December 12, 2007

Mr. J. A. Stall
Senior Vice President, Nuclear and
Chief Nuclear Officer
Florida Power and Light Company
P.O. Box 14000
Juno Beach, Florida 33408-0420

SUBJECT: ST. LUCIE PLANT, UNIT 2 – SAFETY EVALUATION OF RELIEF REQUEST TO USE STRUCTURAL WELD OVERLAY AND ALTERNATIVE EXAMINATION TECHNIQUES ON SAFE END DISSIMILAR METAL WELDS (TAC NO. MD5114)

Dear Mr. Stall:

By letter dated March 29, 2007, and as revised by letter dated September 24, 2007, and supplemented on October 24, 2007, Florida Power & Light Company (FPL) submitted a request to the Nuclear Regulatory Commission (NRC) for relief from certain requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) at St. Lucie Unit 2. Specifically, pursuant to Title 10, *Code of Federal Regulations,* Section 50.55a(a)(3)(i), FPL proposed the use of a full structural weld overlay with temper bead welding for repair and the Performance Demonstration Initiative program for inspection as alternatives to the requirements of the ASME Code, Section XI.

The NRC staff has evaluated FPL's submittal and concludes that the proposed alternatives provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternatives in Relief Request No. 10, Revision 1, are authorized for the repair and examination of the subject welds for the remainder of the third 10-year Inservice Inspection interval at St. Lucie Unit 2, which ends August 7, 2013.

Further details on the bases for the NRC staff's conclusions are contained in the enclosed safety evaluation. If you have any questions regarding this issue, please feel free to contact the St. Lucie Project Manager, Brenda Mozafari, at (301) 415-2020.

Sincerely,

/RA/

Thomas H. Boyce, Chief
Project Directorate II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No.: 50-389

Enclosure: Safety Evaluation

Cc w/enclosure: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NUMBER 10, REVISION 1

FULL STRUCTURAL WELD OVERLAY ANDALTERNATIVE EXAMINATION TECHNIQUES ON PRESSURIZER NOZZLE DISSIMILAR METAL WELDS

FLORDIA POWER AND LIGHT COMPANY

ST. LUCIE UNIT 2

DOCKET NUMBER 50-389

1.0 INTRODUCTION

By letter dated March 29, 2007, Florida Power & Light (FPL) submitted Relief Request Number 10 (RR-10) as an alternative to the repair requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI. By letter dated September 24, 2007, FPL submitted Revision 1 (RR-10, Rev. 1) in response to the Nuclear Regulatory Commission (NRC) request for additional information (RAI) dated August 23, 2007.

By letter dated October 24, 2007, FPL responded to the staff's RAI, provided to FPL in a teleconference on October 12, 2007, concerning overlay and associated thicknesses for reduced ultrasonic (UT) examination coverage involving cast stainless steel safe-ends.

The alternatives will be used in lieu of the requirements contained in ASME code, Section XI, IWA-4410(a), IWA-4611.1(a) and Appendix VIII, Supplement 11 of the 1998 Edition through 2000 Addenda (1998A00 Edition) at St. Lucie, Unit 2 (SL-2). FPL will use Performance Demonstration Initiative (PDI) Program modifications to Appendix VIII, Supplement 11 for UT qualification requirements and Code Case N-740-1 (February 2007 draft), with modifications, for the deposition of full structural weld overlay (SWOL) utilizing the ambient temperature gas tungsten arc welding (GTAW) process. The alternatives will be used to perform full structural weld overlays on pressurizer surge and relief nozzles, surge line pipe nozzle, the shutdown cooling outlet nozzles and the drain nozzle safe ends.

2.0 REGULATORY EVALUATION

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the

Enclosure

ASME Code, Section XI, “Rules for In-service Inspection (ISI) of Nuclear Power Plant Components,” to the extent practical within the limitations of design, geometry, and materials of construction of the components.

The regulations require that in-service examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ASME Code-of-record (COR) for the current, third 10-year ISI interval at SL-2 is the ASME Code, Section XI, 1998A00 Edition. This is also the COR for the Repair/Replacement Program.

Pursuant to 10 CFR 50.55a(a)(3), alternatives to requirements may be authorized by the NRC if the licensee demonstrates that: (i) the proposed alternatives provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

FPL submitted RR-10, Rev 1, as alternatives to the implementation of the ASME Code, Section XI, IWA-4410(a), IWA-4611.1(a) and Appendix VIII Supplement 11. FPL will use the PDI Program modifications to Appendix VIII, Supplement 11 for UT qualification requirements and Code Case N-740-1, with modifications, for the deposition of full SWOL utilizing the ambient temperature GTAW process

3.0 FPL PROPOSED ALTERNATIVE REQUEST

3.1 Reason for Request

Dissimilar metal welds (DMW), primarily consisting of Alloy 82/182 weld metal are frequently used in pressurized water reactor (PWR) construction to connect stainless steel (SS) pipe and safe ends to vessel and pipe nozzles, generally constructed of carbon or low alloy ferritic steel. The welds have shown a propensity for primary water stress corrosion cracking (PWSCC) degradation, especially in components subjected to higher operating temperatures, such as the pressurizer.

For the upcoming SL-2-17 refueling outage, six DMW's located on the pressurizer and reactor coolant system hot leg piping are currently scheduled to have SWOL applied. Repair/replacement activities associated with SWOL repairs are required to address the materials, welding parameters, ALARA [as low as reasonably achievable] concerns, operational constraints, examination techniques and procedure requirements for repairs.

ASME Code, Section XI, IWA-4410(a) and IWA-4611.1(a), 1998A00 Edition does not address all the needed requirements for this type of repair since potential existing defects will not be removed or reduced in size, and weld overlay of potential existing flaws in DMWs will be performed. Also, comprehensive and generic NRC approved criteria are not currently available for application of SWOL repairs to DMWs constructed of Alloy 82/182 weld material for mitigation of potential PWSCC. In addition, ASME Code, Section XI, Appendix VIII, Supplement 11, 1998A00 Edition cannot be implemented as written for UT examination of a SWOL repair. Attachment 1 of RR-10, Rev 1, includes a discussion of the PDI Program and basis with respect to Appendix VIII, Supplement 11, requirements.

3.2 Code Requirements

SL-2 is currently in the third 10-year ISI interval (August 8, 2003 to August 7, 2013). The ASME COR for the current 10-year ISI interval is Section XI, 1998A00 Edition. This is also the version used for the Repair/Replacement Program.

The ASME Code, Section XI, IWA-4000 does not address all the necessary requirements for this type of repair. The Code requirements for which the relief is requested are contained in the following:

1) ASME Code, Section XI, IWA-4410(a) and IWA 4611.1(a) of the 1998A00 Edition for the Repair/Replacement Program.

2) ASME Code Section XI, Appendix VIII, Supplement 11 of the 1998A00 Edition.

3.3 System/Components Requested

FPL states that ASME Code components associated with this request are six Class 1 safe end-to-nozzle DMWs with Alloy 82/182 weld metal that are susceptible to PWSCC. Preemptive SWOLs are planned to be applied to the DMWs and extend across the six adjacent SS pipe/elbow-to-safe end similar metal welds (SMW). The welds are scheduled to have SWOLs applied during the upcoming SL-2-17 refueling outage.

The examination categories are R-A* and the welds are included in the Risk-Informed In-service Inspection (RI-ISI) Program. The six DMW scheduled for full SWOL at SL-2 are listed as follows: *Note: As submitted and approved by SL-2, third 10-year ISI Program Relief Request 2.

ST. LUCIE - UNIT 2 Apply SWOL on six Class 1 safe end-to-nozzle DMWs extending across the adjacent SS pipe/elbow-to-safe end SMWs.			
ITEM	LOCATION	NOZZLE-to-SAFE END WELD	SAFE END-to-PIPE/ELBOW
1	Pressurizer Surge Line Nozzle	RC-514-671	RC-108-FW-1
2	Pressurizer Relief Line Nozzle	RC-506-671	RC-101-FW-1
3	Surge Line to Hot leg B Pipe Nozzle	RC-301-771	RC-108-FW-3
4	Shutdown Cooling Outlet to Hot Leg “A” Pipe	RC-501-771	RC-162-FW-1
5	Shutdown Cooling Outlet to Hot Leg “B” Pipe	RC-302-771	RC-147-FW-1
6	Hot Leg “A” Drain Nozzle	RC-114-502-771	RC-145-FW-1

ST. LUCIE - UNIT 2 Apply SWOL on six Class 1 safe end-to-nozzle DMWs extending across the adjacent SS pipe/elbow-to-safe end SMWs.					
MATERIALS					
ITEM/LOCATION	NOZZLE	SAFE-END	PIPE/ELBOW	DMW & BUTTERING	SMW WELD
1/ Pressurizer Surge Line Nozzle	P-No. 3 Group 3 Low Alloy Steel SA-508 CL2	P-No.8 Cast SS SA-351 CF8M	P-No. 8 Cast SS SA-351 CF8M	F-No. 43 Alloy 82/182	A-8 SS E308L or ER308L
2/ Pressurizer Relief Line Nozzle	P-No. 3 Group 3 Low Alloy Steel SA-508 CL2	Wrought SS SA-182 F316	P-No. 8 SA-312 TP 304 SS		A-8 SS E308 or E316 or ER308 or ER316
3/ Surge Line to Hot leg B Pipe Nozzle	P-No. 1 Group 2 Carbon Steel SA-105 Grade II	P-No.8 Cast SS SA-351 CF8M	P-No. 8 Cast SS SA-351 CF8M		A-8 SS E308L or ER308L
4/ Shutdown Cooling Outlet to Hot Leg "A" Pipe	P-No. 1 Group 2 Carbon Steel SA-105 Grade II	P-No.8 Cast SS SA-351 CF8M	P-No. 8 SA-312 TP 304 SS		A-8 SS E308 or E308L or ER308 or ER308L
5/ Shutdown Cooling Outlet to Hot Leg "B" Pipe	P-No. 1 Group 2 Carbon Steel SA-105 Grade II	P-No.8 Cast SS SA-351 CF8M	P-No. 8 SA-312 TP 304 SS		A-8 SS E308 or E308L or ER308 or ER308L
6/ Hot Leg "A" Drain Nozzle	P-No. 1 Group 2 Carbon Steel SA-105 Grade II	Wrought SS SA-182 F316	P-No. 8 SA-312 TP 304 SS		A-8 SS E308 or E316 or ER308 or ER316

3.4 Proposed Alternatives and Basis

This proposal requests the use of the alternative requirements shown in Attachment 2 of RR-10, Rev. 1 for implementing the six scheduled SWOL for potentially PWSCC susceptible safe end-to-nozzle welds of the pressurizer and reactor coolant hot leg piping. The SWOL will include the six adjacent SS pipe/elbow-to-safe end welds. This request applies to each of the welds listed in Section 3.3 above and generally depicted in Figure 1 of RR-10, Rev. 1. The proposed alternative is scheduled to be performed during the SL-2-17 fall 2007 refueling outage.

The proposed alternative is the result of industry experience with weld overlay modification for flaws suspected or confirmed to be caused by PWSCC and directly applies to the Alloy 52/52M weld material that is primarily being used for the SWOL.

UT examination of the completed SWOL will be performed by procedures and personnel qualified to the PDI program, which is an alternative to the requirements of ASME Code, Section I, Appendix VIII, Supplement 11 of the 1998A00 Edition.

3.4.1 SWOL Design

FPL states that the details surrounding the design analysis for the SWOL are being developed to support the SL-2 fall 2007 refueling outage. The analysis will be available at the plant for NRC review at the beginning of the SL-2-17 refueling outage.

The SWOL will satisfy all the structural design requirements of the pipe as specified in RR-10, Rev. 1 for the original safe end-to-nozzle welds and the pipe/elbow-to-safe end welds. The SWOL will completely cover the existing Alloy 82/182 weld and will extend onto the ferritic nozzle and austenitic SS material on each end of the weld, including the adjacent pipe/elbow-to-safe end weld. The SWOL extends around the entire circumference of the nozzle. Alloy 52/52M filler metals are compatible with all the wrought and cast base materials and the DMWs and SMWs that will be covered by the SWOL.

FPL will assume a 100 percent through-wall flaw for SWOL length and thickness sizing. No UT examination will be performed prior to SWOL application. For flaw growth evaluations, since no UT examination will be performed prior to SWOL application and the post SWOL UT examination is not qualified for flaw detection and sizing in cast SS base material on some of the nozzles, 100 percent through wall flaws will be assumed for the welds on all nozzle locations where SWOL will be applied. Planar flaws detected in the SWOL during the acceptance examination will be characterized and flaw growth calculations will be performed using the flaw(s) detected in the SWOL plus the postulated 100 percent through-wall flaws in the base metal.

FPL states for planar indications outside this examination volume, the nominal wall thickness shall be "t_2" as shown in Figure 1(c) of Attachment 2 to RR-10, Rev. 1 for volumes "A-E-H-D" and "F-B-C-G." For the cast SS material, UT is not currently qualified to examine the base metal following SWOL installation. Initial 100 percent through wall axial and circumferential flaws are assumed for both SWOL design and flaw growth evaluation at all nozzle locations where SWOL will be installed. "t_2" is pipe/weld wall thickness plus SWOL thickness measured from 1/2-inch beyond the toe of the PWSCC susceptible DMW. The portion of the pipe, safe end or nozzle material beyond the PWSCC susceptible material is assumed unflawed. These volumes are also outside any other ASME Code Section XI ISI volume other than associated with the original weld ISI as shown in ASME Code, Section XI, Figure IWB-2500-8(c), so service related flaws therein are not expected to occur. Surface examination is also performed on these areas before the SWOL are applied to verify absence of surface flaws. The volume of the overlay which is more than 1/2-inch from the susceptible region is treated as a cross section which is the SWOL thickness plus the original underlying base metal wall thickness. The acceptance standard for a flaw in the SWOL from ASME Code, Section XI, Table IWB-3514-2 is thus based on "t_2." The approach is consistent with other examinations in ASME Code Section XI including pipe-to-pipe welds where the examination volume does not include the entire thickness but the acceptance criteria does. Furthermore, indications in the overlay are required to be sized. This requirement will assure that the indications which may extend into the base metal are not excluded.

3.4.2 Welding

FPL states that the welding will be performed in accordance with Attachment 2 of RR-10, Rev 1 using a remotely controlled machine GTAW process and using the ambient temperature temper bead method with ERNiCrFe-7A (Alloy 52M) weld metal. Manual GTAW, using ERNiCrFe-7 (Alloy 52) or Alloy 52M will be used if local repairs of weld defects are necessary or additional weld metal is required locally to form the final SWOL contour in location at least 3/16-inch away from the low alloy or carbon steel nozzles. During recent DMW overlay activities, where use of Alloy 52/52M has been used for the filler metal, flaws in the first layer have occurred in the portion of the overlay deposited on the austenitic SS portions (safe ends, pipe, etc.) of the assemblies in some cases.

The flaw characteristics observed above are indicative of hot cracking. This phenomenon has

not been observed on the ferritic steel or ENiCrFe-3 (Alloy 182) DMW portions of the assemblies when welding Alloy 52M thereon. Further studies have determined that this problem may occur when using Alloy 52M filler metal on austenitic SS materials with high sulfur content. Limited tests and evaluation recently performed by AREVA have resulted in the conclusion that welding with Alloy 52M on SS base material with 0.020 weight% (wt%) sulfur results in cracking while welding on SS base materials with less than 0.010 wt% have resulted in no cracking. SL-2 will use the barrier layer on all the SS items prior to weld overlay. The barrier layer will use ER309L on the SS and Alloy 82 on the SS near the DMW-to-SS fusion zone only. The barrier layer will not be used in the structural analysis or in the crack growth analysis. The inside diameter (ID) of the portion of the SWOL over the barrier layer will be the outside diameter (OD) of the barrier layer that is applied over the SS material beneath the SWOL.

FPL's vendor performed a mockup and the chromium (Cr) content of the first layer was verified by weld deposition on an ASTM A-106, Grade B, pipe using double up progression (utilizing two weld machines both starting at the bottom and welding upward to the top on each side). Welding was performed in the 6G position (fixed pipe inclined at a 45-degree angle) with Cr measured at 90-degree increments starting at 45-degrees from the top. All welding parameters were recorded and the 28 percent minimum Cr value specified in Section 1(e) of Attachment 2 to RR-10, Rev. 1 was attained. The same heat of wire, or wire heat with equal or greater Cr content than that used in qualification, will be used in situ for the first layer and the same welding parameters will be specified in the welding procedure specification (WPS) as was used in the mockup for the first layer.

The thickness of the SWOL may exceed 1/2 the carbon and low alloy ferritic steel nozzle base metal thickness as specified in ASME Code Case N-638-1. The requirement therein applies to excavated cavities in the ferritic steel base material that are subsequently welded flush. This requirement is not applicable to SWOLs since they are applied to the nozzle surface and limited to 3/8-inch depth into the ferritic steel as specified in Section I-1(d) of Attachment 2, RR-10, Rev. 1.

3.4.3 Examination

FPL will not perform UT examination in accordance with ASME Code, Section XI, Appendix VIII, Supplement 10 on the DMW prior to the SWOL being applied. FPL states that since the structural integrity at the DMW locations will be restored by the SWOL, the UT examination of the DMW prior to SWOL application is unnecessary and the increased personnel dose that would be incurred performing the examinations is also undesirable and not consistent with good ALARA practice. All welds have postulated 100 percent through-wall cracks for both the SWOL design and for the flaw growth evaluations.

FPL will perform the UT and surface examinations on the temper bead portion of the SWOL no sooner than 48 hours after completion of the third temper bead layers as specified in Sections 3(a)(2) and 3(a)(3) of Attachment 2, RR-10, Rev. 1. The 48-hour delay is intended to provide time for delayed hydrogen cracking occurrence. The alternative requires the machine or automatic GTAW process to be used for temper bead welding, thereby eliminating the use of welding processes requiring flux for arc shielding. The machine GTAW temper bead process uses a welding process that is inherently free of hydrogen. The GTAW process relies on bare welding electrodes and bare wire filler metal with no flux to absorb moisture. An inert gas blanket provides shielding for the weld and surrounding metal, which protects the region during welding from the atmosphere and the moisture it may contain and typically produces porosity free welds. In accordance with the weld procedure qualification, welding grade argon is used for the inert gas blanket. To further reduce the likelihood of any hydrogen effects, specific controls

will be used to ensure the welding electrodes, filler metal and weld region are free of all sources of hydrogen. In addition, the use of the machine GTAW temper bead process provides precise control of heat input, bead placement, bead size and contour. The very precise control over these factors afforded by the machine GTAW process provides effective tempering of the nozzle ferritic steel heat affected zone (HAZ) resulting in achievement of lower hardness and tempered martensite. This further reduces susceptibility to hydrogen-induced cracking.

The Electric Power Research Institute (EPRI) Report 1013558, "Temperbead Welding Applications, 48 Hour Hold Requirements for Ambient Temperature Temperbead Welding, Technical Update, December 2006" provides justification for reducing the 48 hour hold time on P-No. 3, Group No. 3 ferritic steel base material to start after completion of the third temper bead layer, Attachment 2. EPRI Report 1013558 addresses microstructural issues, hydrogen sources, tensile stress and temperature, and diffusivity and solubility of hydrogen in steels. The base materials studied in the EPRI report are primarily P-No. 3. The pressurizer nozzle base materials at SL-2 are P-No. 3, Group No. 3 and the hot leg piping nozzle base materials are P-No. 1, Group No. 2. The concerns associated with hydrogen assisted cracking are generally more significant for P-No. 3 than P-No. 1 base materials due to the P-No. 3 base material's increased hardenability. Also, post weld heat treat exemptions shown in ASME Code, Section III, Table NB-4622.7(b)-1 are provided for P-No. 1, Group No. 2 materials, including temper bead welding, whereas no post weld heat treat exemptions, other than temper bead welding, are permitted for P-No. 3, Group No. 3 materials. Past industry experience with the use of the machine or automatic GTAW process has resulted in no detection of hydrogen induced cracking after the 48 hour hold nondestructive examination (NDE) or subsequent ISIs.

FPL states that all examinations will meet the requirements of RR-10, Rev. 1, Attachment 2. UT examination of the completed SWOL will be performed by procedures and personnel qualified to the PDI program which is an alternative to the requirements of ASME Code, Section XI, Appendix VIII, Supplement 11 of the 1998A00 Edition. See Attachment 1of RR-10, Rev. 1, for the PDI Program alternatives to ASME Code, Section XI, Appendix VIII, Supplement 11. Inservice inspection will be performed as specified in Attachment 2 of RR-10, Rev. 1 with the exceptions that:

1) the limitations associated with the cast SS safe end material will adversely affect the examinations and

2) UT examination procedures and personnel will be qualified in accordance with the PDI program, an alternative to the requirements of ASME Code, Section XI, Appendix VIII, Supplement 11 of the 1998A00 Edition, as specified in Attachment 1 of RR-10, Rev. 1.

FPL states that the cast SS base material of the applicable safe ends and the surge line pipe at the pressurizer surge nozzle and the surge line elbow at the hot leg B surge nozzle are not currently within the scope of PDI qualified UT examination procedures. Qualified representative mockups are not currently available, and examination procedures and personnel qualifications have not yet been demonstrated for the cast material. In these cases, an ASME Code, Section XI, Appendix III UT examination will be performed, using the existing PDI qualified personnel and procedures as shown in Attachment 1 of RR-10, Rev. 1. As stated previously, 100 percent through wall flaws are assumed for both the SWOL design and the flaw growth evaluations at all nozzle locations where SWOLs are being applied.

The UT examination requirements specified in NRC Regulatory Guide (RG) 1.147, Revision 14, as conditional acceptance of Code Case N-638-1 are not applicable to SWOL. UT of the SWOL will be performed in accordance with ASME Code, Section XI, Appendix VIII, Supplement 11

qualified procedures and personnel as modified by PDI and the limitations due to the underlying cast SS base material. Supplement 11 was prepared to be specifically applicable to weld overlays. The UT examination requirements in Section 3 of Attachment 2, RR-10, Rev. 1, are similar to the UT examination requirements provided in ASME Code, Section XI, Nonmandatory Appendix Q, which have been developed specifically for austenitic weld overlays. The UT examinations to be performed, in conjunction with the surface examinations, as specified in Section 3 of Attachment 2, RR-10, Rev. 1, are based on the latest industry experience and practice.

3.5 Duration of Proposed Alternative

The alternative requirements of this request will be applied for the duration of up to and including the last outage of the current third 10-year ISI interval which includes inservice examination requirements of Attachment 2 of RR-10, Rev. 1, for any applied SWOL. Future inservice examinations of SWOL at SL-2 beyond this inspection interval will be as required by the NRC in the regulations.

4.0 NRC STAFF EVALUATION

RR-10, Rev. 1, consists of 3 Attachments: (1) Attachment 1, "PDI Program Modifications to Appendix VIII, Supplement 11," (2) Attachment 2, "Alternative Requirements for Dissimilar Metal Weld Overlays," which includes “Mandatory Appendix I-Ambient Temperature Temper Bead Welding,” and (3) Attachment 3, "Barrier Layer to Prevent Hot Cracking in High Sulfur Stainless Steel.” Currently, the staff has endorsed the use of Code Cases N-504-2, “Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Section XI, Division 1,” and N-638-1, “Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique Section XI, Division 1.” The staff has not endorsed the use of Code Cases N-740, N-740-1, or N-638-2. However, since Code Case N-740-1 is essentially a combination of Code Cases N-504-2 and N-638-2, the staff used the requirements of Code Cases N-504-2 and N-638-1 to aid in the evaluation of Alternative RR-10, Rev. 1, as NRC-approved criteria associated with similar full SWOL applications.

Attachment 2 of RR-10, Rev. 1 is based on ASME Code Case N-740-1 “Dissimilar Metal Weld Overlay for Repair of Class 1, 2, and 3 Items Section XI, Division 1,” with modifications. Code Case N-740-1 was developed as the result of industry’s need to repair (reduce or mitigate) flaws (suspected or confirmed) generated from PWSCC via application of weld overlay. Also, the code case offers relief from post weld heat treatment preheat and a post weld soak by allowing the use of an ambient temperature temper-bead weld process.

FPL’s request is intended as an alternative repair method to mitigate potential effects of PWSCC by means of a full SWOL and to fulfill the examination requirements of ASME Code, Section XI, Appendix VIII, Supplement 11 with the use of a PDI qualified UT examination. The full SWOL will be applied to the DMW (Alloy 82/182) between low alloy steel (LAS)/carbon steel (CS) nozzles and wrought/cast SS safe ends. Nickel base Alloy 82/182 filler metal has been discovered to be susceptible to environmentally assisted stress corrosion cracking when exposed to reactor plant primary water. In general, some damaging factors that may possess a strong influence on the SCC behavior of nickel-based alloys have been identified as primary water hydrogen partial pressure, alloy Cr content, carbide precipitation, grain-boundary properties and temperature. Structural weld overlays have been used for several years on piping of both boiling and pressurized water reactors to inhibit the growth of flaws while establishing a new structural pressure boundary. The SWOL will control growth in PWSCC flaws and maintain weld integrity by producing compressive stress in the DMW. The full SWOL

will be sized to meet all structural requirements independent of the existing weld and will produce a favorable surface for UT examination. Due to their close proximity adjacent SS safe end-to-piping SMW will be incorporated into the area of the weld overlay.

FPL proposed to use Attachment 2 of RR-10, Rev. 1, with modifications, to install the full SWOL. The SWOL is proposed as an alternative to the ASME Code, Section XI, IWA 4000 requirements. For inspection of the full SWOL, FPL proposed using the PDI program with modifications, as specified in Attachment 1 of RR-10, Rev. 1, as an alternative to ASME Code, Section XI, Appendix VIII, Supplement 11 requirements. The staff has evaluated FPL's basis for the proposed alternatives and notes that Attachment 2, based on Code Case N-740-1, is not approved for use by the NRC in RG 1.147, Revision 14. However, the staff recognizes that Code Case N-740-1 does provide alternatives to ASME Code requirements and to those approved in Code Cases N-504-2 and N-638-1.

4.1 General Requirements

ASME Code Case N-504-2 and Nonmandatory Appendix Q (a contingent requirement of Code Case N-504-2 in accordance with RG 1.147, Revision 14) of ASME Code Section XI, require certain specification and surface conditions of the applicable base metal (LAS, CS, SS, and Alloy 82/182), the weld overlay filler metal (Alloy 52M) and the Cr content of weld overlay deposits. Section 1 of Attachment 2 to RR-10, Rev. 1, provides corresponding requirements, with modifications. FPL will deposit a barrier layer of ER309L SS filler metal on the base metal prior to weld overlay as a contingency for preventing possible hot cracking, which may result from high sulfur content in austenitic SS base material. The tendency of certain metals to exhibit hot cracking is caused by the segregation at grain boundaries of low-melting constituents (e.g., sulfur) in the weld metal. This may result in grain-boundary tearing under thermal contraction stresses. Hot cracking may be minimized by employing low impurity welding metals.

FPL stated that a SS barrier layer of alloy ER309L, will be utilized over the appropriate base materials due to the uncertainty in establishing impurity thresholds for successful Alloy 52M SWOL. FPL also stated that the proposed SWOL design does not take structural credit for the buffer/barrier weld layer. FPL will install the barrier layer, ER309L, on the austenitic SS pipe and safe end only and stop short of the Alloy 82/182 weld material. The final tie-in to the existing nickel Alloy 82/182 weld will be performed with nickel Alloy 82 weld metal. Acid Etching may be employed to identify the original Alloy 82/182 weld joint-to-safe end interface as a precaution against weld over of the DMW with ER309L. Welding over the nickel base ENiCrFe-3 (Alloy 182) joint with an iron based ER309L electrode may cause cracking in the ER309L. The Alloy 82 will be welded from the tie-in to the mid point (approximately) of the Alloy 82/182 weld joint and completed with weld overlay Alloy 52M. An informational liquid penetrant test (PT) will be performed on the relevant portion (the SS safe end) of the SWOL first layer. If indications of hot cracking are identified, as determined by the welding engineer, the suspect nickel alloy weld metal will be completely removed along with any indications in the underlying base metal of the SS safe end. Complete removal of the nickel alloy weld metal shall be verified by acid etch and the resulting cavity will be PT inspected. Next, a weld build-up will be applied to the cavity using SS weld material for the bulk of the build-up with the final tie-in to the existing nickel alloy weld being performed using nickel alloy weld metal. The weld build-up will serve two purposes:

(1) to restore the SS base metal to its original contour, and (2) to provide an improved base layer for application of the SWOL by reducing the amount of sulfur available for pick-up when applying the subsequent Alloy 52M full structural SWOL; therefore, reducing susceptibility to hot cracking.

FPL states that the procedure qualification record (PQR) for qualifying the temper-bead section

of the weld reinforcement and for overlay of the buttered P3 nozzle material were performed using austenitic nickel alloy ERNiCrFe-7 (Alloy 52 UNS N06052) or ERNiCrFe-7A (Alloy 52M, UNSN06054) filler metals. These filler materials were selected for their enhanced resistance to PWSCC. The Cr content of Alloy 52 & 52M is identical at 28-31.5 percent providing superior corrosion resistance. Alloy 52M will be used for the full SWOL. Alloy 52M contains a higher Niobium content (0.5-1 percent), which acts as a stabilizer providing resistance to intergranular corrosion. Its chemistry acts to pin grain boundaries inhibiting separation between grains and hot tearing during weld puddle solidification. Also, the difference in composition improves weld-ability. Moreover, Alloy 52M exhibits ductile properties and toughness similar to austenitic SS piping welds at PWR operating temperature. These filler materials are suitable for welding over the ferritic nozzle, the Alloy 82/182 weld, and the adjacent austenitic SS pipe/elbow-to-safe end welds.

Delta ferrite (FN) measurements are not required per Attachment 2 of RR-10, Rev. 1 for weld overlay repairs made of Alloy 52/52M weld metal. Welds of Alloy 52/52M are 100 percent austenitic and contain no delta ferrite due to their high nickel composition (approximately 60 percent nickel). The staff notes that weld filler material ER309L, to be used as a non-structural barrier layer, promotes primary solidification of the weld metal as ferrite in lieu of austenite. FPL's vendor performed a mockup and the Cr content of the first overlaid layer was verified at the 28 percent minimum Cr value specified in accordance with Section 1(e) of Attachment 2 to RR-10, Rev. 1. Furthermore, FPL states that the same heat number of weld wire and welding parameters used in qualification welding for the mockup first overlaid layer will be used for the first overlaid layer of the production SWOL.

4.2 <u>Crack Growth Consideration and Design</u>

ASME Code Case N-504-2 and Nonmandatory Appendix Q of the ASME Code, Section XI, provide requirements for the weld overlay design and crack growth calculations. Section 2 of Attachment 2 to RR-10, Rev. 1 provides the corresponding requirements, with modifications. The proposed full SWOLs are designed to contain the assumed flaw in the underlying base material or weld and is based on the limiting case of the two as follows: (a) 100 percent through-wall for the entire circumference, or (b) 100 percent through-wall for 1.5 inches or the combined width of the weld plus buttering, whichever is greater, in the axial direction for the entire circumference.

Section 2(a) of Attachment 2 to RR-10, Rev. 1 requires that flaw characterization and evaluation requirements be based on the postulated flaw, if UT examination of the weld and base material is not performed. Section 5.1 of RR-10, Rev. 1 states that FPL will not perform UT examination on the DMW prior to weld overlay installation. The staff observes that the condition of the DMW and adjacent base metal may not be known without conducting a UT examination of the DMW prior to weld overlay installation. Because UT examination is qualified to detect only the outer 25 percent of the original weld and base metal, following installation of the SWOL, the condition of the remaining inner 75 percent of DMW and adjacent base metal would not be known. However, Section 2(a)(1) of Attachment 2 per RR-10, Rev. 1 states that for repair overlays, the initial flaw size for crack growth in the original weld or base metal shall be based on the postulated flaw, if no pre-overlay UT examination is performed. In addition, Section 2(a)(2)(b) of Attachment 2 to RR-10, Rev. 1 states if no examination is performed prior to application of the overlay, initial inside-surface-connected planar flaws equal to 100 percent through the original wall thickness shall be assumed, in both the axial and circumferential directions. FPL continues that the SWOL design assumes a 360 degree circumferential flaw and an axial flaw length of the entire face width of the underlying DMW or 1.5-inches, whichever is greater.

The NRC staff finds FPL's preceding flaw assumptions acceptable because the assumed flaw size in the base metal for the crack growth calculation is a conservative assumption, which cannot be exceeded by any actual flaw. Any actual flaw would not exceed the depth of these assumptions and would be detectable by the qualified post weld overlay UT examinations.

Paragraphs g(2) and g(3) of ASME Code Case N-504-2 require evaluations of residual stresses and flaw growth of the repaired weldments. Similar evaluations are required in Section 2 of Attachment 2 to RR-10, Rev. 1. Section 2(b)(8) of Attachment 2 to RR-10, Rev. 1 states that the effects of any changes in applied loads, as a result of weld shrinkage from the entire overlay on other items in the piping system shall be evaluated. The staff notes the report will include crack growth calculations that demonstrate that crack growth in the weld overlay or base metal is acceptable and residual stress distribution in the weld overlay as well as the original weld is favorable. FPL states that the SWOL is extended $0.75(Rt)^{1/2}$ beyond the existing welds which allows adequate stress redistribution between the base metal and SWOL. FPL also states the applicable stress limits in ASME Code, Section III, NB-3200 are satisfied for the SWOL configuration. FPL stated that a structural evaluation is performed to assure that the associated piping and supports are not adversely impacted by the axial shrinkage due to the SWOL and that the evaluation is performed using initial assumed axial shrinkage values. FPL also states the measurements are performed in situ to confirm the assumed shrinkage limits as a result of the SWOL have been maintained and that the analysis includes the crack growth calculation to demonstrate that crack growth in the SWOL. The NRC staff finds that FPL will provide timely stress analyses of the nozzles in support of SWOL and fulfills the stress analysis requirements of ASME Code Case N-504-2.

4.3 Examination and Inspection

Code Case N-504-2 allows the use of weld overlay repair by deposition of weld reinforcement on the outside surface of the pipe. Code Case N-504-2 and Nonmandatory Appendix Q of the ASME Code, Section XI require specific acceptance, preservice and inservice examinations of the installed weld overlay. Section 3 of Attachment 2 to RR-10, Rev. 1, provides corresponding requirements with the following exceptions.

4.3.1 Acceptance Examination

Sections 3(a)(2) and 3(a)(3) of Attachment 2 to RR-10, Rev. 1 requires surface examination and UT examination, respectively. Section 3(a)(2) requires a PT examination of the installed weld overlay and adjacent base material in accordance with the acceptance criteria of the Construction Code or NB-5300 and NB-2500 of ASME code, Section III, respectively. Section 3(a)(3) requires UT examinations of the installed weld overlay to assure adequate fusion/bond with base metal and to detect welding flaws. The required examination surface, volume and thickness are defined in Figure 1(a) of Attachment 2. In addition, planar flaws detected in the weld overlay shall meet the preservice examination standards of Table IWB-3514-2 of ASME Code, Section XI.

The preceding proposed acceptance criteria are consistent with ASME Code Case N-504-2 and Nonmandatory Appendix Q of the ASME Code Section XI, except as follows: Section 3(a)(3) of Attachment 2 to RR-10, Rev.1, requires that "For planar indications outside the examination volume shown in Figure 1(b) of Attachment 2, the nominal wall thickness shall be "t_2" as shown in Figure 1(c) of Attachment 2 for volumes A-E-H-D and F-B-C-G." Volumes A-E-H-D and F-B-C-G refer to the portion of the weld overlay that is 1/2-inch outside/away from the toe of the

original weld. Initially, the NRC staff was concerned that UT examination is not qualified to examine the inner 75 percent of base metal following weld overlay installation. Therefore, the “t_2" dimension, which is the weld overlay thickness plus pipe thickness, should not be a parameter for the acceptance criteria of Table IWB-3514-2 of ASME Code, Section XI because the “t_2" dimension includes the 75 percent depth of the base metal. Furthermore, larger flaws would be permitted to remain inservice within the weld overlay if the “t_2" dimension were used.

However, the NRC staff notes that the pressurizer LAS nozzles and SS safe ends have not had a history of PWSCC. Volumes A-E-H-D and F-B-C-G as defined in Figure 1(c) of Attachment 2 to RR-10, Rev. 1, pertain to the portion of the weld overlay not required to support the pressure boundary function of the SWOL or base metal. If larger flaws are allowed to remain in service in this portion of the weld overlay, the structural integrity of the portion of the SWOL that covers the original weld will not be adversely affected. Therefore, the NRC staff finds that the use of the “t_2" dimension is acceptable provided that the base metal of the pressurizer nozzles and safe ends at SL-2 are not susceptible to PWSCC.

4.3.2 Preservice Inspection

Section 3(b) of Attachment 2 to RR-10, Rev. 1 requires a preservice UT examination of the installed weld overlay and the upper/outer (i.e., measured from the OD toward the ID) 25 percent of the original pipe wall thickness. The required examination volume is defined in Figure 2 of Attachment 2. The current UT examination is qualified only to detect flaws in the outer 25 percent of the pipe base metal after a weld overlay is applied. With the limited UT qualification, the condition of the inner 75 percent of the pipe base metal would not be known. The NRC staff does not believe this is a conservative assumption for crack growth calculation if the original weld was not examined prior to installing the SWOL. A conservative assumption would be to assume existence of a crack of 75 percent through-wall depth in the inner 75 percent pipe base metal. The 75 percent depth flaw should be added to the depth of the crack found in the outer 25 percent of the pipe base metal. This worst-case crack (the sum of two flaws) should be used to calculate crack growth.

FPL modified Section 3(b)(1) and Section 3(b)(2) of Attachment 2 to RR-10, Rev. 1 as follows: (1) Section 3(b)(1) now states “the examination volume in Figure 2 shall be UT examined, except that cast SS base material within the examination volume shall be UT examined to the extent practicable.” and (2) the statement "Cracks in the outer 25% of the base metal shall meet the design analysis requirements of 2(b)" has been deleted from Section 3(b)(2). FPL stated that in addition to the requirements of Section 3(b)(3), flaws in the SWOL that do not comply with the preservice examination acceptance standards of ASME Code, Section XI, Table IWB-3514-2 will be removed. Furthermore, FPL states that the crack shall satisfy Section 2(b)(6) of Attachment 2 to RR-10, Rev. 1 since no pre-SWOL UT will be performed and the SWOL design assumes a 100 percent through-wall, 360 degree, circumferential flaw and a 100 percent through-wall axial flaw with a length of the entire underlying weld or 1.5-inches, whichever is greater. The NRC staff finds that Section 3(b)(3) adequately addresses the flaw size to be used in the crack growth calculation. Therefore, the proposed preservice inspection requirements in Section 3(b), Attachment 2 of RR-10, Rev. 1 are acceptable.

4.3.3 Inservice Inspection

Section 3(c) of Attachment 2 to RR-10, Rev. 1 provides requirements for UT inservice examinations with the examination volume defined in Figure 2 of Attachment 2. FPL notes that Section 3(c)(2) is not applicable for use at SL-2 since qualified UT will not be performed prior to SWOL installation. However, FPL has modified Section 3(c)(2) to discuss UT requirements of

the cast SS base material. FPL states that Subarticle Q-4300 of ASME Code, Section XI, 2004 Edition through 2006 Addenda will be used with exceptions as noted in RR-10, Rev. 1. FPL states that the cast SS volume beneath the SWOL will be UT examined on a "best effort" basis since qualified UT examination of cast SS is not achievable at this time. FPL continued that qualified procedures and personnel will be used in accordance with ASME Code, Section XI, Appendix VIII, Supplement 11 as modified by the PDI Program. FPL stated that the weld overlay will be examined in accordance with the PDI qualified procedure from both sides to the fullest extent practicable, however, no credit for examination coverage can be given in any portion of the examination volume where the UT beam passes through the cast SS material. Section 3(c)(4) allows flaws in SWOL exceeding acceptance criteria of ASME Code, Section XI, Table IWB-3514-2 to be evaluated by analytical procedures and accepted for continued service by IWB-3640. The staff agrees with the acceptance criteria of IWB-3600 for flaws in the weld overlay if the flaw growth is caused by fatigue, which could be considered insignificant; however, flaw growth caused by PWSCC could be significant and the staff finds such a growth mechanism in the SWOL as unacceptable. FPL stated if flaw growth in the weld overlay occurs and inservice inspection acceptance standards of Table IWB-3514-2 of ASME Code, Section XI cannot be met, a determination will be made whether the flaw is PWSCC. FPL continued that if the cause is determined to be PWSCC or PWSCC cannot be excluded as the cause of the flaw, IWB-3600 shall not be used to accept these types of flaws and the flaws shall be repaired. Therefore, the NRC staff accepts Section 3(c), with modifications, based on the preceding discussion and FPL's affirmation not to use ASME Code, Section XI, IWB-3600 to accept suspected PWSCC flaws.

4.3.4 Examination Coverage of Cast Stainless Steel Components

FPL stated that UT examination of the SWOL will be performed in accordance with ASME Code, Section XI, Appendix VIII, Supplement 11 using qualified procedures and personnel as modified by PDI with limitations due to the underlying cast SS base material. FPL states that the safe-end cast SS base material identified in Section 3.3 above is not currently within the scope of PDI qualified UT examination procedures. FPL states qualified representative mockups are not currently available and examination procedures and personnel have not been demonstrated for the cast SS material. In these cases, FPL will perform UT examination in accordance with ASME Code, Section XI, Appendix III, using the existing PDI qualified personnel and procedures as shown in Attachment 1 of RR-10, Rev. 1.

FPL, as previously stated, will assume a postulated 100 percent through-wall flaw for SWOL length and thickness sizing. In addition, FPL will assume a postulated 100 percent through wall flaw for welds on all nozzle locations where the SWOL will be applied because the post SWOL UT examination is not qualified for flaw detection and sizing in cast SS base material.

FPL provided, in response to the NRC staff's RAI as stated in Section 1.0, weld overlay thickness and reduction in UT testing volume coverage information for weld overlaid locations of the cast SS components at SL-2.

WELD LOCATION	MINIMUM ANALYZED THICKNESS[1]	BARRIER LAYER THICKNESS[2]	NOMINAL PIPE THICKNESS	REDUCTION IN UT COVERAGE DUE TO CAST SAFE-END[3]
Pressurizer Surge Line	0.54-inch	0.065-inch	1.312-inch	<10%
Hot Leg Surge Line	0.68-inch			
Shutdown Cooling to A RCS	0.50-inch			
Shutdown Cooling to B RCS				

Note(s):

1. At the nozzle side of the weld overlay design.
2. Barrier layer is not credited in the analysis of the SWOL design.
3. ISI volume of the cast SS safe-ends.

Based on the information provided the staff understands the following: 1) FPL will perform preservice and inservice UT examinations, to the extent practicable, of the 25 percent underlying cast SS utilizing PDI qualified procedures and personnel qualified to wrought SS, 2) FPL will assume initial 100 percent axial and circumferential through-wall flaws for both SWOL design and flaw growth analysis for all cast SS material, 3) FPL states, in the table above, that the cast SS amounts to less than 10 percent of the total volume required to be UT inspected, 4) FPL stated that the barrier layer thickness, indicated in the table above, will not be used in the structural or crack growth analysis of the SWOL, 5) The staff notes that although the barrier layer is not considered in the analysis of the SWOL the barrier layer will contribute compressive forces to the cast SS safe-ends and add to the overall structural integrity of the SWOL, 6) The staff notes the SWOL will control growth in PWSCC flaws and maintain weld integrity by producing compressive stress on the DMW and adjacent components, 7) The staff notes that the full SWOL will be sized to meet all structural requirements independent of the existing DMW, 8) The staff also notes that industry operational experience has shown PWSCC in Alloy 82/182 will blunt at the interface with SS base metal, and 9) The staff notes Cast SS has not shown a susceptibility to PWSCC.

The staff accepts FPL's method to UT inspect, to the extent practicable, the underlying cast SS safe-end material by utilizing PDI qualified procedures and personnel based on the preceding conclusions. FPL's design and flaw growth analysis, based on the most conservative initially postulated (100 percent) axial and circumferential through-wall flaws in addition to the use of a barrier layer would provide sufficient thickness, promote reasonable assurance of structural integrity and provide an acceptable level of quality and safety.

4.4 Mandatory Appendix I-Ambient Temperature Temper-Bead Welding

ASME Code Case N-638-1 provides requirements for ambient temperature temper bead welding. Mandatory Appendix I, Attachment 2 of RR-10, Rev. 1 is based on ASME Code Case N-638-2. The major difference between the two documents is discussed below.

Section I-1(b) of Mandatory Appendix I in Attachment 2 of RR-10, Rev. 1 states that the maximum area of the weld overlay based on the finished surface over the ferritic base material shall be 300 square-inches. Code Case N-638-1 allows only l00 square-inches over the ferritic base material. FPL stated that the SWOL will require welding on more than 100 square-inches, but less than 300 square-inches of surface on the pressurizer surge nozzle LAS base material, the hot leg surge nozzle and shutdown cooling CS nozzles. FPL continued that the SWOL will extend toward the pressurizer/hot leg onto the ferritic steel nozzle base material for a sufficient length so that qualified ultrasonic examination of the required volume can be performed following SWOL application. FPL notes in Section 5.2 of RR-10, Rev. 1 the ASME committee has indicated ID compressive stress levels remain essentially the same between 100-square inches and 500-square inches in relation to SWOL applications. The presentation slides entitled, "Bases for 500 Square Inch Weld Overlay Over Ferritic Material," was provided to the NRC staff in a public meeting held on January 10, 2007, as summarized in (ADAMS Accession No. ML070470565). Additional justification is provided in EPRI Report 1014351, "Repair and Replacement Applications Center: Topical Report Supporting Expedited NRC Review of Code Cases for Dissimilar Metal Weld Overlay Repairs, December 2006." The staff notes the industry provided results of finite element analysis demonstrating that the stresses of a nozzle with the 500 square-inch weld area will not adversely affect the integrity of the pressurizer nozzle. Therefore, the staff accepts the proposed Section I-1(b) maximum area of the weld overlay based on a review of the preceding information.

Section I-1(d) of Mandatory Appendix I states that if a defect penetrates into the ferritic base material, repair of the base material, using a nonferritic weld filler material, may be performed provided the depth of repair in the base material does not exceed 3/8-inch. FPL stated that the thickness of the weld overlays may exceed 1/2 the CS nozzle base metal thickness limit as specified in ASME Code Case N-638-1. FPL states that the ASME Code Case N-638-1 requirement applies to excavated cavities in the ferritic steel base material that are subsequently welded flush and this requirement is not applicable to weld overlays since they are applied to the nozzle surface and limited to 3/8-inch depth into the ferritic steel. FPL noted that additional justification is provided in Appendix F of EPRI Report 1014351, “Repair and Replacement Applications Center: Topical Report Supporting Expedited NRC Review of Code Cases for Dissimilar Metal Weld Overlay Repairs, December 2006.” The staff believes depth of preparation is not applicable to the SWOL design because the overlay requires no preparation other than surface cleanup prior to application. The staff also believes that the one half thickness limit was included in the code case as a conservative measure to assure sufficient material existed to support weld shrinkage stresses generated by the constraint of a deep cavity in a component. ASME Code Case N-638-1 was not written for overlay design applications and is not specific enough to be used without modification for this type application. Therefore, the staff concludes the depth of preparation is not applicable to this SWOL repair based on the preceding discussion.

Section I-2.1(c) of Mandatory Appendix I states that the maximum interpass temperature for the first three layers of the test assembly shall be 150°F. Section I-3(d) of Mandatory Appendix I requires the maximum interpass temperature for field applications to be 350°F regardless of the interpass temperature during qualification. However, ASME Code, Section IX, QW-256 specifies maximum interpass temperature as a supplementary essential variable that must be held within 100°F above that used during procedure qualification. FPL stated that the maximum interpass temperature during welding on the ferritic steel nozzle material will be limited to 350°F maximum, although the maximum interpass temperature is limited to 150°F maximum for the first three layers in the PQR test assembly. In addition, FPL noted this is greater than the maximum 100°F interpass temperature increase permitted by ASME Code, Section IX, QW-406.3. FPL states

that the limitation on the PQR maximum interpass temperature is to ensure the cooling rates achieved during procedure qualification are more severe than those encountered during field welding (are not slower than those achievable during field welding) and that the higher interpass temperature is permitted during field welding because it would only result in slower cooling rates which could be helpful in producing more ductile transformation products in the ferritic steel HAZ. Furthermore, FPL noted additional justification is provided in Appendix F of EPRI Report 1014351, "Repair and Replacement Applications Center: Topical Report Supporting Expedited NRC Review of Code Cases for Dissimilar Metal Weld Overlay Repairs, December 2006." Therefore, the staff agrees the 350°F maximum interpass temperature may prove beneficial for favorable metallurgical transformation during field applications by producing slower cooling rates.

Section I-3(d)(1) states the interpass temperature shall be determined by pyrometers, temperature indicating crayons or thermocouples. FPL modified Section I-3(d)(1) to state that thermocouples will be used to measure interpass temperature. FPL states that thermocouples are required by ASME Code, Section XI, IWA-4610 for measurement of process temperatures when temper bead welding is used. FPL noted that surface examination in accordance with ASME Code, Section III, NB-4435(b)(3) will be used on thermocouple removal areas. The staff concludes that FPL's use of thermocouples and surface examination requirements of thermocouple removal sites is acceptable based on compliance with ASME Code Case N-638-1 requirements.

The NRC staff finds that the requirements of Enclosure 1 together with Mandatory Appendix I of the alternate request are consistent with the intent of provisions approved in ASME Code Cases N-504-2 and N-638-1 including Section XI, Nonmandatory Appendix Q, of the ASME Code. Therefore, the proposed alternative is acceptable.

4.5 Modifications to Appendix VIII, Supplement 11

The U.S. nuclear utilities created the PDI program to implement performance demonstration requirements contained in Section XI, Appendix VIII, of the ASME Code. Moreover, the PDI program is designed for qualifying equipment, procedures and personnel to examine weld overlays in accordance with the UT criteria of Appendix VIII, Supplement 11. Preceding the Supplement 11 program, EPRI maintained a performance demonstration program for weld overlay qualification under the Tri-party Agreement.[1] In lieu of having two programs with similar objectives, the NRC staff recognized the PDI program[2] for weld overlay qualifications as an acceptable alternative to the Tri-party Agreement.

The PDI program is routinely assessed by the staff for consistency with the current ASME Code and proposed modifications. The PDI program does not fully comport with the existing requirements of Supplement 11. PDI presented alternatives/modifications at public meetings in which the NRC participated.[3, 4] The modifications involve flaw location within test specimens and fabricated flaw tolerances. The modifications in flaw location permitted the use of test specimens from the Tri-party Agreement and the modifications in fabricated flaw tolerances provide UT acoustic responses similar to responses associated with intergranular stress corrosion cracking. The PDI program is presented in Attachment 1 "PDI Program Modifications to Appendix VIII, Supplement 11" of RR-10, Rev. 1. The NRC staff evaluated the modifications identified in the PDI program in comparison with Supplement 11 in the September 24, 2007 submittal. The NRC staff concludes that the PDI program provides an acceptable level of quality and safety.

5.0 FPL COMMITMENTS

As stated in RR-10, Rev. 1, dated September 24, 2007, FPL committed to provide a report of the SWOL UT examinations within 60 days from the end of the SL2-17 refueling outage.

In addition, as stated in RR-10, Rev. 1 and the response to RAI #21-2, any flaws detected that exceed the acceptance standards of ASME Code, Section XI, Table IWB-3514-2 will be reported to the NRC as soon as possible. A discussion and reason for any weld overlay or base metal repairs shall be provided.

6.0 CONCLUSION

The NRC staff has reviewed FPL's submittal and has determined that RR-10, Rev. 1 will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the use of the RR-10, Rev. 1, for the full SWOL of DMWs on the subject pressurizer and hot leg piping welds for the remainder of the third 10-year ISI interval at SL-2, which ends August 7, 2013. All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: David Terantino

Date: December 12, 2007

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1 The Tri-party Agreement is between NRC, EPRI, and the Boiling Water Reactor Owners Group (BWROG), "Coordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE (Nondestructive Examination) Personnel," July 3, 1984.

2 US NRC Letter from William H. Bateman to Michael Bratton, "Weld Overlay Performance Demonstration Administered by PDI as an Alternative for Generic Letter 88-01 Recommendations," January 15, 2002 (ML020160532).

3 US NRC Memorandum from Donald G. Naujock to Terence Chan, "Summary of Public Meeting Held June 12 through June 14, 2001, with PDI Representatives," November 29, 2001 (ML013330156).

4 US NRC Memorandum from Donald G. Naujock to Terence Chan, "Summary of Public Meeting Held January 31 - February 2, 2002, with PDI Representatives," March 22, 2002 (ML010940402).

cc:
Mr. William E. Webster
Vice President, Nuclear Operations,
South Region
Florida Power & Light Company
P.O. Box 14000
Juno Beach, FL 33408-0420

Senior Resident Inspector
St. Lucie Plant
U.S. Nuclear Regulatory Commission
P.O. Box 6090
Jensen Beach, Florida 34957

Craig Fugate, Director
Division of Emergency Preparedness
Department of Community Affairs
2740 Centerview Drive
Tallahassee, Florida 32399-2100

M. S. Ross, Managing Attorney
Florida Power & Light Company
P.O. Box 14000
Juno Beach, FL 33408-0420

Marjan Mashhadi, Senior Attorney
Florida Power & Light Company
801 Pennsylvania Avenue, NW.
Suite 220
Washington, DC 20004

Mr. Douglas Anderson
County Administrator
St. Lucie County
2300 Virginia Avenue
Fort Pierce, Florida 34982

Mr. William A. Passetti, Chief
Department of Health
Bureau of Radiation Control
2020 Capital Circle, SE, Bin #C21
Tallahassee, Florida 32399-1741

Mr. Gordon L. Johnston
Site Vice President
St. Lucie Nuclear Plant
6351 South Ocean Drive
Jensen Beach, Florida 34957-2000

Mr. Christopher R. Costanzo
Plant General Manager
St. Lucie Nuclear Plant
6351 South Ocean Drive
Jensen Beach, Florida 34957

Mr. Terry Patterson
Licensing Manager
St. Lucie Nuclear Plant
6351 South Ocean Drive
Jensen Beach, Florida 34957

Don E. Grissette
Vice President, Nuclear Training
and Performance Improvement
Florida Power & Light Company
P.O. Box 14000
Juno Beach, FL 33408-0420

Mr. Rajiv S. Kundalkar
Vice President - Nuclear Technical Services
Florida Power & Light Company
P.O. Box 14000
Juno Beach, FL 33408-0420

Mr. J. Kammel
Radiological Emergency
Planning Administrator
Department of Public Safety
6000 Southeast Tower Drive
Stuart, Florida 34997

Mr. Bill Parks
Operations Manager
St. Lucie Nuclear Plant
6351 South Ocean Drive
Jensen Beach, Florida 34957-2000

Mr. Seth B. Duston
Training Manager
St. Lucie Nuclear Plant
6351 South Ocean Drive
Jensen Beach, Florida 34957-2000