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Manager of
Nuclear Regulatory Affairs

February 21, 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 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 of ISI-3-27 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) Unit 2 and Unit 3 for the third 10-year inservice inspection (ISI) interval.

Relief request ISI-3-27, similar to ISI-3-18, ISI-3-24, and ISI-3-25, is enclosed with this letter. ISI-3-27 contains criteria for the proposed SONGS structural weld overlay of the welds with Unit 2 ISI Designation Numbers 02-006-010, 02-006-011, and 02-007-009, and Unit 3 ISI Designation Numbers 03-006-010, 03-006-011, and 03-007-009.

Similar relief requests have been previously approved for AmerGen Energy Company for its Three Mile Island Nuclear Station, Unit 1 on July 21, 2004; for Susquehanna Steam Electric Station, Unit 1, June 22, 2005; for Indiana Michigan Power Company for Donald C. Cook Nuclear Plant, Unit 1 on June 27, 2005; for Constellation Energy's Calvert Cliffs Nuclear Power Plant, Unit 2 on July 20, 2005; for Dominion Nuclear Connecticut for Millstone Power Station Unit 3, on January 20, 2006; and for SONGS Unit 2 on December 14, 2006.

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SCE requests approval of ISI-3-27 by approximately December 15, 2007, to support return to service from the SONGS Unit 2 Cycle 15 refueling outage.

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

Sincerely,

Lynn Pressley for AES

Enclosures:

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

Enclosure

Southern California Edison (SCE)

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

Docket No. 50-361 and 50-362

Relief Request ISI-3-27

Use of Structural Weld Overlay and Associated Alternative Repair Techniques

CONTENTS

1.0 REASON FOR THE REQUEST 2
2.0 CODE COMPONENTS FOR WHICH RELIEF IS REQUESTED 2
3.0 CODE REQUIREMENTS FOR WHICH RELIEF IS REQUESTED..... 4
4.0 PROPOSED ALTERNATIVES AND SUPPORTING INFORMATION..... 5
5.0 DURATION OF THE PROPOSED RELIEF REQUEST 12
6.0 PRECEDENTS 13
7.0 REFERENCES 14
8.0 CONCLUSION 14

ATTACHMENT 1

Table 1: Modifications To Code Case N-504-2 and Corresponding Nonmandatory Appendix Q Requirements
Table 2: Alternatives To Appendix VIII. Supplement 11
Table 3: Modification To Code Case N-638-1

ATTACHMENT 2

Chemical Analyses of Incremental Milling of Weldment

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

Currently, there are no comprehensive criteria for a licensee to apply a structural weld overlay repair to a dissimilar metal weld that is constructed of Alloy 82/182 weld material, which is susceptible to primary water stress corrosion cracking (PWSCC). Although the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1995 Edition through 1996 Addenda, IWA-4000 (Reference 1), is used for the San Onofre Nuclear Generating Station (SONGS) Unit 2 and Unit 3 Section XI repair/replacement program, it does not have the needed requirements for this type of repair. The latest Nuclear Regulatory Commission (NRC) approved ASME Code also does not have the needed requirements for this type of repair. Repair/replacement activities associated with a structural weld overlay repair of this type are required to address the materials, welding parameters, ALARA concerns, operational constraints, examination techniques, and procedure requirements. Thus, this is the reason for this relief request.

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 PWSCC and adjacent stainless steel welds.

a) Name of Components:

1. Reactor Coolant System Hot Leg surge 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.

2. Reactor Coolant System Hot Leg surge nozzle adjacent stainless steel welds (ISI Designation Number 02-016-016/03-016-016).

3. 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.

4. Reactor Coolant System Hot Leg drain nozzle adjacent stainless steel welds (ISI Designation Number 02-030-001/03-030-010).

5. 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.

6. Shutdown Cooling System Hot Leg nozzle adjacent stainless steel welds (ISI Designation Number 02-021-001/03-021-010).

The size of the weld overlay repair on each of the three dissimilar metal welds in each unit has not yet been determined. The stainless steel welds are included in this request contingent upon final sizing of the weld overlay.

b) 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) Code Category:

Examination Category B-J, "Risk-Informed Piping Examinations"

e.1) Code Item No. B9.11

"Welds subject to PWSCC" (ISI Designation Numbers 02-006-010, 02-007-009, 03-006-010, and 03-007-009)

"Welds subject to Thermal Fatigue" (ISI Designation Numbers 02-006-010, 02-007-009, 02-016-016, 02-021-001, 03-006-010, 03-007-009, 03-016-016, and 03-021-010)

e.2) Code Item No. B9.21

"Welds subject to PWSCC" (ISI Designation Number 02-006-011 and 03-006-011)

"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

1995 Edition through the 1996 Addenda of the ASME Code Section XI, (Reference 1), IWA-4610(a).

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

Modification to the Nuclear Regulatory Commission (NRC) approved Code Case N-504-2 with the 2005 Addenda, Nonmandatory Appendix Q (Reference 3).

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

Attachment 1, Tables 1, 2, and 3 provide details of relief requested from each of the above requirements.

4.0 PROPOSED ALTERNATIVES AND SUPPORTING INFORMATION

Full Structural Weld Overlay Design Criteria

A structural weld overlay repair is proposed for the dissimilar metal welds identified in Section 2.0 a). The material of the above three nozzles is provided in the following table.

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	

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. Temperature monitoring requirements contained within this Code Case will be performed using contact pyrometers in lieu of thermocouples required by IWA-4610(a) of the ASME Code, Section XI 1995 Edition through 1996 Addenda (Reference 1).

The weld overlays will be sized as Full-Structural Weld Overlays designed to satisfy the ASME Section III requirements without crediting the existing pipe. See Attachment 2 for the chromium content information of the weld material being used.

In the sizing calculations, SCE assumes the crack depth for weld overlay (WOL) sizing is equal to the original wall thickness ($t_{orig\ pipe}$). To meet the general Section XI requirement that no flaw of depth greater than 75% through-wall is acceptable, this requires:

crack depth / ($t_{orig\ pipe}$ + t_{WOL}) = 0.75, twol = 1/3 original pipe wall thickness.

SCE also considers the piping loads in the WOL sizing. The final size of each WOL will be the larger of these two calculations.

The planned full-structural WOL is designed to be more conservative than an "optimized " WOL that assumes a crack depth equivalent to 75% of the original wall thickness only.

Crack growth calculations will be performed to determine the time for any observed flaw indications to grow to the overlay design basis in the structural sizing calculations (through wall flaw) due to fatigue and stress corrosion crack growth. These calculations will use as an initial flaw size the flaw depth detected by NDE (if any) prior to the weld overlay. If no flaws are detected, the initial flaw size will be assumed to be 10% of the original wall thickness, based on a conservative estimate of the detection threshold for the NDE.

This structural weld overlay (weld reinforcement) will completely cover the existing Alloy 82/182 weld metal and will extend onto the ferritic and austenitic stainless steel material on each end of the weld. To avoid stress risers, the weld material is extended and tapered across the pipe and nozzle side. The end slope is required to be no steeper than 45 degrees to minimize stress concentration.

Sufficient overlay length is provided to allow for adequate transfer of axial loads between the pipe and the weld overlay. Therefore, the length of the actual structural weld overlay will exceed the minimum length required by ASME Code Case N-504-2 and Section XI Appendix Q for load redistribution and inspection purposes.

It is important to note that inspection requirements are a controlling factor in the structural weld overlay repair design. The length of the structural weld overlay must be sufficient for inspection of an area that is 1/2 inch beyond the required repair length and the outer 25% of the original wall thickness. It should be noted that the length of the structural weld overlay may be extended and blended into the low alloy steel nozzles outer diameter taper to permit UT inspection of the weld and minimize stress concentration on the nozzle outer diameter. Since generally the outside diameter of the nozzle is larger than that of the safe end, the structural weld overlay thickness on the safe end will be increased to allow a smooth transition surface for UT inspection. Therefore, the final structural weld overlay length and thickness after taking into consideration the UT inspection requirements will exceed the length required for a structural weld overlay repair in accordance with the ASME Code Case N-504-2 and Section XI Appendix Q.

In summary, the combination of deposition of PWSCC resistant weld reinforcement on the outside surface of the dissimilar metal weld, with favorable axial and hoop residual compressive stress produced on the inside diameter due to shrinkage will result in acceptable assurance for long term crack mitigation. In addition, inservice inspection is facilitated because of the enhanced ability to inspect the joint.

Code Case N-504-2(g) Flaw Evaluations and Shrinkage Stress Effects Analyses

Flaw evaluations and shrinkage stress effects evaluations will be completed prior to returning Unit 2 and Unit 3 to service from their respective Cycle 15 refueling outage. The evaluation records will be maintained on site and available for NRC review at any time.

Pre-Weld Overlay Non-Destructive Examinations (NDE)

SCE will perform NDE to meet the requirements of Appendix VIII, Supplement 10, as modified by the Performance Demonstration Initiative (PDI) Program. However, because the material of the hot leg surge line safe end and the shutdown cooling line safe end is cast austenitic stainless steel SCE will perform the qualified Appendix VIII, Supplement 10, as modified by the PDI Program UT exam, on the Alloy 82/182 welds from the nozzle side, which is ferritic steel. Appendix VIII, Supplement 9 "Qualification Requirements for Cast Austenitic Piping Welds" is in the course of preparation and is not required by 10CFR50.55a(g)(6)(ii)(C). Therefore, to meet the RI-ISI UT examination

requirement of the hot leg surge line and shutdown cooling line nozzles, SCE will perform UT examination from the cast austenitic stainless steel side in accordance with ASME Section XI, Appendix III. Additionally, the UT examination of the stainless steel weld adjacent to the hot leg surge line and shutdown cooling line nozzles will be performed in accordance with ASME Section XI, Appendix III from the cast austenitic stainless steel side and Appendix VIII, Supplement 2, as modified by the PDI Program UT exam, from austenitic stainless steel side.

Post Weld Overlay NDE

The examinations of the completed full structural weld overlay and heat affected zone beneath the weld overlay will be performed in accordance with the requirements of Code Case N-504-2 and Appendix Q, including the flaw acceptance standards specified in Article Q-4000. These inspections, and associated acceptance standards provide full assurance that the weld and adjoining base material are fully capable of performing their intended function. Thus it is SCE's intent to meet the condition specified in Regulatory Guide 1.147 for the use of Code Case N-504-2. The following discussion is provided to clarify how SCE will comply with the condition specified in Regulatory Guide 1.147.

ASME Section XI pre-service acceptance standards, as specified in Appendix Q, are the appropriate standards for pre-service ultrasonic examinations of weld overlay repairs to nuclear plant components. These standards are consistent with the highly sensitive ultrasonic examination procedures being used, which are qualified in accordance with ASME Section XI, Appendix VIII, Supplement 11 as implemented via the EPRI Performance Demonstration Initiative (PDI). The post-repair inspection volume includes the full thickness of the weld overlay plus 25% of the underlying base metal/weldment thickness. The specimen sets for PDI qualification of weld overlay examinations include construction type flaws in the overlays in addition to simulated service flaws in the underlying base metal and weldment. Therefore, use of PDI-qualified personnel and procedures will result in the reliable detection of construction type flaws.

The ASME Section XI flaw acceptance standards are based on fracture mechanics principles that evaluate the potential effect of flaw indications on the safe operation of a component. ASME Section III ultrasonic standards, on the other hand, are derived from radiographic standards in earlier construction codes and tend to be workmanship-based, addressing flaws occurring in the original construction process that are likely to be detected by radiography. The ASME Section III acceptance criteria do not allow the presence of any cracks or crack-like indications, regardless of their size, and are geared more towards construction-type welds. Many indications that are detectable by PDI qualified

ultrasonic techniques, and thus require evaluation, would not be detected by the radiographic examinations required by the original construction Code or Section III.

The Section XI pre-service examination standards were developed for exactly the above-stated reasons, and consider the materials in which the flaw indications are detected, the orientation and size of the indications, and ultimately their potential structural impact on the component. They are the logical choice for evaluation of potential flaw indications in post-overlay examinations, in which unnecessary repairs to the overlays would result in additional personnel radiation exposure without a compensating increase in safety and quality, and could potentially degrade the effectiveness of the overlays by affecting the favorable residual stress field that they produce.

Acceptance of ultrasonic indications in weld overlay repairs using Section XI acceptance criteria has been approved by NRC in past weld overlay applications (e.g. References 1, 2).

Qualification requirements for full structural overlaid wrought austenitic piping welds, (i.e., ASME Section XI, Appendix VIII, Supplement 11 as modified by the PDI program) are not currently qualified for cast austenitic stainless steel. The hot leg surge line and shutdown cooling line nozzle safe end are cast austenitic stainless steel. For the 25% of the underlying cast austenitic stainless steel of the structural weld overlay SCE will perform an UT examination using the best available technique for the pre-service and inservice inspections for these welds. This is consistent with information provided to support previously approved relief requests ISI-3-18 and ISI-3-24.

Code Case N-638-1 addresses the use of the temper bead welding technique including those welds made in deep cavities in ferritic material. In the case of weld overlays to be applied at SONGS Unit 2 and Unit 3, this technique will be used to apply a non-ferritic overlay to the P3 ferritic nozzle base material adjacent to the dissimilar metal weld (DMW). The PDI qualified ultrasonic examination procedure is designed and qualified to examine the entire volume of the overlay weld as well as the region of the P3 material containing the weld heat affected zone (HAZ) and a volume of unaffected base material beyond the HAZ. In addition to verifying the soundness of the weld, a purpose of these examinations is to assure that delayed cracking that may be caused by hydrogen introduced during the temper bead welding process is not present. In the unlikely event that this type of cracking does occur, it would be initiated on the surface on which the welding is actually performed or in the HAZ immediately adjacent to the weld. The most appropriate technique to detect surface cracking is the surface examination technique that SCE will perform on the weld overlay and the adjacent base material in a band at least 1.5 times the thickness of the base

material on either side of the overlay. The maximum achievable inspection volume is 100 percent of the volume susceptible to weld induced flaws.

While it would be possible to extend the examination volume to a larger extent on either side of the weld overlay, it would not be possible with current technology to ultrasonically inspect 100 percent of the volume within 1.5 times the thickness of the base material because of geometric considerations. Inspection of an increased volume would result in increased dose to inspection personnel without a compensating increase in safety or quality because there is no plausible mechanism for formation of new flaws or propagation of existing flaws in the region. The overlay volume is small relative to the volume of the underlying pipe and does not present the same concerns as those related to welds in deep cavities contemplated by the requirements of Code Case N-638-1. Therefore, the examinations tailored for overlay inspection and required by Code Case N-504-2 and Appendix Q, as modified in the request for relief, provide full assurance that the weld and adjoining base material are fully capable of performing their intended function.

Later revisions to Code Case N-638-1 (N-638-2 and N-638-3), approved by ASME Code in 2005 and 2006 respectively recognize that inspection of the larger volume is not necessary to assure quality and safety.

The NRC has previously granted relief on this specific issue for temper bead welding for use at other plants for the reasons mentioned above. Specifically, San Onofre Nuclear Generating Station Unit 2 in December of 2006, Millstone Power Station, Unit No. 3 in January 2006, and Three Mile Island Unit 1 in Fall 2003 have received approval to use inspection methods essentially identical to those proposed by SCE for San Onofre Unit 2 and Unit 3 by ISI-3-27.

Post Weld Overlay NDE Report

A report that summarizes the results of the examinations will be submitted to the NRC within fourteen days of completion of the final UT examination. The report will include the following details as applicable,

- a listing of indications detected[1]
- the disposition of all indications using the standards of ASME Section XI, IWB-3514-2 and/or IWB-3514-3 criteria and, if possible,
- the type and nature of the indications,[2] and
- a discussion of any repairs to the overlay material and/or base metal and the reason for the repair.

[1] The recording criteria of the ultrasonic examination procedure to be used for the examination of the SONGS pressurizer overlays will require that all indications, regardless of amplitude, be investigated to the extent necessary to provide accurate characterization, identity, and location. Additionally, the procedure requires that all indications, regardless of amplitude, that cannot be clearly attributed to the geometry of the overlay configuration be considered flaw indications.

[2] The ultrasonic examination procedure requires that all suspected flaw indications are to be plotted on a cross sectional drawing of the weld and that the plots should accurately identify the specific origin of the reflector.

Comprehensive Criteria of the Weld Overlays

Tables 1, 2, and 3, when used with the ASME Code, Section XI, 1995 Edition through 1996 Addenda, Article IWA-4000 (Reference 1), provide a comprehensive package of proposed detailed criteria with requirements, proposed alternatives, methodologies, modifications, and the bases for these differences, to support this relief request.

This SONGS Unit 2 and Unit 3 structural weld overlay repair of a piping weld with Alloy 82/182 weld material will be performed as a repair/replacement activity in accordance with IWA-4000 of the 1995 Edition, through 1996 Addenda, of ASME Section XI (Reference 1) with the exception of the requirements in IWA-4610(a).

In lieu of the weld-attached thermocouple requirements and recording instruments in IWA-4610(a), contact pyrometers and manual recording of the process temperatures will be used at SONGS Unit 2 and Unit 3. These contact pyrometers will be calibrated in accordance with the measuring and test equipment program and will be capable of monitoring the process temperatures from 50°F, minimum preheat temperature to 350°F, maximum interpass temperature. Additionally, the methodology of Code Case N-504-2 (Reference 3), as modified and shown in Table 1, will be used.

The ultrasonic examination of the completed structural weld overlay will be accomplished in accordance with ASME Section XI, 1995 Edition with the 1996 Addenda, Appendix VIII, Supplement 11 (Reference 2) with the alternatives used to comply with the Performance Demonstration Initiative (PDI) program as shown in Table 2.

The temper bead weld technique requirements in accordance with Code Case N-638-1 (Reference 4) will be applied to the ferritic nozzle base material with the modifications described in Table 3. Code Case N-638-1 specifies a limit of 100 square inches for a temper bead weld. Approval to exceed this limit will be needed for the hot leg surge line and the shutdown cooling line nozzles. The intent of the code case is clarified to limit the area of an individual weld over the ferritic material. Electric Power Research Institute Technical Report 1003616 (reference 6) provides justification for a maximum area of 500 square inches. The hot leg surge line and shutdown cooling line nozzle weld area can be assumed to not exceed 300 square inches. SCE is anticipating the weld overlays on ISI Designation 02-006-010, 03-006-010, 02-007-009, and 03-007-009 will exceed 100 square inches. The weld overlays on 02-006-011 and 03-006-011 will not exceed 100 square inches.

Any applicable requirements not addressed by Tables 1, 2, and 3 will be met 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).

Code Case N-504-2 (Reference 3) is approved for use for austenitic stainless steel material in NRC Regulatory Guide 1.147, Revision 14, August 2005, provided it is used with Nonmandatory Appendix Q, of ASME Section XI, 2005 Addenda. Provided in Table 1 are SCE's proposed modifications for structural weld overlay repair of nickel based and ferritic materials due to the specific construction of the SONGS Unit 2 and Unit 3 dissimilar metal welds. Therefore, SCE intends to follow the methodology of Code Case N-504-2 (Reference 3), except for the modifications identified in Table 1.

5.0 DURATION OF PROPOSED RELIEF REQUEST

This request will be applied for the remainder of the current SONGS Unit 2 and Unit 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 Unit 2 and Unit 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 Richard J. Laufer, NRC, to Christopher M. Crane, AmerGen, "Three Mile Island Nuclear Station, Unit 1 (TMI-1) Request for Relief from Flaw Removal, Heat Treatment, and Nondestructive Examination Requirements for the Third 10-year Inservice Inspection (ISI) Interval (TAC.No. MC1201)," Accession Number ML041670510, dated July 21, 2004.

2. Letter from Richard J. Laufer, NRC, to Bryce L. Shriver, PPL Susquehanna, "Susquehanna Steam Electric Station, Unit 1 - Relief from American Society of Mechanical Engineers, Boiler and Pressure Vessel Code (ASME Code), Section XI, Appendix VIII, Supplement 11, Requirements and Code Cases N-504-2 and N-638 Requirements (TAC Nos. MC2450, MC2451 and MC2594)," Accession Number ML051220568, dated June 22, 2005.

3. Letter from L. Raghavan, NRC, to Mano K. Nazar, I&M, "Donald C. Cook Nuclear Plant, Unit 1 - Alternative to Repair Requirements of Section XI of the American Society of Mechanical Engineers Code (TAC No. MC06751)," Accession Number ML051720006, dated June 27, 2005.

4. Letter from Richard J. Laufer, NRC, to George Vanderheyden, Calvert Cliffs, "Calvert Cliffs Nuclear Power Plant, Unit No. 2 - Relief Request for Use Weld Overlay and Associated Alternative Inspection Techniques (TAC Nos. MC6219 and MC6220)," Accession Number ML051930316, dated July 20, 2005.

5. Letter from Leslie N. Darrell J. Roberts, NRC, to David A. Christian Dominion Nuclear Connecticut, Inc., "Millstone Power Station, Unit No. 3 – Issuance of Relief from Code Requirements (TAC No. MC8609)," Accession Number ML053260012, dated January 20, 2006.

6. Letter from David Terao (NRC) to Richard M. Rosenblum (SCE), "San Onofre Nuclear Generating Station, Unit 2 – Re: Request for Relief From the Requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (TAC No. MD0191) dated December 14, 2006.

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) Letter from A. E. Scherer (SCE) to the U. S. Nuclear Regulatory Commission dated February 22, 2006; Subject: Docket Nos. 50-361 Third Ten-Year Inservice Inspection (ISI) Interval Relief Request ISI-3-18 Use of Structural Weld Overlay and Associated Alternative Repair Techniques, San Onofre Nuclear Generating Station, Unit 2

(6) Electric Power Research Institute Technical Report 1003616, "Additional Evaluations to Extend Repair Limits for Pressure Vessels and Nozzles," March 2004.

8.0 CONCLUSION

SCE has determined that the approach described in this relief request includes available operating experience (OE) related to previously approved NRC requirements that have been used to produce acceptable structural weld overlay repairs when applied to a dissimilar metal weld with Alloy 82/182 weld material. The basis for this determination is the application of this same type of structural weld overlay repair at Three Mile Island, Donald C. Cook, Calvert Cliffs, Millstone, and SONGS Unit 2 and Unit 3. Those structural weld overlay repairs were based on, and this relief request includes, the NRC approved ASME Code requirements and Code Cases. SCE believes that the use of this relief request for a structural weld overlay repair at SONGS Unit 2 and Unit 3 will result in an acceptable level of quality and safety that meets the requirements of 10 CFR 50.55a(a)(3)(i).

Attachment 1

San Onofre Nuclear Generating Station, Unit 2 and Unit 3, Comprehensive Criteria For Structural Weld Overlay of Welds Contains Modifications and Alternatives for the Use Of Relief Request ISI-3-27

Tables 1, 2, and 3

Table 1
Modifications To Code Case N-504-2 and Corresponding Non-Mandatory Appendix Q Requirements

Code Case N-504-2	Modification/Basis
Reply: It is the opinion of the Committee that, in lieu of the requirements of IWA-4120 in Editions and Addenda up to and including the 1989 Edition with the 1990 Addenda, in IWA-4170(b) in the 1989 Edition with the 1991 Addenda up to and including the 1995 Edition, and in IWA-4410 in the 1995 Edition with the 1995 Addenda and later Editions and Addenda, defect in austenitic stainless steel piping may be reduced to a flaw of acceptable size in accordance with IWB-3640 from the 1983 Edition with the Winter 1985 Addenda, or later Editions and Addenda, by deposition of weld reinforcement (weld overlay) on the outside surface of the pipe, provided the following requirements are met. **[Essentially same as Scope of Appendix Q]:**	**Modification.** Code Case N-504-2 will be used for weld overlay repairs to the ferritic (P3) and nickel alloy (F43/P43) base material as well as the austenitic stainless steel (P8) base material. **Basis:** Code Case N-504-2 is accepted for use along with Nonmandatory Appendix Q in the current NRC Regulatory Guide 1.147 Rev. 14. For the weld overlay of the identified welds at SONGS Unit 2 and Unit 3 the base material will be ferritic material (P1) with existing nickel alloy weld metal (F43/P43) to which an austenitic stainless steel (P8) safe end is welded. Industry operational experience has shown that PWSCC in Alloy 82/182 will blunt at the interface with stainless steel base metal, ferritic base metal, or Alloy 52/52M weld metal. SONGS Unit 2 and Unit 3 plans to apply a 360° structural weld overlay to control growth in any PWSCC crack and maintain weld integrity. The weld overlay will induce compressive stress in the weld, thus impeding growth of any reasonably shallow cracks. Furthermore, the overlay will be sized to meet all structural requirements independent of the existing weld.
(b) Reinforcement weld metal shall be low carbon (0.035% max.) austenitic stainless steel applied 360° around the circumference of the pipe, and shall be deposited in accordance with a qualified welding procedure specification identified in the Repair Program. **[Same as Q-2000(a)]**	**Modification.** In lieu of austenitic stainless steel filler material, the reinforcement weld metal will be a nickel alloy. **Basis:** The weld metal used may be ERNiCrFe-7A (Alloy 52M, UNS N06054) or ERNiCrFe-7 (Alloy 52 UNS N06052). This weld metal is assigned F43 by ASME per Code Case 2142-2. The requirements of ASME Section III, NB-2400 will be applied to all filler material. The chromium content of Alloy 52M is 28-31.5%, identical to that of Alloy 52. The main difference in Alloy

Table 1
Modifications To Code Case N-504-2 and Corresponding Non-Mandatory Appendix Q Requirements

	52 vs. Alloy 52M is a higher Niobium content (0.5- 1 %). The difference in chemical composition between Alloy 52 and Alloy 52M improves the weldability of the material and pins the grain boundaries thus preventing separation between the grains and hot tearing during weld puddle solidification. These filler materials were selected for their improved resistance to PWSCC. Alloys 52 and 52M contain about 30% chromium that imparts excellent corrosion resistance. The existing Alloy 82/182 weld and the Alloy 52/52M overlay are nickel base and have ductile properties and toughness similar to austenitic stainless steel piping welds at pressurized water reactor operating temperature. These filler materials are suitable for welding over the ferritic nozzle or pipe Alloy 82/182 weld and the austenitic stainless steel pipe or safe ends.
(e) The weld reinforcement shall consist of a minimum of two weld layers having as-deposited delta ferrite content of at least 7.5 FN. The first layer of weld metal with delta ferrite content of least 7.5 FN shall constitute the first layer of the weld reinforcement design thickness. Alternatively, first layers of at least 5 FN may be acceptable based on evaluation. **[Same as *Q*-2000(d)]**	**Modification:** Delta ferrite (FN) measurements will not be performed for weld overlay repairs made of Alloy 52/52M weld metal. **Basis:** Welds of Alloy52/52M are **100% austenitic** and contain no delta ferrite due to the high nickel composition (approximately 60% nickel).

Table 2
Alternatives to Appendix VIII, Supplement 11

Appendix VIII of Section XI cannot be used for NDE of a structural weld overlay repair. Relief is requested to use the PDI program implementation of Appendix VIII. A detailed comparison of Appendix VIII and PDI requirements is summarized below.

Relief is requested to allow closer spacing of flaws provided they don't interfere with detection or discrimination. The specimens used to date for qualification to the Tri-party (NRC/BWROG/EPRI) agreement have a flaw population density greater than allowed by current Code requirements. These samples have been used successfully for all previous qualifications under the Tri-party agreement program. To facilitate their use and provide continuity from the Tri-party agreement program to Supplement 11, the PDI program has merged the Tri-party test specimens into their structural weld overlay program.

SUPPLEMENT 11 - QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
1 0 SPECIMEN REQUIREMENTS	
1.1 General. The specimen set shall conform to the following requirements.	
(b) The specimen set shall consist of at least three specimens having different nominal pipe diameters and overlay thicknesses. They shall include the minimum and maximum nominal pipe diameters for which the examination procedure is applicable. Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent. If the procedure is applicable to pipe diameters of 24 in. or larger, the specimen set must include at least one specimen 24 in. or larger but need not include the maximum diameter. The specimen set must include at least one specimen with overlay thickness within -0.1 in. to +0.25 in. of the maximum nominal overlay thickness for which the procedure is applicable.	**Alternative:** (b) The specimen set shall include specimens with overlays not thicker than 0.1 in. more than the minimum thickness, nor thinner than 0.25 in. of the maximum nominal overlay thickness for which the examination procedure is applicable. **Basis:** To avoid confusion, the overlay thickness tolerance contained in the last sentence was reworded and the phrase "and the remainder shall be alternative flaws" was added to the next to last sentence in paragraph 1.1 (d) (1) .

Table 2
Alternatives to Appendix VIII, Supplement 11

(d) Flaw Conditions	
(1) Base metal flaws. All flaws must be cracks in or near the ~ butt weld heat-affected zone, open to the inside surface, and extending at least 75% through the base metal wall. Flaws may extend 100% through the base metal and into the overlay material; in this case, intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the cracking. Specimens containing IGSCC shall be used when available.	**Alternative:** (1) ... must be in or... intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws. Specimens containing intergranular stress corrosion cracking shall be used when available. At least 70% of the flaws in the detection and sizing tests shall be cracks and the remainder shall be alternative flaws. Alternative flaw mechanisms, if used, shall provide crack-like reflective characteristics and shall be limited by the following: (a) The use of alternative flaws shall be limited to when the implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. (b) Flaws shall be semi elliptical with a tip width of less than or equal to 0.002 inches. **Basis:** This paragraph requires that all base metal flaws be cracks. Implanting a crack requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. To resolve this issue, the PDI program revised this paragraph to allow use of alternative flaw mechanisms under controlled conditions. For example, alternative flaws shall be limited to when implantation of cracks precludes obtaining an effective ultrasonic response, flaws shall be semi elliptical with a tip width of less than or equal to 0.002 inches, and at least 70% of the flaws in the detection and sizing test shall be cracks and the remainder shall be alternative flaws. To avoid confusion, the overlay thickness tolerance contained in paragraph 1.1(b) last sentence, was

Table 2
Alternatives to Appendix VIII, Supplement 11

	reworded and the phrase "and the remainder shall be alternative flaws" was added to the next to last sentence. Paragraph 1.1(d)(1) includes the statement that intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws.
(e) Detection Specimens	
(1) At least 20% but less than 40% of the flaws shall be oriented within +/-20° of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. The rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws.	**Alternative:** (1) At least 20% but less than 40% of the base metal flaws shall be oriented within +/-20° of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. **Basis:** The requirement for axially oriented overlay fabrication flaws was excluded from the PDI Program as an improbable scenario. Weld overlays are typically applied using automated GTA W techniques with the filler metal applied in a circumferential direction. Because resultant fabrication induced discontinuities would also be expected to have major dimensions oriented in the circumferential direction axial overlay fabrication flaws are unrealistic. The requirement for using IWA-3300 for proximity flaw evaluation was excluded, instead indications will be sized based on their individual merits.
(2) Specimens shall be divided into base and overlay grading units. Each specimen shall contain one or both types of grading units.	**Alternative:** (2) Specimens shall be divided into base metal and overlay fabrication grading units. Each specimen shall contain one or both types of grading units. Flaws shall not interfere with ultrasonic detection or characterization of other flaws.
(a)(1) A base grading unit shall include at least 3 in. of the length of the overlaid weld. The base grading unit includes the outer 25% of the overlaid weld and base metal on both sides. The base grading unit shall not include the inner 75% of the overlaid weld and base metal overlay material, or base metal	**Alternative:** (a)(1) A base metal grading unit includes the overlay material and the outer 25% of the original overlaid weld. The base metal grading unit shall extend circumferentially for at least 1 in. and shall start at the weld centerline and be wide enough in the axial direction to encompass one half of the

Table 2
Alternatives to Appendix VIII, Supplement 11

to-overlay interface.	original weld crown and a minimum of 0.50" of the adjacent base material. **Basis:** The phrase "and base metal on both sides," was inadvertently included in the description of a base metal grading unit, The PDI program intentionally excludes this requirement because some of the qualification samples include flaws on both sides of the weld. To avoid confusion several instances of the term "cracks" or "cracking" were changed to the term "flaws" because of the use of alternative Flaw mechanisms. Modified to require that a base metal grading unit include at least1in. of the length of the overlaid weld, rather than 3 inches.
(a)(2) When base metal cracking penetrates into the overlay material, the base grading unit shall include the overlay metal within 1 in. of the crack location. This portion of the overlay material shall not be used as part of any overlay grading unit.	**Alternative:** (a)(2) When base metal flaws penetrate into the overlay material, the base metal grading unit shall not be used as part of any overlay fabrication grading unit.
(a)(3) When a base grading unit is designed to be unflawed, at least 1 in. of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. The segment of weld length used in one base grading unit shall not be used in another base grading unit. Base grading units need not be uniformly spaced around the specimen.	**Alternative:** (a)(3) Sufficient unflawed overlaid weld and base metal shall exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws. Modified to require sufficient unflawed overlaid weld and base metal to exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws, rather than the 1 inch requirement.
(b)(1) An overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 in^2. The overlay grading unit shall be rectangular, with minimum dimensions of 2 in.	**Alternative:** (b)(1) An overlay fabrication grading unit shall include the overlay material and the base metal-to-overlay interface for a length of at least 1 in. Modified to require sufficient unflawed overlaid weld and base metal to exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws, rather than the I inch requirement
(b)(2) An overlay grading unit designed to be unflawed shall be	**Alternative:** (b)(2) Overlay fabrication grading units designed

Table 2
Alternatives to Appendix VIII, Supplement 11

surrounded by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. around its entire perimeter. The specific area used in one overlay grading unit shall not be used in another overlay grading unit. Overlay grading units need not be spaced uniformly about the specimen.	to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. at both ends. Sufficient unflawed overlaid weld and base metal shall exist on both sides of the overlay fabrication grading unit to preclude interfering reflections from adjacent flaws. The specific area used in one overlay fabrication grading unit shall not be used in another overlay fabrication grading unit. Overlay fabrication grading units need not be spaced uniformly about the specimen. **Basis:** Paragraph 1.1 (e)(2)(b)(2) states that overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. at both ends, rather than around its entire perimeter.
(b)(3) Detection sets shall be selected from Table VIII-S2-1. The minimum detection sample set is five flawed base grading units, ten unflawed base grading units, five flawed overlay grading units, and ten unflawed overlay grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units.	**Alternative:**...base metal grading units, ten unflawed base metal grading units, five flawed overlay fabrication grading units, and ten unflawed overlay fabrication grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units. For initial procedure qualification, detection sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required.
(f) Sizing Specimen	
(1) The minimum number of flaws shall be ten. At least 30% of the flaws shall be overlay fabrication flaws. At least 40% of the flaws shall be cracks open to the inside surface.	**Alternative:** (1) The...least 40% of the flaws shall be open to the inside surface. Sizing sets shall contain a distribution of flaw dimensions to assess sizing capabilities. For initial procedure qualification, sizing sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required.
(3) Base metal cracking used for length sizing demonstrations	**Alternative:** (3) Base metal flaws used...circumferentially.

Table 2
Alternatives to Appendix VIII, Supplement 11

shall be oriented circumferentially.	
(4) Depth sizing specimen sets shall include at least two distinct locations where cracking in the base metal extends into the overlay material by at least 0.1 in. in the through-wall direction.	**Alternative:** (4) Depth sizing specimen sets shall include at least two distinct locations where a base metal flaw extends into the overlay material by at least 0.1 in. in the through-wall direction.
2.0 Conduct of Performance Demonstration	
The specimen inside surface and identification shall be concealed from the candidate. All examinations shall be completed prior to grading the results and presenting the results to the candidate. Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited.	**Alternative:** The specimen ...prohibited. The overlay fabrication flaw test and the base metal flaw test may be performed separately.
2.1 Detection Test.	
Flawed and unflawed grading units shall be randomly mixed. Although the boundaries of specific grading units shall not be revealed to the candidate, the candidate shall be made aware of the type or types of grading units (base or overlay) that are present for each specimen.	**Alternative:** Flawed...(base metal or overlay fabrication)...each specimen.
2.2 Length Sizing Test	
(d) For flaws in base grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base wall thickness.	**Alternative:** (d) For . . . base metal grading . . . base metal wall thickness.
2.3 Depth Sizing Test.	
For the depth sizing test, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. For the remaining flaws, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.	**Alternative:** (a) The depth sizing test may be conducted separately or in conjunction with the detection test. (b) When the depth sizing test is conducted in conjunction with the detection test and the detected flaws do not satisfy the requirements of 1.1(f), additional specimens shall be provided to the candidate. The regions containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region. (c) For a separate depth sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the

Table 2
Alternatives to Appendix VIII, Supplement 11

	candidate. The candidate shall determine the maximum depth of the flaw in each region.
3.0 ACCEPTANCE CRITERIA	
3.1 Detection Acceptance Criteria	
Examination procedures, equipment, and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. The criteria shall be satisfied separately by the demonstration results for base grading units and for overlay grading units.	Alternative: Examination procedures are qualified for detection when: a. All flaws within the scope of the procedure are detected and the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for false calls. b. At least one successful personnel demonstration has been performed meeting the acceptance criteria defined in (c). c. Examination equipment and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. d. The criteria in (b) and (c) shall be satisfied separately by the demonstration results for base metal grading units and for overlay fabrication grading units.
3.2 Sizing Acceptance Criteria	
(a) The RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal to 0.75 inch. The length of base metal cracking is measured at the 75% through-base-metal position.	**Alternative:** (a) The...base metal flaws is...position.
(b) All extensions of base metal cracking into the overlay material by at least 0.1 in. are reported as being intrusions into the overlay material.	**Alternative:** This requirement is omitted. **Basis:** The requirement for reporting all extensions of cracking into the overlay is omitted from the PDI Program because it is redundant to the RMS calculations performed in paragraph 3.2(c) and its presence adds confusion and ambiguity to depth sizing as required by paragraph 3.2(c). This also makes the weld overlay program consistent with the supplement 2 depth sizing criteria

Table 3
Modification To Code Case N-638-1

Code Case N-638-1	Modification/Basis
1.0 (a) The maximum area of an individual weld based on the finished surface shall be 100 sq. in., and the depth of the weld shall not be greater than one-half of the ferritic base metal thickness.	**Modification:** The maximum area of an individual weld based on the finished surface over the ferritic material will not exceed 300 square inches, and the depth of the WOL shall not be greater than one-half of the ferritic base metal thickness. **Basis:** The maximum finished area of the WOL for the hot leg surge line and shutdown cooling line nozzles will exceed 100 sq-in over the ferritic material. EPRI Technical Report 1003616 provides technical justification for extending the size of the temper bead repairs up to a finished area of 500 sq-in over the ferritic material. The area of the finished overlays will be substantially less than this. The WOL will extend to the transition taper of the low alloy steel nozzle so that qualified UT of the required volume can be performed'. There have been a number of temper bead WOL repairs applied to safe-end to nozzle welds in the nuclear industry, and a WOL repair having a 300 sq. in. surface was recently approved for the Susquehanna Steam Electric Station and the D. C. Cook (Precedents 2 and 3). Results of industry analyses and testing performed to date have indicated that there is no direct correlation of amount of surface area repaired when comparing residual stresses using temper bead welding. Residual stresses associated with larger area repairs (> 100 sq in) remain compressive at an acceptable level.
(Referenced below in 4.0(b) para. 1.0(d) Prior to welding the area to be welded and a band around the area of at least 11/2 times the component thickness or 5in., whichever is less shall be at least 50°F.) 4.0(b) The final weld surface and a band around the area defined in para. 1.0 (d) shall be examined using a surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours. The ultrasonic examination shall be in accordance with Appendix I.[3]	**Modification:** In lieu of the required ultrasonic examination of 4.0(b) only the required liquid penetrant examination will be performed. The ultrasonic examination will be in accordance with N-504-2 and Appendix Q. **Basis:** For the application of the weld overlay repair addressed in this request it is not possible to perform a meaningful ultrasonic examination of the required band of base material because of the existing nozzle configurations. This Code Case applies to any type of welding where a temper bead technique is to be employed and is not specifically written for a weld overlay repair. However, it is believed that for this type of repair that

Table 3
Modification To Code Case N-638-1

[3]Refer to the 1989 Edition with the 1989 Addenda and later Editions and Addenda	any major base material cracking would take place in the HAZ directly below the weld overlay or in the underlying Inconel 82/182 weld deposit and not in the required band of material out beyond the overlay. Therefore, it is assumed that if this cracking were to occur it would be identified by the ultrasonic examination of the weld overlay and not performing the required base material ultrasonic examination should be considered acceptable.
4.0(c) requires temperature monitoring by welded thermocouples per IWA-4610(a)	**Modification:** Preheat and interpass temperatures for the weld pad will be measured using a contact pyrometer. Interpass temperature will be monitored for the first three layers at each repair location. On the first repair location, the interpass temperature measurements will be taken every three to five passes. After the first three layers, interpass temperature measurements will be taken every six to ten passes for the subsequent layers. The heat input from layers beyond the third layer will not have a metallurgical affect on the low alloy steel HAZ. **Basis:** Due to the location of the repair and area radiation dose rate, the placement of welded thermocouples for monitoring weld interpass temperature is determined to be not beneficial based on dose savings. Therefore, welded thermocouples are not planned for use to monitor interpass temperature during welding.

ATTACHMENT 2
CHEMICAL ANALYSES OF INCREMENTAL MILLING OF WELDMENT
SONGS Unit 2 and Unit 3

The data shown below are typical of several mockups that are representative of the weld overlays to be installed. These data are from an overlay on carbon steel base material and testing has confirmed that the chromium content of overlays on stainless steel base materials is similar. The data supports the current overlay design, which specifies a single sacrificial layer that is not credited in the structural analysis of the overlay.

Chromium Content (wt. %)
For Orbital Welding Utilizing Alloy 52M

	Alloy 52M 0.035" wire from CMTR	**2nd Layer by X-ray Fluoroscope**	**1st Layer by X-ray Fluoroscope**	**1st Layer by Electron Diffraction Spectroscopy**		
Element/ Quadrant	**SFA 5.14 ER NiCrFe-7A**	Near Surface	Near Surface	Near Surface	Mid-layer	Near Base Metal
Chromium 0°	-	28.8	26.3	27.3	27.4	27.5
Chromium 90°	-	29.5	26.9	29.1	28.0	27.4
Chromium 180°	-	29.1	26.6	28.0	27.5	27.5
Chromium 270°	-	29.4	27.0	26.7	26.9	26.4
Avg. % Cr	29.3	29.2	26.7	27.8	27.5	27.2

N0TE: These data are representative of the alloy 52M structural weld overlay repair to be at SONGS. Subsequent layers will have %Cr equal to or greater than the 2nd layer