June 23, 2003

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 NUCLEAR PLANT, UNITS 1 AND 2 - RELIEF REQUEST NOS. 24 AND 36 REGARDING QUALIFICATION REQUIREMENTS FOR INSPECTION OF DISSIMILAR METAL PIPING WELDS (TAC NOS. MB8178 AND MB8179)

Dear Mr. Stall:

By a letter dated March 25, 2003, Florida Power and Light Company (the licensee) submitted Relief Requests (RRs) 24 and 36 for St. Lucie Units 1 and 2, respectively, requesting relief from the qualification requirements for inspection of dissimilar metal piping welds specified in the 1989 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, Appendix VIII, Supplement 10 (Supplement 10). In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i), RRs 24 and 36 proposed to implement the dissimilar metal weld criteria of the Electric Power Research Institute-Performance Initiative Program as an alternative to the current ASME Code, Supplement 10 requirements.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's proposed alternative and has concluded that it provides an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternative for the remainder of the third inservice inspection (ISI) interval for St. Lucie Unit 1, which began February 11, 1998, and for the remainder of the second ISI interval for St. Lucie Unit 2, which began August 8, 1993.

Further details of the bases for the NRC staff's conclusions are contained in the enclosed safety evaluation. If you have any questions regarding this issue, please contact Eva Brown at (301) 415-2315 or Brendan Moroney at (301) 415-3974.

Sincerely,

/RA/

Allen G. Howe, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-335 and 50-389

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION PROGRAM

RELIEF REQUEST NOS. 24 AND 36

FLORIDA POWER AND LIGHT

ST. LUCIE NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-335 AND 50-389

1.0 INTRODUCTION

By a letter dated March 25, 2003, Florida Power and Light Company (the licensee) submitted Relief Requests (RRs) 24 and 36 for St. Lucie Units 1 and 2, respectively, requesting relief from the qualification requirements for inspection of dissimilar metal piping welds specified in the 1989 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, Appendix VIII, Supplement 10 (Supplement 10). In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i), RRs 24 and 36 proposed to implement the dissimilar metal weld criteria of the Electric Power Research Institute (EPRI)-Performance Demonstration Initiative Program (PDI) as an alternative to the current ASME Code, Supplement 10 requirements. This proposed alternative is requested to be authorized for the remainder of the third inservice inspection (ISI) interval for St. Lucie Unit 1, which began February 11, 1998, and for the remainder of the second ISI interval for St. Lucie Unit 2, which began August 8, 1993.

2.0 REGULATORY EVALUATION

The ISI of the ASME Code Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by 10 CFR 50.55a(g), except where specific written relief has been granted by the U.S. Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). Additionally, 10 CFR 50.55a(a)(3) states, in part, that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the

limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year 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, and is subject to the limitations and modifications listed therein. The ISI Code of record for the third 10-year ISI interval for St. Lucie Unit 1, which began February 11, 1998, and the second 10-year ISI interval for St. Lucie Unit 2, which began August 8, 1993, is the 1989 Edition. The components (including supports) meeting the requirements set forth in subsequent editions and addenda of the ASME Code, incorporated by reference in 10 CFR 50.55a(b), are subject to the limitations and modifications listed therein and are subject to commission approval.

3.0 TECHNICAL EVALUATION

By a letter dated March 25, 2003, the licensee requested approval to use the dissimilar metal weld criteria of the EPRI-PDI in lieu of the 1989 Edition of the ASME Code, Supplement 10 requirements.

3.1 RELIEF REQUEST NOS. 24 AND 36

3.1.1 Component Identification

Class 1 and 2 pressure retaining dissimilar metal piping welds subject to ultrasonic testing (UT) examinations using procedures, personnel, and equipment qualified to the 1995 Edition, 1996 Addenda of the ASME Code Section XI, Appendix VIII, Supplement 10, “Qualification Requirements for Dissimilar Metal Piping Welds.”

3.1.2 Code Requirements for which Relief is Requested

The licensee proposed alternatives to the following Supplement 10 requirements:

Item 1 - Paragraph 1.1(b) states in part - Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent.

Item 2 - Paragraph 1.1(d) states - All flaws in the specimen set shall be cracks.

Item 3 - Paragraph 1.1(d)(1) states - At least 50% of the cracks shall be in austenitic material. At least 50% of the cracks in austenitic material shall be contained wholly in weld or buttering material. At least 10% of the cracks shall be in ferritic material. The remainder of the cracks may be in either austenitic or ferritic material.

Item 4 - Paragraph 1.2(b) states in part - The number of unflawed grading units shall be at least twice the number of flawed grading units.

Item 5 - Paragraphs 1.2(c)(1) and 1.3(c) state in part - At least one third of the flaws, rounded to the next higher whole number, shall have depths between 10% and 30% of the nominal pipe wall thickness. Paragraph 1.4(b) distribution table requires 20% of the flaws to have depths between 10% and 30%.

Item 6 - Paragraph 2.0 first sentence states - The specimen inside surface and identification shall be concealed from the candidate.

Item 7 - Paragraph 2.2(b) states in part - The regions containing a flaw to be sized shall be identified to the candidate.

Item 8 - Paragraph 2.2(c) states in part - For a separate length sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate.

Item 9 - Paragraph 2.3(a) states - 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.

Item 10 - Paragraph 2.3(b) states - 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.

Item 11 - Table VIII-S2-1 provides the false call criteria when the number of unflawed grading units is at least twice the number of flawed grading units.

3.1.3 Licensee's Proposed Alternative to Code and Basis for Relief

The licensee proposed the following alternatives to the ASME Code, Supplement 10 requirements for the St. Lucie Plant Units 1 (RR-24) and 2 (RR-36), during the current interval. The proposed alternative will be implemented through the EPRI-PDI Program.

Paragraph 1.1(b) alternative:

> The specimen set shall include the minimum and maximum pipe diameters and thicknesses for which the examination procedure is applicable. Pipe diameters within a range of ½ in. (13 mm) of the nominal diameter shall be considered equivalent. Pipe diameters larger than 24 in. (610 mm) shall be considered to be flat. When a range of thicknesses is to be examined, a thickness tolerance of ±25% is acceptable.
>
> Technical Basis - The change in the minimum pipe diameter tolerance from 0.9 times the diameter to the nominal diameter minus 0.5 inch provides tolerances more in line with industry practice. Though the alternative is less stringent for small pipe diameters they typically have a thinner wall thickness than larger diameter piping. A thinner wall thickness results in shorter sound path distances that reduce the detrimental effects of the curvature. This change maintains consistency between Supplement 10 and the recent revision to Supplement 2.

Paragraph 1.1 (d) alternative:

> At least 60% of the flaws shall be cracks, the remainder shall be alternative flaws. Specimens with IGSCC [intergranular stress-corrosion cracking] shall be

used when available. Alternative flaws, if used, shall provide crack-like reflective characteristics and shall be limited to the case where implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. Alternative flaw mechanisms shall have a tip width of less than or equal to 0.002 in. (.05 mm). Note, to avoid confusion the proposed alternative modifies instances of the term "cracks" or "cracking" to the term "flaws" because of the use of alternative flaw mechanisms.

Technical Basis - As illustrated below, 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. In addition, it is important to preserve the dendritic structure present in field welds that would otherwise be destroyed by the implantation process. To resolve these issues, the proposed alternative allows the use of up to 40% fabricated flaws as an alternative flaw mechanism under controlled conditions. The fabricated flaws are isostatically compressed which produces ultrasonic reflective characteristics similar to tight cracks.

Paragraph 1.1(d)(1) alternative:

At least 80% of the flaws shall be contained wholly in weld or buttering material. At least one and a maximum of 10% of the flaws shall be in ferritic base material. At least one and a maximum of 10% of the flaws shall be in austenitic base material.

Technical Basis - Under the 1995 Edition with 1996 Addenda of the ASME Code Section XI, Appendix VIII, Supplement 10, as few as 25% of the flaws are contained in austenitic weld or buttering material. Recent experience has indicated that flaws contained within the weld are the likely scenarios. The metallurgical structure of austenitic weld material is ultrasonically more challenging than either ferritic or austenitic base material. The proposed alternative is, therefore, more challenging than the current Code.

Paragraph 1.2(b) alternative:

Detection sets shall be selected from Table VIII-S10-1. The number of unflawed grading units shall be at least one and a half times the number of flawed grading units.

Technical Basis - New Table VIII-S10-1 provides a statistically based ratio between the number of unflawed grading units and the number of flawed grading units. The proposed alternative reduces the ratio to 1.5 times to reduce the number of test samples to a more reasonable number from the human factors perspective. However, the statistical basis used for screening personnel and procedures is still maintained at the same level with competent personnel being successful and less skilled personnel being unsuccessful. The acceptance

criteria for the statistical basis are in Table VIII-S10-1.

Paragraph 1.2(c)(1) and 1.3(c) alternative:

The proposed alternative to the flaw distribution requirements of Paragraph 1.2(c)(1) (detection) and 1.3(c) (length) is to use the Paragraph 1.4(b) (depth) distribution table (see below) for all qualifications.

Flaw Depth (% Wall Thickness)	Minimum Number of Flaws
10-30%	20%
31-60%	20%
61-100%	20%
At least 75% of the flaws shall be in the range of 10 to 60% of wall thickness.	

Technical Basis - The proposed alternative uses the depth sizing distribution for both detection and depth sizing because it provides for a better distribution of flaw sizes within the test set. This distribution allows candidates to perform detection, length, and depth sizing demonstrations simultaneously utilizing the same test set. The requirement that at least 75% of the flaws shall be in the range of 10 to 60% of wall thickness provides an overall distribution tolerance yet the distribution uncertainty decreases the possibilities for testmanship that would be inherent to a uniform distribution. It must be noted that it is possible to achieve the same distribution utilizing the present requirements, but it is preferable to make the criteria consistent.

Paragraph 2.0 first sentence alternative:

For qualifications from the outside surface, the specimen inside surface and identification shall be concealed from the candidate. When qualifications are performed from the inside surface, the flaw location and specimen identification shall be obscured to maintain a “blind test.”

Technical Basis - The 1995 Edition with 1996 Addenda of the ASME Code Section XI, Appendix VIII, Supplement 10 requires that the inside surface be concealed from the candidate. This makes qualifications conducted from the inside of the pipe (e.g., PWR [pressurized-water reactor] nozzle to safe end welds) impractical. The proposed alternative differentiates between ID [inner diameter] and OD [outer diameter] scanning surfaces, requires that they be conducted separately, and requires that flaws be concealed from the candidate. This is consistent with the recent revision to Supplement 2.

Paragraph 2.2(b) and 2.2(c) alternative:

> ... containing a flaw to be sized may be identified to the candidate.
>
> Technical Basis - The 1995 Edition with 1996 Addenda of the ASME Code Section XI, Appendix VIII, Supplement 10 requires that the regions of each specimen containing a flaw to be length sized shall be identified to the candidate. The candidate shall determine the length of the flaw in each region (note that length and depth sizing use the term "regions" while detection uses the term "grading units" - the two terms define different concepts and are not intended to be equal or interchangeable). To ensure security of the samples, the proposed alternative modifies the first "shall" to a "may" to allow the test administrator the option of not identifying specifically where a flaw is located. This is consistent with the recent revision to Supplement 2.

Paragraph 2.3(a) and 2.3(b) alternative:

> ... regions of each specimen containing a flaw to be sized may be identified to the candidate.
>
> Technical Basis - The 1995 Edition with 1996 Addenda of the ASME Code Section XI, Appendix VIII, Supplement 10 requires that a large number of flaws be sized at a specific location. The proposed alternative changes the "shall" to a "may" which modifies this from a specific area to a more generalized region to ensure security of samples. This is consistent with the recent revision to Supplement 2. It also incorporates terminology from length sizing for additional clarity.

Paragraph 3.1 alternative:

Use the acceptance Table VIII-S10-1 which is a modification of Table VIII-S2-1.

> Technical Basis - The proposed alternative is identified as new Table VIII-S10-1 above. It was modified to reflect the reduced number of unflawed grading units and allowable false calls. As part of ongoing Code activities, Pacific Northwest National Laboratory (PNNL) has reviewed the statistical significance of these revisions and offered a revised Table VIIIS10-1.

3.1.4 Evaluation

Paragraph 1.1(b):

The Code requirement of “0.9 to 1.5 times the nominal diameter shall be considered equivalent” was established for single nominal pipe diameters. Under the current code requirements, a 5-inch OD pipe would be equivalent to a range of 4.5-inch to 7.5-inch diameter pipe, and a 16-inch nominal diameter pipe would be equivalent to a range of 14.4-inch to 24 inch diameter pipe. In analyzing the above equivalent ranges, when the Code-required tolerance is applied to a range of diameters, the tolerance rapidly expands on the high side.

Under the proposed PDI guidelines, the equivalent range for the 5-inch OD pipe would be reduced to a 4.5-inch to 5.5-inch diameter, and the tolerance for the 16-inch nominal diameter pipe would be significantly reduced to an equivalent range of 15.5-inch to 16.5-inch diameter pipe. The difference between the Code and the proposed alternative for diameters less than 5 inches is not significant because of the shorter metal path and beam spread associated with smaller diameter piping. The proposed alternative is considered more conservative than the current Code requirements and is, therefore, acceptable.

Paragraph 1.1(d):

The Code requires "all flaws in the specimen set to be cracks." In lieu of this requirement, the proposed alternative requests that the Code be modified to replace the term "cracks" or "cracking" with the term "flaws" because of proposed use of "alternative flaw mechanisms." These "alternative flaw mechanisms," developed by PDI, are crack-like reflective characteristics that produce UT acoustic responses similar to the responses associated with real cracks. This process for fabricating flaws has been developed to overcome the extreme difficulty of manufacturing austenitic material test specimens that contain cracks free of spurious reflections and telltale indicators. PDI is selectively installing these fabricated flaws in specimen locations that are unsuitable for real cracks. PDI presented this process for discussion at the public meetings held on June 12 through 14, 2001, and January 31 through February 2, 2002, located at the EPRI Nondestructive Examination Center in Charlotte, NC. The NRC staff attended these meetings and determined that the process parameters used for manufacturing fabricated flaws resulted in acceptable acoustic responses, therefore, the proposed alternative is acceptable.

Paragraph 1.1(d)(1):

Field experience shows that flaws identified during ISI of dissimilar metal welds are more likely to be located in the weld or buttering material than in the base material. While conducting ISI on dissimilar metal welds, the grain structure of austenitic weld and buttering material represents a much more stringent ultrasonic scenario than that of a ferritic material or austenitic base material. Flaws made in austenitic base material are difficult to create free of spurious reflectors and telltale indicators. Accordingly, the Code requires that at least 50% of the flaws be contained in austenitic material, and that 50% of the flaws in the austenitic material shall be contained fully in weld or buttering material. This means that at least 25% of the total flaws must be located in the weld or buttering material. The proposed alternative states that 80% of the flaws be contained in the weld metal or buttering material. This would provide a more challenging testing scenario reflective of field experience while minimizing the testmanship associated with telltale reflectors common to placing flaws in austenitic base material. The proposed alternative is considered more conservative than the current Code requirements and is, therefore, acceptable.

Paragraph 1.2(b):

The Code requires that detection sets meet the requirements of Table VIII-S2-1 which specifies the minimum number of flaws in a test set to be five with 100% detection. The current Code also requires the number of unflawed grading units to be two times the number of flawed grading units. The proposed alternative would follow the detection criteria of the table

beginning with a minimum number of flaws in a test set being 10, and would reduce the number of false calls to 1½ times the number of flawed grading units. The staff finds that the proposed alternative satisfies the pass/fail objective established for the Appendix VIII performance demonstration acceptance criteria and is, therefore, acceptable.

Paragraph 1.2(c)(1) and 1.3(c):

For detection and length sizing, the Code requires at least one third of the flaws be located between 10 and 30% through the wall thickness and one third located greater than 30% through the wall thickness. The remaining flaws would be located randomly throughout the thickness of the wall. The proposed alternative sets the distribution criteria for detection and length sizing equivalent to the depth sizing distribution criteria. This change would simplify assembling test sets for detection and sizing qualifications in addition to being more indicative of conditions in the field. The proposed alternative stipulates that at least 20% of the flaws be located in each of the following percentage ranges of the wall thickness: 10-30%, 31-60%, and 61-100%. These percentage ranges would each be a subset of the current Code requirements except for the 10-30% range, which would be a subset if it contained at least one third of the flaws. The proposal also stipulates that at least 75% of the flaws shall be in the range of 10 to 60% of the wall thickness. The NRC staff finds that the proposed alternative would provide an acceptable level of quality and safety and is, therefore, acceptable.

Paragraph 2.0:

The Code requires the specimen inside surface be concealed from the candidate. This requirement is applicable for test specimens used for qualification performed from the outside surface, however, with the expansion of Supplement 10 to include qualifications performed from the inside surface, the inside surface must be accessible while maintaining the specimen integrity. The proposed alternative would require that flaws and specimen identifications be obscured from candidates, thus maintaining blind test conditions. The staff finds this to be appropriate and is, therefore, acceptable.

Paragraph 2.2(b) and 2.2(c):

The Code requires that, for a test set, regions of each specimen containing a flaw to be sized shall be identified to the candidate. The Code also requires that the candidate shall determine the length of the flaw in each region. The proposed alternative would make identifying the location of additional flaws an option. This option would provide an additional element of difficulty to the testing process because the candidate would be expected to demonstrate the skill of detecting and sizing flaws over an area larger than a specific location. The alternative is more conservative than Code requirements and is, therefore, acceptable.

Paragraph 2.3(a):

The Code requires that for a depth sizing test, 80% of the flaws shall be sized in a specific location that is identified to the candidate. The proposed alternative permits detection and depth sizing tests be conducted separately or concurrently. For depth sizing that is conducted separately, allowing the test administrator the option of not identifying flaw locations would make the testing process more challenging. This would maintain the blind testing of samples

because the location of flaws would not be shared with the candidate. The alternative is more conservative than the Code requirements and is, therefore, acceptable.

Paragraph 2.3(b):

The Code requires that, for a test set, regions of each specimen containing a flaw to be sized shall be identified to the candidate. The Code also requires that the candidate shall determine the maximum depth of the flaw in each region. The proposed alternative would make identifying the location of additional flaws an option. This option would provide an additional element of difficulty to the testing process because the candidate would be expected to demonstrate the skill of finding and sizing flaws in an area larger than a specific location. The alternative is more conservative than Code requirements and is, therefore, acceptable.

Paragraph 3.1 (Table VIII-S2-1):

The Code requirements, as discussed in Paragraph 1.2(b) above, are based on the statistical parameters for examination procedures, equipment, and personnel screening that satisfy the acceptance criteria of Table VIII-S2-1. The proposed alternative, Table VIII-S10-1, would increase the minimum number of flawed grading units in detection testing and would reduce the number of unflawed grading units in false call testing while maintaining the same statistical parameters as Code. The staff finds this acceptable because the same pass/fail criteria used to develop the test size tables in Appendix VIII were used to create the PDI alternative Supplement 10, Table VIII-S10-1.

4.0 CONCLUSION

Based on the information provided in the licensee's submittal, the NRC staff has determined that the proposed alternative will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternative for the remainder of the third ISI interval for St. Lucie Unit 1 (RR-24), which began February 11, 1998, and for the remainder of the second ISI interval for St. Lucie Unit 2 (RR-36), which began August 8, 1993. 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: Jay W. Collins, NRR

Date: June 23, 2003

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