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A Edward Scherer
Manager of Nuclear
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May 24, 2002

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

Subject: San Onofre Nuclear Generating Station Units 2 and 3
Docket Nos. 50-361 and 50-362
Relief Requests to Support Alternative Repair Methods for Reactor Vessel Head Penetrations

References 1) Westinghouse letter LTR-NRC-01-41, "ASME Section XI Inservice Inspection Program Relief Requests - Alternative Repair Technique," dated December 13, 2001, from H. A. Sepp, Manager Regulatory and Licensing Engineering to Samuel J. Collins, USNRC

2) Westinghouse letter LTR-NRC-02-6, "ASME Section XI Inservice Inspection Program Relief Request – Alternative Repair Techniques," dated February 18, 2002, from H. A. Sepp, Manager Regulatory and Licensing Engineering to D. Holland, USNRC

Dear Sir or Madam:

During the San Onofre Nuclear Generation Station (SONGS) Unit 2 refueling outage, Southern California Edison (SCE) will be conducting inspections of the reactor vessel head penetrations (RVHP) in accordance with commitments made in response to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles." The same inspections will also be performed at Unit 3 in January, 2003. In accordance with 10 CFR 50.55a(a)(2), systems and components of pressurized water-cooled nuclear power reactors must meet the requirements of the ASME Code. SCE is proposing 2 enclosed relief requests (RR) to the requirements of Section III and Section XI of the ASME Code for repair of flaws that may be identified during these inspections.

1) RR RVHP-1	Temperbead Technique	(Enclosure 1)
2) RR RVHP-2	Embedded Flaw Repair Technique	(Enclosure 2)

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Westinghouse presented similar proposed repair alternatives to the NRC on December 13, 2001, (Reference 1) and February 18, 2002 (Reference 2). The Temperbead technique repair alternative for the Half-Bead Technique is similar to the repair alternative proposed by Waterford 3, Arkansas Nuclear One Unit 2, Palo Verde Nuclear Generating Station, North Anna Power Station Unit 2, Turkey Point Unit 3, and D.C. Cook Units 1 and 2 and the repair alternative for the Embedded Flaw Repair Technique is similar to the repair alternative proposed by Palo Verde Nuclear Generating Station, North Anna Power Station Unit 2, and D.C. Cook Units 1 and 2.

Relief requests RR RVHP-1 and RR RVHP-2 are being submitted pursuant to 10 CFR 50.55a(a)(3)(i) and 10 CFR 50.55a(a)(3)(ii). Under these provisions, licensees may propose alternatives to the requirements of 10 CFR 50.55a if they meet the following criteria.

- The proposed alternative would provide an acceptable level of quality and safety
- Compliance with the specified requirements would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

SCE requests approval of the proposed alternatives in the event that RVHP inspections that are scheduled during the Unit 2 refueling outage in May, 2002 and the Unit 3 refueling outage in January, 2003, reveal the need for such repairs.

No commitments are being made to the NRC in this letter.

Should you have any questions, please contact Mr. Jack Rainsberry at (949) 368 7420.

Sincerely,

Enclosures

cc: E. W. Merschoff, Regional Administrator, NRC Region IV
A. B. Wang, NRC Project Manager, San Onofre Units 2, and 3
C. C. Osterholtz, NRC Senior Resident Inspector, San Onofre Units 2 & 3

ENCLOSURE 1

Proposed Alternative Repair Method for SONGS Reactor Vessel Head Penetrations

Relief Request No. RVHP-1

Temperbead Technique

<u>Relief Request No. RVHP-1</u>

Temperbead Technique

Code Class: 1

Code References: American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section XI, 1989 Edition, No Addenda

American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section III, 1992 Edition, No Addenda

Section XI, IWB-2500-1
Examination Category: B-E

Item Numbers: B4.11, B4.12, and B4.13

System/Component: Control Element Drive Mechanism (CEDM) nozzles (91 penetrations)
Incore Instrumentation (ICI) nozzles (10 penetrations)
Reactor head vent nozzle (1 penetration)

SONGS Units: 2 and 3

Inspection Interval: Second 10-Year ISI Interval

Code Requirement:

ASME Section XI, IWA-4120, 1989 Edition requires the following:

> "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 Code Cases may be used. If repair welding cannot be performed in accordance with these requirements, the applicable alternative requirements of IWA-4500 and the following may be used:..."

Per paragraph IWA-4120, repair welding must be performed in accordance with the original Construction Code unless it is not possible to perform the repair. In that case the rules of IWA-4500 may be used. For any weld excavation that results in a repair within 1/8 inch of the ferritic material of the vessel head, Section III of the ASME Code (NB-4620) requires a postweld heat treatment of the repair weld.

The 1989 Edition of Section XI of the ASME Code provides alternative rules for such a repair, in paragraph IWA-4500. The provisions of IWA-4500 permits the use of "Welding Dissimilar Materials By Half-Bead Welding Technique," which involves the establishment and maintenance of a 300°F minimum preheat temperature for 30 minutes prior to welding and during welding, maintaining a maximum interpass temperature of 400°F. The "repair technique", only allows for the use of the Manual Shielded Metal Arc (SMAW) welding process, using a low hydrogen flux coated electrode. The ferritic side of the cavity is then buttered, using a 3/32" electrode. Approximately one half the thickness of this buttering layer shall be removed by grinding or machining before depositing the second layer with an 1/8" electrode. Buttering shall continue until a minimum of 3/16" of weld metal has been deposited. Prior to completing the balance of the weld, a minimum of a 3T band shall be maintained during a post weld bake-out (soak) at 450°F - 550°F for a minimum of 2 hours. For the balance of welding, the maximum interpass temperature shall be 350°F and the minimum preheat temperature shall be 60°F. Thermocouples may be attached by welding or by mechanical methods.

Code Examination Requirements:

After the heat treatment of 450 - 550°F for 2 hours has been performed, the weld shall be examined by liquid penetrant examination. In addition, each subsequent 1/4" of deposited weld metal shall be examined by liquid penetrant examination. Once the completed repair welded region has been at ambient temperature for a minimum of 48 hours, a 3T band shall be nondestructively examined by radiography, if practical, ultrasonic examination and liquid penetrant. Areas, from which weld attached thermocouples have been removed, shall be ground and examined by the magnetic particle or liquid penetrant method.

Proposed Alternative:

As an alternative to the Half-Bead Technique rules contained in the 1989 ASME Section XI, IWA-4500, it is requested that the NRC approve the use of the proposed Temperbead Technique method presented to the NRC by Westinghouse Electric Company, LLC (Reference 1).

Basis for Alternative Requirements:

SCE believes the proposed alternative provides an equivalent repair method. Several organizations including EPRI have conducted research on the use of room temperature machine Gas-Tungsten Arc Welding (GTAW) temperbead technique. This effort is documented in EPRI Report GC-111050, Ambient Temperature Preheat for Machine GTAW Temperbead Applications (Reference 2). The EPRI report indicates that repair welds performed with an ambient temperature temperbead procedure which utilizes a machine GTAW process exhibit mechanical properties equivalent to those of the surrounding base material.

Section 3.0, Welding Preheat/Post-Weld Bake, of Reference 2 discusses the principal cracking concerns associated with the need to preheat a weld or weldment substrate. However, when using a process such as the one proposed in Reference 1, the heat of the deposited weld layers is precisely controlled to provide sufficient heat to temper each previously deposited weld layer. This tempering, as stated in Reference 2, will produce requisite material strength and toughness properties without a need for any post-weld heat treatment.

Additionally, SCE believes that the preheat and post weld bake requirements for the reactor vessel head are considered a hardship for the following reasons.

1. Preheat, interpass, and postweld soak temperatures must be monitored which requires thermocouples be welded to the reactor pressure vessel head.

2. Heating blankets and thermal insulation must be installed and removed. It will be difficult to install blankets effectively and remove them because of the weld locations.

3. Thermocouples and stud welds would be removed by grinding, and the removal areas examined by the liquid penetrant or magnetic particle method.

The radiation exposures to worker personnel for set-up, monitoring, and removal of preheat/post-weld bake equipment is unjustified based upon the marginal value of performing these heat treatments. This repair process would be extremely difficult and require personnel to incur significant radiation exposure. Using the proposed method of repair will result in a significant decrease in the radiation exposure to personnel involved in the repair.

Conclusion(s):

Repairs to pressure vessel component weldments requiring welding within 1/8 inch of the ferritic base metal has typically involved the use of the Half-bead requirements of Paragraph IWA-4500 of Section XI of the ASME Code. These rules specify that the repair be performed using the manual SMAW welding technique and include both preheat and post weld bake-out.

In the case of repairs to the reactor vessel head penetration "J" groove attachment welds, where welding within 1/8 inch of the vessel material is required, SCE proposes to use the repair method presented to the NRC by Westinghouse Electric Company, LLC. (Reference 1). SCE has shown in this submittal that use of this alternative repair method will provide an acceptable level of quality and safety, and has shown that compliance with the specified requirements of IWA-4500 would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Reference(s):

1. Westinghouse letter LTR-NRC-02-6, "ASME Section XI Inservice Inspection Program Relief Request – Alternative Repair Technique," dated February 18, 2002, from H. A. Sepp, Manager Regulatory and Licensing Engineering to D. Holland, USNRC.

2. EPRI Report GC-111050, "Ambient Temperature Preheat for Machine GTAW Temperbead Applications," November 1998.

3. American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section XI, 1989 Edition, No Addenda

4. American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section III, 1992 Edition, No Addenda

ENCLOSURE 2

Proposed Alternative Repair Method for SONGS Reactor Vessel Head Penetrations

Relief Request No. RVHP-2

Embedded Flaw Repair Technique

<u>Relief Request No. RVHP-2</u>

Embedded Flaw Repair Technique

Code Class: 1

Code References: American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section XI, 1989 Edition, No Addenda

American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section III, 1992 Edition, No Addenda

Section XI, IWB-2500-1
Examination Category: B-E

Item Numbers: B4.11, B4.12, and B4.13

System/Component: Control Element Drive Mechanism (CEDM) nozzles (91 penetrations)
Incore Instrumentation (ICI) nozzles (10 penetrations)
Reactor head vent nozzle (1 penetration)

SONGS Units: 2 and 3

Inspection Interval: Second 10-Year ISI Interval

Code Requirement:

ASME Section XI, IWA-4120, "Rules and Requirements," 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 Code Cases may be used."

Normally, repairs would be performed in accordance with the Vessel Construction Code, ASME III, as provided for in ASME XI, IWA-4120. ASME III requires that defects either in base metal or weld metal be removed or reduced in size to meet established acceptance standards prior to repair welding.

The following parts of ASME III contain the requirements for elimination of defects and weld repair:

NB-4131/NB-2539.1 and NB-4453.1 address defect removal and require surface examinations meeting the acceptance standards in NB-2545/2546 and NB-5340/5350, respectively, prior to repair welding.

NB-2539.2 and NB-4453.2 discuss requirements for welding material, welders, and weld procedures.

NB-2539.3 and NB-4453.3 require the repaired area to be uniformly blended into the surrounding surface.

NB-2539.4 and NB-4453.4 stipulate the examination requirements for the repair welds. Base metal repairs made per NB2539.4 require surface examinations per NB-2545/2546 and radiography per NB-5110/5320 where the depth of the repair exceeds the lesser of 3/8" or 10% of the section thickness. Repairs to welds made per NB-4453 require the same examination method specified for the original weld be performed, which in this case is a progressive surface examination per NB-5245.

NB-2539.5 and NB-4453.5 require that repair welds be post weld heat treated if required by NB-4620.

ASME Section XI Applicability: The examinations that are being performed which may occasion the need to perform embedded flaw repairs are in excess of the Code mandated inspection for the reactor head penetrations and attachment welds. The inservice examination requirements of Table IWB-2500-1 mandate a visual examination from above the insulation for 25% of the penetration welds, with IWB-3522 as the acceptance standard. Besides this visual examination there is no other ISI requirement for the penetration tubes or repairs to them. We do believe paragraphs IWB-3132 and IWB-3142 are not applicable to the proposed embedded flaw repairs because these paragraphs discuss requirements related to Code imposed examinations, as is clear from their location in sub-article IWV-3130, "Inservice Volumetric and Surface Examinations. As a consequence of the inapplicability of paragraphs IWB-3132 and IWB-3142 it is concluded that sub-subarticle IWB-2420 dealing with successive inspections is not applicable either since it specifically discusses flaw evaluations performed in accordance with IWB-3132.4 or IWB-3142.4.

Proposed Alternative:

The embedded flaw repair technique will be used as an alternative to ASME Section XI, 1989 Edition, No Addenda and ASME III, 1992 Edition, No Addenda Code requirements.

Specifically, alternatives are being proposed for the following parts of ASME Section III:

NB-4131/NB-2539.1 and NB-4453.1 address defect removal and require surface examinations meeting the acceptance standards in NB-2545/2546 and NB-5340/5350, respectively, prior to repair welding. In the proposed repairs, defects will not be removed. Instead, it is proposed that the defects be embedded with a weld overlay that will isolate them from the reactor coolant and preclude further propagation from primary water stress corrosion cracking (PWSCC). The structural integrity of the embedded flaw repair areas will be maintained by the remaining unflawed portion of the base metal or weld.

NB-2539.2 and NB-4453.2 discuss requirements for welding material, welders and weld procedures. These requirements will be met in the proposed embedded flaw repair process.

NB-2539.3 and NB-4453.3 require the repaired area to be uniformly blended into the surrounding surface. These requirements will be met in the proposed embedded flaw repair process.

NB-2539.4 and NB-4453.4 stipulate the examination requirements for the repair welds. Base metal repairs made per NB-2539.4 require surface examinations per NB-2545/2546 and radiography per NB-5110/5320 where the depth of the repair exceeds the lesser of 3/8" or 10% of the section thickness. Repairs to welds made per NB-4453 require the same examination method specified for the original weld be performed, which in this case is a progressive surface examination per NB-5245. In the proposed repair process, where excavation of the J-weld has occurred, the repair weld will be subject to a progressive liquid penetrant examination per the requirements of NB-5245. If no excavation of the J-weld is performed prior to the deposit of the weld overlay, or the excavation is performed in the nozzle base metal in preparation for the weld overlay, the final surface of the weld overlay will be examined by liquid penetrant. The acceptance criteria will be per NB-5350 in either case.

NB-2539.5 and NB-4453.5 require that repair welds be post weld heat treated if required by NB-4620. No post weld heat treatment will be required for the embedded repair technique because all of the base metal and welds being welded on are either high nickel alloys or austenitic stainless steels and do not require post weld heat treatment by NB-4620.

Basis for Alternative Requirements:

Complete removal of identified flaws in the penetration will be performed for relatively shallow flaws initiating on the inside diameter of the penetration. If deep flaws are identified which are connected to the inside diameter of the penetration or if flaws are identified in the penetration attachment weld or the outside diameter of the penetration including through wall, the proposed alternative is to repair those flaws using the embedded flaw repair technique. The repair process to accomplish complete flaw removal would have a negative impact due to the following reasons:

1. The excavated volume would need to be significantly larger to ensure complete flaw removal

2. The weld deposits required to fill in the larger excavations would be significantly larger, resulting in very high, localized residual stresses and potential distortion of the penetration

3. The potential for a required Temperbead weld repair substantially increases

Each of the above concerns could result in substantial outage schedule impact and additional dose to personnel performing the repairs, with no increase in safety. In addition, the potential exists for detrimental impact to the structural integrity of the penetration and/or attachment weld as a result of large excavations.

The embedded flaw repair technique is considered a permanent repair for the following reasons:

1. The flaw will be isolated from the primary water environment and therefore primary water stress corrosion cracking will not cause the flaw to propagate. The only remaining mechanism to propagate the crack is fatigue. A fatigue crack propagation analysis has been completed for all ranges of postulated flaws in any penetration. References 1, 2, and 3 provide an acceptable means to determine the life of the repair based on the actual characteristics of the flaw and the subsequent repair.

2. The additional residual stresses produced by the embedded flaw technique have been measured and found to be relatively low (Reference 1).

3. The thermal expansion properties of Alloy 52 weld-metal, Alloy 182 weld-metal, and Alloy 600 base material are relatively close. The small difference does not create significant stress in the resulting repair configuration.

4. The additional small residual stress produced by the embedded flaw will act constantly, and therefore, will have no impact on the fatigue effects in the CEDM region.

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

Conclusion(s):

To accomplish repairs to reactor pressure vessel head penetrations and/or attachment welds, SCE proposes to use the repair method presented to the NRC by Westinghouse Electric Company, LLC. (Reference 4), namely the embedded flaw technique. SCE has shown in this submittal that use of this alternative repair method will provide an acceptable level of quality and safety, and compliance with the specified requirements of ASME III or IWA-4000 would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Reference(s):

1. WCAP-13998, Revision 1, “RV Closure Head Penetration Tube ID Weld Overlay Repair”, dated November 1995.

2. LTR-SMT-02-51 Technical Basis for Application of the Embedded Flaw Technique to Head Penetration Attachment Welds San Onofre Units 2 and 3

3. LTR-SMT-02-52 Technical Basis for Application of the Embedded Flaw Technique to Head Penetration Nozzles San Onofre Units 2 and 3

4. Westinghouse letter LTR-NRC-01-41, "ASME Section XI Inservice Inspection Program Relief Requests - Alternative Repair Technique," dated December 13, 2001, from H. A. Sepp, Manager Regulatory and Licensing Engineering to Samuel J. Collins, USNRC