI) issued Technical Report 1013558, "48-Hour Hold Requirements for Ambient Temperature Temperbead Welding" (Reference 5, ADAMS Accession No. ML070670060). Although the technical data provided by EPRI in their report is based on testing performed on SA-508 Class 2 low alloy steels and other P-Number 3, Group 3 materials, the conclusions are bounding and applicable to P-Number 1 materials such as SA-105 GR II which have a lower carbon equivalent and lower hardenability. This is important because SONGS hot leg surge line, hot leg drain and shut down cooling lines have this SA-105 GR II forging type nozzle material.

The technical report focuses on four key concerns associated with the 48-hour hold time. The four key concerns are:

(1) Microstructural Issues
(2) Sources for Hydrogen Introduction
(3) Diffusivity and Solubility of Hydrogen in Steels
(4) Tensile Stress and Temperature

A summary of the EPRI research results are as follows:

The microstructure in the P-3 material directly beneath the temperbead Weld Overlay (WOL) consists of a tempered martensite or tempered upper bainite that has excellent toughness, combined with a modest maximum hardness (of the order of Rockwell [Rc] 30 or lower).

The microstructure at the toe of the temperbead WOL in the P-3 weld heat affected zone (HAZ) at the outside diameter (OD) surface where tempering is somewhat limited may have a very small HAZ with a maximum hardness of the order of Rc 36, at a distance of approximately 40 mils from the toe of the WOL. At a depth of approximately 2 to 2.5 mm (80 to 100 mils) beneath the toe of the WOL, the hardness is reduced to less than 294 Knoop hardness (29 Rc), a hardness level well below that required to cause hydrogen cracking.

Sources of hydrogen include moisture, poor shielding gas, and contamination. It is noted that moisture in the shielding gas or high humidity is not a problem for

Gas-Tungsten Arc Welding (GTAW) temperbead welding. Contamination will affect the weld, and should be identified either during the welding process or during the subsequent Non-Destructive Examination (NDE) of the overlay. Good welding practice should eliminate this problem for the temperbead WOL.

Tensile stresses should not be an issue for cold cracking as the thermal stresses diminish with each weld overlay layer. Following the final layer, it is expected that the maximum surface temperature at the toe of the WOL in the P-3 HAZ would reach temperatures only on the order of 400 degrees Fahrenheit (°F) to 500 °F. Slow cooling to ambient temperatures from these temperatures would be expected to produce relatively small stresses.

The diffusion rate for hydrogen is greater in ferritic material than in austenitic materials, but the solubility of hydrogen in austenite is from five to seven times greater in the austenite than in the ferrite or martensite. Consequently, due to the temperatures expected during the welding of the temperbead layers, and during the welding of the non-temperbead WOL layers, the temperature should be sufficient for the hydrogen to diffuse out of the material, either escaping the structure or diffusing into the austenite, where it can be held in much greater quantities. Thus, even if hydrogen is produced, a large hydrogen inventory in the P-3 material is not expected.

Based on the above discussion, EPRI Technical Report 1013558 concludes that there is no technical basis for waiting 48 hours after cooling to ambient temperature before beginning the NDE of the completed weld.

In addition to the EPRI report, the ASME Section XI Code Committee approved Revision 4 to ASME Code Case N-638 in October 2006 to allow the 48-hour hold time to begin after completing the third weld layer when using austenitic filler metals. Paragraph 4(a)(2) of the code case states in part: "When austenitic materials are used, the weld shall be nondestructively examined after the three tempering layers (i.e., layers 1, 2, and 3) have been in place for at least 48 hours." The ASME Section XI technical basis for this change is documented in an ASME white paper (ADAMS Accession No. ML070790679). The ASME white paper points out that introducing hydrogen to the ferritic HAZ is limited to the first weld layer since this is the only weld layer that makes contact with the ferritic base material. While the potential for introducing hydrogen to the ferritic HAZ is negligible during subsequent weld layers, these layers provide a heat source that accelerates the dissipation of hydrogen from the ferritic HAZ in non-water backed applications. Furthermore, the solubility of hydrogen in austenitic materials such as Alloy 52M is much higher than that of ferritic materials while the diffusivity of hydrogen in austenitic materials is lower than that of ferritic materials. As a result, hydrogen in the ferritic HAZ tends to diffuse into the austenitic weld metal which has a much higher solubility for hydrogen. This diffusion process is enhanced by heat supplied in subsequent weld layers. Like the EPRI report, the ASME white paper concludes that there is sufficient delay time to facilitate detecting potential hydrogen cracking when NDE is performed 48 hours after completing the third weld layer.

## 5.0 DURATION OF PROPOSED RELIEF REQUEST

This request will be applied for the remainder of the current SONGS Units 2 and 3 third 10-year ISI interval that started on August 18, 2003. Once these structural weld overlays are installed they will remain in place for the design life of the repair that is defined by the evaluation required in paragraph (g) of Code Case N-504-2 and corresponding requirements in Nonmandatory Appendix Q (Reference 3). The structural weld overlays are also subject to the satisfactory examination requirements of Article Q-4000 for inservice inspection. Those requirements include adding any installed structural weld overlay repairs into the SONGS Units 2 and 3 ISI plan per Subarticle Q-4300 for at least one inservice examination to be completed within the next 2 refueling cycles.

## 6.0 PRECEDENTS

1. Letter from Thomas H. Boyce, NRC, to William R. Campbell, Jr., Tennessee Valley Authority, "Sequoyah Nuclear Plant, Units 1 and 2, and Watts Bar Nuclear Plant, Unit 1 – Request for Relief G-RR-1 Regarding Preemptive Weld Overlays on Pressurizer Nozzles (TAC Nos. MD2381, MD2382 and MD2383)," dated June 11, 2007.

2. Letter from David Terao, NRC, to Timothy G. Mitchell, Entergy Operations, "Arkansas Nuclear One, Unit 1 – Request for Alternative ANO1-R&R-010 to Use Proposed Alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code Requirements for Pressurizer Nozzle Weld Overlay Repairs (TAC No. MD4019)," dated April 6, 2007.

## 7.0 REFERENCES


(1) 1995 Edition through 1996 Addenda, ASME Code, Section XI, IWA-4000.

(2) 1995 Edition, ASME Code, Section XI, with the 1996 Addenda, Appendix VIII, Supplement 11.

(3) ASME Code Case N-504-2, Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Section XI, Division 1, March 12, 1997, including ASME Code Section XI, 2005 Addenda, Nonmandatory Appendix Q, Weld Overlay Repair of Class 1 , 2, and 3 Austenitic Stainless Steel Piping Weldments.

(4) ASME Code Case N-638-1, Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique Section XI, Division 1, February 13, 2003.

(5) EPRI Technical Report 1013558, "48-Hour Hold Requirements for Ambient Temperature Temperbead Welding" (ADAMS Accession No. ML070670060).


## 8.0 CONCLUSION

SCE has determined that the approach described in this relief request provides sufficient delay time to facilitate the detection of potential hydrogen cracking when non-destructive examination is performed 48 hours after completion of the third weld layer. SCE believes that the use of this relief request to begin the 48-hour hold period after application of the third temperbead layer on the pressurizer surge nozzle and RCS hot leg structural weld overlay repairs at SONGS Units 2 and 3 will result in an acceptable level of quality and safety that meets the requirements of 10 CFR 50.55a(a)(3)(i).