November 22, 2005

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, UNIT 1 - SAFETY EVALUATION FOR RELIEF REQUEST NO. 26 REGARDING REACTOR COOLANT PIPING HOT LEG ALLOY-600 SMALL BORE NOZZLES (TAC NO. MC6944)

Dear Mr. Stall:

By a letter dated April 29, 2005, as supplemented by letters dated August 25 and October 13, 2005, Florida Power and Light Company (the licensee) submitted Relief Request No. 26 for St. Lucie Unit 1, requesting relief from the American Society of Mechanical Engineers Code Section XI, Sub-article IWB-3132.3, "Acceptance by Replacement." Pursuant to Title 10 of the *Code Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i), the licensee proposed to use the half-nozzle technique as an alternative to the requirement to remove the remnant nozzle and its attachment weld that contains the flaw.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's proposed alternative and has concluded that the proposed alternative provides an acceptable level of safety and quality. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for the remainder of the third 10-year inservice inspection interval at St. Lucie Unit 1, which began on February 11, 1998, and ends on February 10, 2008.

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 Brendan Moroney at (301) 415-3974.

Sincerely,

/RA/
Michael L. Marshall, Jr., Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-335

Enclosure: Safety Evaluation

cc: See next page

November 22, 2005

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, UNIT 1 - SAFETY EVALUATION FOR RELIEF REQUEST NO. 26 REGARDING REACTOR COOLANT PIPING HOT LEG ALLOY-600 SMALL BORE NOZZLES (TAC NO. MC6944)

Dear Mr. Stall:

By a letter dated April 29, 2005, as supplemented by letters dated August 25 and October 13, 2005, Florida Power and Light Company (the licensee) submitted Relief Request No. 26 for St. Lucie Unit 1, requesting relief from the American Society of Mechanical Engineers Code Section XI, Sub-article IWB-3132.3, "Acceptance by Replacement." Pursuant to Title 10 of the *Code Federal Regulation* (10 CFR) Section 50.55a(a)(3)(i), the licensee proposed to use the half-nozzle technique as an alternative to the requirement to remove the remnant nozzle and its attachment weld that contains the flaw.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's proposed alternative and has concluded that the proposed alternative provides an acceptable level of safety and quality. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for the remainder of the third 10-year inservice inspection interval at St. Lucie Unit 1, which began on February 11, 1998, and ends on February 10, 2008.

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 Brendan Moroney at (301) 415-3974.

Sincerely,

/RA/
Michael L. Marshall, Jr., Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-335

Enclosure: Safety Evaluation

cc: See next page

DISTRIBUTION:

PUBLIC	LPLII-2 R/F	RidsNrrDorl	RidsNrrDorlLpld	BClayton(paper copy)
RidsNrrPMBMoroney		RidsOgcRp	RidsAcrsAcnwMailCenter	
RidsRgn2MailCenter (BDesai)		BWetzel	TChan	WKoo

ADAMS Accession No.: ML053140196 NRR-028

OFFICE	LPL2-2/PM	LPL2-2/LA	CPNB/C	OGC	LPL2-2/C
NAME	BMoroney	BClayton	TChan by memo dated	SHamrick	MMarshall
DATE	11/22/05	11/22/05	11/8 /05	11/21/05	11/22/05

OFFICIAL RECORD COPY

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION PROGRAM

RELIEF REQUEST NO. 26

FLORIDA POWER AND LIGHT COMPANY

ST. LUCIE NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-335

1.0 INTRODUCTION

By letter dated April 29, 2005, as supplemented by letters dated August 25 and October 13, 2005, Florida Power & Light Company (the licensee) submitted Relief Request No. 26 (RR-26) for St. Lucie Unit 1, which proposed an alternative repair for 19 of the Alloy 600 small-bore reactor coolant system (RCS) hot leg nozzles, in lieu of the ASME Code Section XI requirement. Specifically, the licensee proposed to use the half-nozzle technique as an alternative to the requirement to remove the remnant nozzle and its attachment weld that contains the flaw.

The basis of the licensee's proposed alternative relies mainly on the application of the results of analyses performed in accordance with Westinghouse Topical Report WCAP-15973-P-A, Revision 0, "Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Program" (the TR).

2.0 REGULATORY EVALUATION

The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code requires inservice inspection (ISI) of Class 1, Class 2, and Class 3 components to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda, as required by Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 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.

ENCLOSURE

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 (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 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, subject to the limitations and modifications listed therein. The ISI Code of record for the third 10-year ISI interval at St. Lucie Unit 1 is the 1989 Edition. Sub-article IWB-3132.3, Acceptance by Replacement, of ASME Code Section XI, 1989 Edition states, “As an alternative to the repair requirement of IWB-3132.2, the component or the portion of the component containing the flaw shall be replaced.”

In a safety evaluation (SE) dated January 12, 2005, the staff found that the TR is acceptable for referencing in licensing applications for Combustion Engineering (CE) designed pressurized water reactors (PWRs) to the extent specified and under the limitations delineated in the TR and in the SE. The SE also specified additional conditions that needed to be met in order to assess the applicability of the TR. The licensee addressed the additional conditions in its submittal.

3.0 TECHNICAL EVALUATION

3.1 Licensee’s Code Relief Request

The licensee proposed the use of the half-nozzle technique as an alternative to the Code repair as delineated in IWB-3132.3. The half-nozzle technique will not remove the remnant nozzle and its attachment weld that contain the flaw.

In lieu of removing the remaining portion of the nozzle component and its attachment weld that contain the flaw, the licensee assumed a worst-case flaw in the Alloy 600 base and weld material and used the methodology presented in the TR to support the relief request.

3.2 Components for Which Relief Is Requested

RR-26 applies to 19 of the Alloy 600 small-bore RCS hot leg nozzles at St. Lucie Unit 1. The identification number (ID#) of each nozzle was provided in the licensee’s submittal dated August 25, 2005. During the fall 2005 refueling outage, the licensee has scheduled the replacement of 18 of the Alloy 600 small-bore hot leg nozzles as a preventive measure to mitigate primary water stress corrosion cracking (PWSCC). One nozzle (ID# PDT-1121D) was previously repaired with a half-nozzle replacement during the 2001 refueling outage. In RR-26, the licensee is also requesting staff approval of this previously repaired nozzle as a permanent repair. This repair was approved on a temporary cycle-by-cycle basis in SEs dated May 9, 2003, and May 18, 2004.

3.3 Licensee's Basis for Proposed Alternative

During fabrication of the RCS piping, Alloy 600 small-bore nozzles were welded to the interior of the RCS hot leg piping, using partial penetration welds. Industry experience has shown that cracks may develop in the nozzle or in the weld metal joining the nozzles to the reactor coolant pipe and lead to leakage of the reactor coolant fluid. The cracks are believed to be caused by PWSCC.

The licensee stated that the exact leak path, through the weld or through the base metal or through both, cannot be determined. The total removal of all Alloy 600 small-bore nozzle and/or Alloy 82/182 weld material would require accessing the internal surface of the reactor coolant piping and grinding out the attachment weld and any remaining nozzle. Such an activity would result in high radiation exposure to the personnel involved. Grinding within the pipe would also expose personnel to other safety hazards. Grinding will also increase the possibility of introducing foreign material that could damage the fuel cladding. The licensee stated that the analysis in the TR has shown that there is no compensating increase in the level of quality or safety as a result of removing the remnant nozzle or the attaching weld metal.

3.4 Licensee's Proposed Alternative and Basis

The licensee proposed an alternative to the Code requirement as delineated in IWB-3132.3 of ASME Code Section XI. In the application of the alternative repair, the licensee will not remove the remnant nozzle and its attachment weld that contain the flaw. The licensee's proposed alternative repair is based on the use of the half-nozzle technique to relocate the attachment weld from the interior surface of the pipe to the exterior surface of the pipe. In the half-nozzle technique, nozzles are cut outboard of the partial penetration weld, approximately mid-wall of the hot leg piping. The cut-out section of the Alloy 600 nozzle is replaced with a short section (half-nozzle) of Alloy 690, which is welded to the exterior surface of the pipe. Alloy 690 material has been shown to be more resistant to PWSCC than Alloy 600 material. The remainder of the Alloy 600 nozzle, including the original fabrication partial penetration weld, remains in place.

The basis of the licensee's proposed alternative relies mainly on the application of the analysis results from the TR. The licensee identified the analysis results presented in the TR that showed that (1) the corrosion of the carbon or low alloy steel in the crevices between the nozzles and components does not exceed ASME Code limits, (2) thermal-fatigue crack-growth and crack stability meet the ASME Code acceptance criteria and (3) growth of the existing flaw by stress corrosion into the vessel or piping is improbable. The licensee asserts that results of these analyses are applicable to the replacement of the St. Lucie Unit 1 hot leg small-bore nozzles. The SE also specified additional conditions that needed to be met in order to assess the applicability of the Topical Report. The licensee addressed the additional conditions in their submittal. The staff's evaluation of the licensee's evaluation is contained in Section 3.0 of this SE.

Based on the analysis provided in the TR, the licensee has determined that the proposed alternative would not result in a reduction of the level of quality and safety.

3.5 Duration of Proposed Relief Request

The subject relief request is requested for the remainder of the current (third) 10-year ISI interval for St. Lucie Unit 1, which began on February 11, 1998, and is scheduled to end on February 10, 2008.

3.6 Staff Evaluation

As stated in Section 3.2 above, RR-26 applies to 19 of the Alloy 600 small-bore RCS hot leg nozzles at St. Lucie Unit 1. The NRC staff considers this replacement action by the licensee to be a proactive approach to mitigate PWSCC susceptibility of these Alloy 600 components in the RCS.

The licensee is requesting relief from Sub-article IWB-3132.3 of ASME Section XI, 1989 Edition, which states, "As an alternative to the repair requirement of IWB-3132.2, the component or the portion of the component containing the flaw shall be replaced." The licensee's proposed alternative repair does not remove the remnant nozzle and its attachment weld that contain the flaw, but rather assumes a worst-case flaw in the Alloy 600 base and weld material and uses the methodology presented in the TR for determining the following:

1. The overall general/crevice corrosion rate for the internal surfaces of the low-alloy or carbon steel materials that will now be exposed to the reactor coolant and for calculating the amount of time the ferritic portions of the vessel or piping would be acceptable if corrosive wall thinning occurs.

2. The thermal-fatigue crack-growth life of existing flaws in the Alloy 600 nozzles and/or Alloy 82/182 weld material into the ferritic portion of the vessels or piping.

3. Acceptable bases and arguments for concluding that unacceptable growth of the existing flaw by stress corrosion into the vessel or piping is improbable.

In its SE approving the TR, the staff found that licensees could use the methods of the TR as a basis for implementing half-nozzle techniques, provided responses to several plant-specific questions were submitted to the NRC for review in the areas of general corrosion assessment, thermal-fatigue crack growth assessment, stress corrosion cracking growth assessment and a few other considerations. The staff's evaluation of the licensee's responses to these questions is provided below.

In the area of general corrosion assessment, the staff finds the licensee's responses meet the requirements of NRC's final SE for the TR. The minimum acceptable wall thickness due to thinning by corrosion for the ferritic piping that will adjoin to the half-nozzle repair was evaluated in the TR as one of the limiting dimensions for the hot leg pipe half-nozzle repair. The minimum acceptable wall thickness is discussed in terms of the maximum acceptable nozzle bore-hole diameter associated with the replaced hot leg nozzle. The TR reported the maximum acceptable nozzle bore-hole diameter to be 1.27 inches, which is based on a bounding CE-designed PWR. This value is applicable to St. Lucie Unit 1, which is a CE-designed PWR. The licensee calculated the amount of general corrosion for the first half-nozzle repair that was made in April 2001. The general corrosion was calculated in accordance with the methodology of the TR with plant-specific operating experience from January 1, 1995, to December 31,

2004. The corrosion rate was calculated to be 1.34 mils per year. Using this corrosion rate, the potential corrosion from April 2001 to the end of the renewed operating license period (about 35 years of operation) would result in a material loss of 46.9 mils. Therefore, the nozzle bore-hole diameter will increase from 0.997 inches to 1.09 inches after 35 years of service, which is still less than the limiting nozzle bore-hole diameter of 1.27 inches.

The SE for the TR requires licensees to track the time at cold shutdown to determine whether this time does not exceed the assumptions made in the analysis. The licensee proposed not to track the time at cold shutdown conditions because the relief request applies only to a period of 27 months. This is based on the consideration that even if the Unit 1 plant is in cold shut down condition for all 27 months, the resulting nozzle bore-hole diameter (1.045 inches) will still be less than the limiting bore hole diameter of 1.27 inches. The licensee also stated that it will reassess the plant operating conditions and submit another relief request at the start of the next inspection interval, which begins in February 2008. The staff finds the licensee has provided reasonable justification to support the proposal not to track plant operating conditions during the remainder of the current inspection interval. Therefore, in the area of general corrosion assessment, the licensee's proposed alternative is acceptable.

In the area of thermal-fatigue crack growth assessment, the NRC staff finds the licensee's responses meet the requirements of the staff's SE for the TR. The licensee has shown that the geometry of the referenced nozzles is bounded by the corresponding nozzle penetration reported in Calculation Report CN-CI-02-71, Revision 01. Therefore, the analysis results of the TR are applicable to St. Lucie Unit 1. The plant-specific pressure and temperature profiles were not required for this relief request since RR-26 applies only to RCS hot leg piping. Furthermore, the plant-specific Charpy upper shelf energy data was not applicable because the hot leg piping is bounded by the linear fracture mechanics analysis. The licensee stated that the hot leg piping associated with the referenced small bore Alloy 600 nozzles was manufactured by Lukens Steel, using two heats of material (melt number C7293 and slab numbers 65 and 67). The RT_{NDT} for the two heats of material is reported to be plus 30 degrees Fahrenheit ($+30^0$ F), which is conservative in comparison to the value of $+60^0$ F used in the TR. Therefore, in the area of thermal-fatigue crack growth assessment, the licensee's proposed alternative is acceptable.

In the area of stress corrosion cracking growth assessment, the NRC staff finds the licensee's responses meet the requirements of the staff's SE for the TR. The licensee stated that a level of hydrogen overpressure between 25 and 35 pounds per square inch gauge is typically maintained in the RCS and the steady state contaminant concentrations in the reactor coolant are typically maintained at a level below 5 parts per billion for dissolved oxygen, halide ions and sulfate ions. The licensee reviewed the coolant chemistry analysis results for the last two cycles and confirmed that the above contaminant limits have been maintained during steady state operation, and no water chemistry transients were identified. Therefore, in the area of stress corrosion cracking growth assessment, the licensee's proposed alternative is acceptable.

In summary, the staff's review of the licensee's responses in the areas of general corrosion assessment, thermal-fatigue crack growth assessment and stress corrosion cracking growth assessment, supports the licensee's use of the TR as a basis for RR-26. Therefore, staff concludes that the proposed alternative will provide an acceptable level of quality and safety for the remainder of the third 10-year ISI interval at St. Lucie Unit 1.

4.0 CONCLUSION

The staff has reviewed the licensee's proposal in RR-26 regarding the use of the half-nozzle technique as an alternative repair for 19 of the Alloy 600 small-bore RCS hot leg nozzles in lieu of the ASME Code Section XI, IWB-3132.3 requirement. Based on its review, the staff finds the proposed alternative will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the licensee's proposed alternative is authorized for the remainder of the third 10-year ISI interval at St. Lucie Unit 1, which began on February 11, 1998, and ends on February 10, 2008.

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: William Koo

Date: November 22, 2005

Mr. J. A. Stall
Florida Power and Light Company

ST. LUCIE PLANT

cc:
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. William Jefferson, Jr.
Site Vice President
St. Lucie Nuclear Plant
6351 South Ocean Drive
Jensen Beach, Florida 34957-2000

Mr. G. L. Johnston
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

Mark Warner, Vice President
Nuclear Operations Support
Florida Power and Light Company
P.O. Box 14000
Juno Beach, FL 33408-0420

Mr. Rajiv S. Kundalkar
Vice President - Nuclear Engineering
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