May 18, 2004

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 UNITS 1 AND 2 - RELIEF REQUEST NOS. 23 AND 5 REGARDING REPAIR OF SMALL BORE PIPING NOZZLES (TAC NOS. MC1398 AND MC1399)

Dear Mr. Stall:

By a letter dated November 21, 2003, as supplemented in letters dated March 24, 2004, and April 20, 2004, Florida Power and Light Company (the licensee) requested extension of Relief Request (RR) 23 for St. Lucie Unit 1 and RR 5 (formerly RR 33) for St. Lucie Unit 2 for one additional operating cycle. RRs 23 and 5 propose alternatives to certain American Society of Mechanical Engineers (ASME) Code requirements regarding repair of Alloy 600 small-bore nozzles without flaw removal.

The U. S. Nuclear Regulatory Commission (NRC) staff previously granted RRs 23 and 33 (now RR 5) for one operating cycle with the expectation that it would provide sufficient time for the NRC staff to complete its review of an industry report and provide guidance for requesting approval to use the alternative repair techniques on a permanent basis. However, the evaluation of the industry report has not been completed.

The NRC staff has reviewed the licensee's request to extend RRs 23 and 5 for one additional operating cycle and has concluded that bases for granting relief remain valid. Therefore, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(ii), RR 23 is extended for one additional operating cycle at St. Lucie Unit 1, commencing with the startup from the SL1-19 refueling outage. Pursuant to 10 CFR 50.55a(a)(3)(ii), RR 5 is extended for one additional operating cycle at St. Lucie Unit 2, commencing with the startup from the SL2-15 refueling outage.

The requested one-cycle extensions include extension of relief for use of recently-installed reactor coolant system hot-leg instrument nozzles that were replaced in both units using the alternative techniques. The NRC staff concluded that these recently-installed nozzles will continue to provide reasonable assurance of structural integrity for one additional operating cycle, subject to satisfactory leakage inspection results as noted in the enclosed safety evaluation. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the use of these recently-installed reactor coolant system hot-leg instrument nozzles is authorized for one additional operating cycle at each unit, subject to acceptable leakage inspection results, because the proposed alternative will provide an acceptable level of quality and safety.

In a telephone conversation with members of your staff on April 19, 2004, the NRC staff gave verbal approval for extension of RR 23, so as not to delay startup of the St. Lucie Unit 1 from the SL1-19 outage. During that conversation, your staff stated that a visual inspection of all small-bore nozzles in Unit 1 had been conducted and no leakage was observed.

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/

William F. Burton, Section 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: See next page

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,

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION PROGRAM

RELIEF REQUEST NOS. 23 AND 5

FLORIDA POWER AND LIGHT COMPANY, ET AL.

ST. LUCIE UNITS 1 AND 2

DOCKET NOS. 50-335 AND 50-389

1.0 INTRODUCTION

By letter dated November 21, 2003 (Reference 1) as supplemented by letters dated March 24 and April 20, 2004 (References 7 and 8), Florida Power & Light Company (FPL, the licensee), submitted Relief Request (RR) 23, Revision 1 for Saint Lucie Unit 1 and RR 5 (formerly RR 33) for St. Lucie Unit 2, asking for relief from certain provisions of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, for Inservice Inspection (ISI) and Repair and Replacement Programs. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(ii), the licensee has requested relief from the ASME Code, Section XI requirements for repair/replacement of Alloy 600 small-bore nozzles at St. Lucie Units 1 and 2. Specifically, the licensee proposed to use a half-nozzle or sleeved full-nozzle repair technique without removing the flaws as an alternative to the ASME Code requirements of paragraph IWB-3132.3, which requires that the component or the portion of the component containing the flaws be replaced. Industry experience has shown that cracks may develop in small-bore Alloy 600 nozzles such as instrument nozzles in pressurizers and reactor coolant system (RCS) hot-leg piping and may lead to leaking of the nozzles. These cracks are caused by primary water stress corrosion cracking (PWSCC) and have been found in a number of pressurized-water reactors. Because of hardship and unusual difficulty associated with removing the flaws in the degraded small-bore Alloy 600 nozzles, the licensee proposed to use repair techniques without removing the flaws. The U.S. Nuclear Regulatory Commission (NRC) staff previously approved RRs 23 and 33 for one operating cycle (Reference 3).

In addition, the licensee requested extension of relief for recently-installed RCS hot-leg instrument nozzle replacements in both units for one additional operating cycle.

2.0 REGULATORY EVALUATION

As stated in 10 CFR 50.55a(g), nuclear power facility components must meet the requirements contained in applicable editions of the ASME Code. However, in some instances, the implementation of an ASME Code repair or replacement may not be practical. Pursuant to 10 CFR 50.55a(a)(3), alternatives to the ASME Code requirements may be used, when authorized by the NRC, if the applicant demonstrates that (i) the proposed alternatives would

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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. To perform a non-ASME Code repair/replacement, the licensee must submit a request for NRC approval of relief from applicable ASME Code requirements. 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 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 Section 50.55a(b) 12 months prior to the start of the 10-year interval, subject to the limitations and modifications listed therein.

The applicable code of record for the third 10-year ISI interval at St. Lucie Unit 1 is the 1989 Edition of the ASME Code, Section XI, with no addenda. For St. Lucie Unit 2, it is the 1998 Edition through the 2000 Addenda.

3.0 TECHNICAL EVALUATION

This safety evaluation (SE) documents the NRC staff's evaluation of the licensee's proposed use of the sleeved full-nozzle technique or the half-nozzle technique for repair/replacement of the small-bore Alloy 600 nozzles in the pressurizers and RCS hot-leg piping at St. Lucie Units 1 and 2 for one operating cycle. For implementation of the sleeved full-nozzle or half-nozzle repair technique on a permanent basis, the licensee must submit a separate relief request.

The NRC staff is currently assessing the requirements that would allow the operation of half-nozzle repairs on a permanent basis. In view of the recent event of significant corrosion of the reactor vessel head at Davis-Besse, the NRC staff is evaluating several issues associated with the long-term implementation of the sleeved full-nozzle or half-nozzle repair, such as the effect of water chemistry on crack growth and the need for periodic volumetric inspections, to ensure that there is no occurrence of significant corrosion and fatigue crack growth in the ferritic materials of pressurizer and RCS hot-leg piping.

The issues of corrosion of ferritic materials, stress corrosion cracking and fatigue crack growth associated with the Alloy 600 small-bore nozzle repair are discussed in the Westinghouse Topical Report, WCAP-15973-P, Revision 00 (Reference 2), which has been submitted for NRC review. The required conditions for operation of the half-nozzle repairs on a permanent basis will be provided in the NRC staff's SE of Reference 2. Since the issues of concern resulting from repairs using either a half-nozzle technique or a sleeved full-nozzle technique are similar, the required conditions for operation that will be stipulated in the NRC staff's SE of Reference 2 will also be applicable to sleeved full-nozzle repairs.

Until issuance of the SE for Reference 2, the NRC staff will approve use of the sleeved full-nozzle and the half-nozzle repair/replacement techniques for one operating cycle. A new relief request will be required for additional cycles. In Reference 3, the NRC previously approved a similar repair/replacement using a full-nozzle or sleeved full-nozzle technique at St. Lucie Unit 1 for the operating cycle that began in October 2002 and ended in March 2004, and at St. Lucie Unit 2 for the current operating cycle that began in June 2003. This evaluation addresses the request to extend the reliefs for one additional operating cycle.

3.1 RELIEF REQUEST NOS. 23 AND 5

3.1.1 Component Identification

Small-bore Alloy 600 instrument nozzles in pressurizers and RCS hot-leg piping at St. Lucie Units 1 and 2.

3.1.2 Code Requirements for which Relief is Requested

The ASME Code Section XI requires that repairs or replacement of ASME Code Class components be performed in accordance with the rules delineated in the ASME Code. Relief is requested from the requirements of paragraph IWB-3132.3 (Acceptance by Replacements) of ASME Code Section XI. The acceptance standards in IWB-3132.3 require that the component or the portion of the component containing the flaws be replaced. The licensee's proposed sleeved full-nozzle and half-nozzle repairs do not include removal of the portion of the component containing the flaws.

3.1.3 Licensee's Proposed Alternative to Code

The licensee's proposed alternative is based on the use of the sleeved full-nozzle or the half-nozzle repair technique. In the sleeved full-nozzle or half-nozzle technique, the cracks in the attachment weld are left in place. The sleeved full-nozzle or the half-nozzle repair will relocate the primary pressure boundary from the internal surface to the external surface of the pressurizer and RCS hot-leg piping. The sleeved full-nozzle repair is achieved by removing the Alloy 600 nozzle, but not the attachment weld, and replacing it with an Alloy 690 sleeve (liner) and an Alloy 690 full length nozzle. The half-nozzle repair is achieved by removing a portion of the Alloy 600 nozzle outboard of the attachment weld, and replacing it with an Alloy 690 half-nozzle. A gap of about 1/8 inch will be left between the Alloy 690 half-nozzle segment and the remnant Alloy 600 nozzle. The Alloy 690 nozzle/sleeve or the Alloy 690 half-nozzle is welded to either the external surface of the pressure boundary or to an external Alloy 690 temper bead weld build-up pad with a partial penetration and reinforcing fillet weld.

3.1.4 Licensee's Basis for Relief

The small-bore Alloy 600 nozzles were typically welded to the interior surface of the pressurizers and the RCS hot-leg piping using Alloy 82/182 weld material. Alloy 600 and Alloy 82/182 materials are susceptible to PWSCC. Therefore, cracks may initiate from the nozzle base metal and/or in the weld metal joining the nozzle to the pressurizer or RCS piping. Industry experience has shown that such cracking may lead to primary coolant leakage. To remove all of the cracks during repair would require access to the interior surface of the pressurizer or hot-leg piping in order to perform grinding of the affected nozzle base metal and the attachment welds. These activities will expose personnel to a high-radiation environment and potential safety hazards.

The licensee performed a plant specific fatigue-crack-growth evaluation since the cracks left in the attachment weld(s) may propagate into the ferritic material of the pressurizer or hot-leg piping. The results of the licensee's fatigue-crack-growth evaluation showed that the cracks in the attachment weld will not propagate through the reactor coolant pressure boundary, because the calculated crack growth is small and the presence of these cracks would not impact the structural integrity of the pressurizer and the hot-leg piping. Therefore, the licensee determined that compliance with the subject ASME Code requirement of removing the flaws would result in hardship and unusual difficulty without a compensating increase in the level of quality or safety.

3.1.5 Staff Evaluation

In support of the relief requests, the licensee provided, in Reference 5, a structural analysis to demonstrate the structural integrity of the proposed replacement, and to demonstrate by analysis that the proposed repair methodology meets the current licensing basis design rules for ASME Section III, Class 1 components (1971 Edition and Addenda through summer 1972). The sleeved full-nozzle repair consists of replacing the entire Alloy 600 nozzle and internal "J" weld with an Alloy 690 full-length nozzle and an Alloy 690 corrosion liner (sleeve). The original bore diameter in the component wall is enlarged along its full length in the component wall to accommodate the replacement liner/nozzle combination. The Alloy 690 corrosion liner is rolled in the interior surface of the penetration for a minimum length of 2 inches. The purpose of the liner is to provide protection against corrosion of the component wall. However, as discussed below, this may not be achieved when the cracks in the attachment weld are not removed.

The Alloy 690 nozzle is welded to the external surface of the component or to an external Alloy 690 temper bead weld build-up pad by a partial penetration and reinforcing fillet weld. The weld is designed and fabricated in accordance with ASME Section III, Subsection NB, rules for partial penetration welds. To demonstrate compliance with ASME Section III, Subsection NB, the licensee described in Reference 5 the analysis of the external weld region using a finite element model consisting of the component wall, the full length nozzle, and the external surface partial penetration weld that attaches the nozzle to the component. The results of this analysis were shown to comply with the ASME Section III design criteria for pressure boundary integrity, for both strength and fatigue.

The geometry of the half-nozzle design is different from that of the sleeved full-nozzle design. For the half-nozzle application, the length of the bore is enlarged only partially, and no liner is used. The Alloy 690 half-nozzles will also be welded to the external component surfaces, in a similar manner and under the same ASME Section III Subsection NB rules as the full-length nozzles.

The Alloy 690 sleeved full-nozzle and the Alloy 690 half-nozzle will be welded to the external component surfaces in accordance with ASME Section III, Subsection NB, rules. In Reference 4, the licensee stated that the post-weld inspection of the half-nozzle repairs will be performed in accordance with the requirements of ASME Section III NB-5245 for partial penetration welds. The NRC staff finds this is acceptable for the post-weld inspection of the sleeved full-nozzle or half-nozzle repairs because it conforms with the plant licensing basis.

To further support the staff's review of the subject relief requests, Reference 8 provided the following clarification regarding the maximum cumulative usage factors (CUF). For the small bore nozzles at the pressurizer and piping, the maximum CUFs are 0.742 and 0.124, respectively. For the steam generator, the CUFs were negligibly small.

There are two concerns resulting from the sleeved full-nozzle or half-nozzle repair. The first concern is the effect of corrosion of the ferritic material due to the exposure of the low Alloy and carbon steel behind the nozzle to the borated primary coolant. In the sleeved full-nozzle repair, the liner (sleeve) is designed to provide protection against corrosion of the component interior wall. However, corrosion on a local scale will occur when the cracks left in the attachment weld start to propagate into the adjacent carbon and low-alloy steels or in areas where tight bonding between the liner and interior surface of the component is not formed or is subsequently relaxed. Industry experience has shown that the rolled component has a potential to leak after a short period of service. The potential for general corrosion of the ferritic material was evaluated in Reference 2. The general corrosion was estimated to be about 1.53 mils per year. Based on this rate, the degradation of the ferritic material will not exceed the ASME Code allowable at the end of the plant life. Accelerated boric acid corrosion is not considered in the licensee's evaluation because free oxygen does not exist in the closed environment and there is no known mechanism for concentrating boric acid in the crevice region of the nozzle and the ferritic vessel or hot-leg piping. However, Reference 2 is still under evaluation; thus, approval of the sleeved full-nozzle or half-nozzle repair for the life of the plant cannot be authorized at this time. Nevertheless, the NRC staff has determined that the results of the licensee's corrosion analysis provide adequate safety margin to support the operation of the sleeved full-nozzle or half-nozzle repair for one operating cycle.

The second concern is the potential for the cracks left in the attachment weld to propagate into the adjacent carbon and low Alloy steels by means of the fatigue-crack-growth mechanism. The licensee performed a plant-specific evaluation of fatigue crack growth for St. Lucie Units 1 and 2. The calculations are documented in Westinghouse Electric Company, LLC, Calculation Note Number CN-CI-02-69, Revision 0 (Reference 5). The results of the calculations show that the flaws left in place after small-bore nozzle repair/replacement are acceptable because the final flaw sizes at the end of plant life will not exceed the ASME Code allowable. Although the review of Reference 5 is not complete, the NRC staff has determined that there is enough safety margin in the licensee's calculations to support the operation of the sleeved full-nozzle or half-nozzle repair for one operating cycle.

Based on a review of the information provided, the NRC staff concludes that the licensee has provided a reasonable basis to support the application of the sleeved full-nozzle repair and the half-nozzle repair for one operating cycle, without adversely affecting the health and safety of the public. Therefore, the extension of RRs 23 and 5 for one additional operating cycle is acceptable.

3.1.6 One Cycle Extension of Recently Installed Hot-Leg Instrument Nozzle Replacements

The licensee also requested a one cycle relief extension for recently installed hot-leg nozzle replacements in the RCS. By letter dated March 24, 2004 (Reference 7), the licensee stated that 10 resistance temperature detector instrument nozzles in Unit 2 were replaced during the last refueling outage (SL1-14). Five of these nozzles (TE-1112HA, TE-1111X, TE-1122HC, TE-1122HD and TE-1121X) were replaced with the sleeved full-nozzle design and the other five nozzles (TE-1112HB, TE-1112HC, TE-1112HD, TE-1122HA, and TE-1122HB) were replaced with the half-nozzle design. These repairs were approved by NRC for one operating cycle by letters dated May 9, 2003 and May 23, 2003 (Reference 3).

In Unit 1, one RCS hot-leg instrument nozzle for PDT-1121D was replaced with the half-nozzle design during the spring 2001 refueling outage (SL1-17), using the same methodology that was approved by the NRC in Reference 3. The methodology used for this replacement was documented in the licensee's letters dated May 24, 2001, April 10, 2002, and June 14, 2002. In those letters, this nozzle was referred to as RC-126. In a letter dated April 20, 2004 (Reference 8), the licensee provided clarification that RC-126 and PDT-1121D refer to the same nozzle. PDT-1121D is the instrument name and RC-126 is the piping nomenclature. The licensee also indicated that during the spring 2004 (SL1-19) refueling outage at Unit 1, a visual inspection of all small-bore nozzles, including nozzle RC-126 (PDT-1121D), was performed and no leakage was identified.

Based on the above discussion and the NRC staff's SE in Reference 3, the NRC staff concludes that the recently installed hot-leg nozzle replacements in St. Lucie Units 1 and 2 will continue to provide reasonable assurance of structural integrity for one additional operating cycle, provided a visual inspection is performed during the refueling outage prior to the start up for the next cycle to ensure there is no leakage through the installed replacements. The proposed alternative to allow operation of the repaired nozzles for one additional operating cycle would provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the extension of relief for recently installed hot-leg instrument nozzle replacements for one additional cycle is authorized, subject to acceptable leakage inspection results, as stated above.

The extension of one additional operating cycle will allow time for the NRC staff to complete the review of the Westinghouse Topical Report (Reference 2) and for the licensee to submit its application for permanent installation. As stated in Reference 3, the applicable conditions to support the implementation of the half-nozzle or sleeved full-nozzle repairs on a permanent basis should follow those that will be stipulated in the NRC Staff's SE of Reference 2.

4.0 CONCLUSION

Based on its review of the licensee's submittal, the NRC staff has determined that the licensee's proposed sleeved full-nozzle repair and half-nozzle repair techniques are acceptable for one cycle of operation. The NRC staff has also determined that the performance of ASME Code repair/replacement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, since an immediate ASME Code repair would result in potentially excessive radiation exposure and safety hazards to personnel. Furthermore, there is reasonable assurance that flaws left in place will not impact the structural integrity of the primary pressure boundary. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the NRC staff authorizes the licensee's proposed alternatives in RRs 23 and 5, as described in Section 3.1.3, for one operating cycle at St. Lucie Unit 1, commencing with the startup from the SL1-19 refueling outage, and at St. Lucie Unit 2, commencing with the startup from the SL1-15 refueling outage. Additionally, the NRC staff concludes that the recently installed RCS hot-leg nozzle replacements at St. Lucie Units 1 and 2 will continue to provide reasonable assurance of structural integrity for one additional operating cycle. Pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff concludes that the extension of relief for recently installed hot-leg instrument nozzle replacements for one additional cycle is authorized, subject to acceptable leakage inspection results as stated above, because the proposed alternative will provide an acceptable level of quality and safety.

All other ASME Code, Section XI requirements for which relief was not specifically requested by the licensee and approved in this safety evaluation remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

5.0 REFERENCES

1. Letter dated November 21, 2003, from William Jefferson, Jr., FPL, to the NRC Document Control Desk, with Attachment.

2. Westinghouse Topical Report, WCAP-15973-P, Revision 00 (CE NPSD-1198-P, Revision 01) "Low-Alloy Steel Component Corrosion Analysis Supporting Small-diameter Alloy 600/690 Nozzle Repair/Replacement Programs."

3. Letters dated May 9 (half-nozzle repair) and May 23 (sleeved full-nozzle repair), 2003, from the NRC to J. A. Stall, FPL.

4. Letter dated June 14, 2002, from D. E. Jernigan, FPL, to the NRC Document Control Desk.

5. Asea Brown Boveri-Combustion Engineering Report "CR-9417-CSE95-1102, Rev. 02, Structural Analysis of Replacement Instrumentation Nozzles and Heater Sleeves for Florida Power and Light - St. Lucie #1 & 2 Pressurizer, #1 & 2 Piping, and #2 Steam Generator," January 19, 1996.

6. Westinghouse Electric Company, LLC, Calculation Note Number CN-CI-02-69, Revision 0, "Evaluation of Fatigue Crack Growth Associated with Small Diameter Nozzles for St. Lucie 1 & 2," dated October 9, 2002.

7. Letter dated March 24, 2004, from William Jefferson, Jr., FPL to the NRC Document Control Desk.

8. Letter dated April 20, 2004, from William Jefferson, Jr., FPL to the NRC Document Control Desk.

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