FPL

Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

April 29, 2005

L-2005-099
10 CFR 50.4
10 CFR 50.55a

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Re: St. Lucie Unit 1
Docket No. 50-335
Inservice Inspection Plan
Third 10-Year Interval
Relief Request 26 - Repair of Alloy 600
Small Bore Nozzles Without Flaw Removal

By letter L-2003-285 dated November 21, 2003 as supplemented by FPL letter L-2004-065 on March 24, 2004, Florida Power & Light Company (FPL) requested extension of Unit 1 Relief Request (RR) 23. This request was made based on the NRC review status of WCAP-15973-P. Unit 1 RR 23 was previously submitted by FPL letter L-2002-247 on January 8, 2003 and supplemented by FPL letter L-2003-108 on April 23, 2003. The NRC approved the RR for one operating cycle by NRC letters dated May 9, 2003 and May 23, 2003.

The NRC staff stated in their May 9, 2003 and May 23, 2003 letters that prior to use of the half nozzle and sleeved full-nozzle replacements on a permanent basis, FPL will be required to submit a separate relief request for NRC approval. The NRC planned to issue the required conditions for implementing the half nozzle and sleeved full-nozzle repairs on a permanent basis in the NRC staff's safety evaluation of the Westinghouse Topical Report WCAP-15973-P, Revision 00, that was under NRC staff review.

By letter L-2004-100 dated April 20, 2004, FPL requested a one cycle extension of the NRC approval of Unit 1 Relief Request 23, Revision 1. On May 18, 2004, the NRC approved the requested one cycle extension. The extension of the Unit 1 RR 23 for one additional cycle was approved to allow time for the NRC staff to complete the topical report review. It also allowed time for FPL to submit and the NRC to review the permanent RRs.

On January 12, 2005, the NRC approved WCAP-15973-P and in February 2005 Westinghouse issued the approved version of the topical report, WCAP-15973-P-A, dated February 2005.

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NRC approval of the attached permanent repair Relief Request Number 26 for St. Lucie Unit 1 is requested to support the upcoming fall 2005 refueling outage (SL1-20).

Please contact George Madden at 772-467-7155 if there are any questions about this submittal.

Very truly yours,

William Jefferson, Jr.
Vice President
St. Lucie Plant

WJ/GRM

Attachment

St. Lucie Unit 1
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Proposed Alternative in Accordance with 10CFR 50.55a(a)(3)(ii)
Hardship or Unusual Difficulty Without Compensating
Increase in Level of Quality or Safety

REPAIR OF ALLOY 600 SMALL BORE NOZZLES WITHOUT FLAW REMOVAL

1. ASME Code Component(s) Affected

Small bore alloy 600 nozzles welded to the reactor coolant piping hot legs St. Lucie (PSL) Unit 1 Reactor Coolant Piping Nozzle Details FPL Drawing Numbers: 8770-366, 8770-1496, and 8770-3344

2. Applicable Code Edition and Addenda

ASME Section XI, Rules for In-Service-Inspection of Nuclear Power Plant Components, 1989 Edition.

3. Applicable Code Requirement

Pursuant to 10 CFR 50.55a (a)(3)(ii) FPL requests an alternative to the requirements of paragraph IWB-3132.3, Acceptance by Replacements, that 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."

4. Reason for Request

Small bore nozzles were welded to the interior of the hot leg of the reactor coolant piping, using partial penetration welds, during fabrication of the piping. Industry experience has shown that cracks may develop in the nozzle base metal 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 primary water stress corrosion cracking (PWSCC). The exact leak path, through the weld or through the base metal or through both, cannot be determined. The hardship to remove all possible leak paths requires accessing the internal surface of the reactor coolant piping and grinding out the attachment weld and any remaining nozzle base metal. Such an activity results in high radiation exposure to the personnel involved. Grinding within the pipe also exposes personnel to safety hazards. Additionally, grinding on the internal surface of the reactor coolant piping increases the possibility of introducing foreign material that could damage the fuel cladding. The NRC approved topical report, Reference 3, and the following "basis for use" show that there is "no compensating increase in the level of quality or safety."

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5. Proposed Alternative and Basis for Use

ALTERNATIVE

The leaking nozzles have been and will be repaired by relocating the attachment weld from the interior surface of the pipe to the exterior surface of the pipe. The nozzles have been and will be repaired using the "half-nozzle" technique. In the "half-nozzle" technique, nozzles are cut outboard of the partial penetration weld, approximately mid-wall of the hot leg piping. The external cut sections of the Alloy 600 nozzles are replaced with short sections (half-nozzles) of Alloy 690, which are welded to the exterior surface of the pipe. The remainder of the Alloy 600 nozzles, including the original fabrication partial penetration weld, remains in place.

BASIS FOR USE

A plant-specific evaluation of the small bore nozzles located in the hot leg piping for St. Lucie Units 1 and 2 has been completed. These nozzles are the locations where half-nozzles could be utilized or have been utilized, thereby leaving flaws in the original weldments, which could potentially grow into adjacent ferritic material. Postulated flaws were assessed for flaw growth and flaw stability as specified in the ASME Code, Section XI. The results demonstrate compliance with the requirements of the ASME Code, Section XI. The St. Lucie plant specific evaluation, Reference 1, has been submitted to the NRC as Attachments 2 and 3 to Reference 2.

WCAP-15973-P-A Revision 0, Reference 3, evaluates the effect of component corrosion resulting from primary coolant in the crevice region on component integrity and evaluates the effects of propagation of the flaws left in place by fatigue crack growth and stress corrosion cracking mechanisms. In the half-nozzle repair, small gaps of 1/8 inch or less remain between the remnants of the Alloy 600 nozzles and the new Alloy 690 nozzles. As a result, primary coolant (borated water) will fill the crevice between the nozzle and the wall of the pipe. Low alloy and carbon steels used for reactor coolant systems components are clad with stainless steel to minimize corrosion resulting from exposure to borated primary coolant. Since the crevice regions are not clad, the low alloy and carbon steels are exposed to borated water.

Reference 3 provides bounding analyses for the maximum material degradation estimated to result from corrosion of the carbon or low alloy steel in the crevices between the nozzles and components. Results show that the quantity of material lost does not exceed ASME code limits. The report also provides results of fatigue crack growth evaluations and crack stability analyses for hot leg pipe nozzles. The results indicate that the ASME Code acceptance criteria for crack growth and crack stability are met. Further, available laboratory data and field experience indicate that continued propagation of cracks into the carbon and low alloy steels by a stress corrosion mechanism is unlikely.

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The topical report, Reference 3, demonstrates that the carbon and low alloy steel Reactor Coolant System components at St. Lucie 1 and 2 will not be unacceptably degraded by general corrosion as a result of the implementation of replacement of small diameter Alloy 600 nozzles. Although some minor corrosion may occur in the crevice region of the replaced nozzles, the degradation will not proceed to the point where ASME Code requirements will be exceeded before the end of plant life, including the period of extended operation.

Reference 4 states "The staff has found that WCAP 15972-P, Revision 01, is acceptable for referencing in licensing applications for Combustion Engineering designed pressurized water reactor to the extent specified and under the limitations delineated in the TR (Topical Report) and in the enclosed SE (Safety Evaluation)."

Sections 4.1, 4.2, and 4.3 of the SE present additional conditions to assess the applicability of the topical report. The FPL response for each additional condition is provided below. The FPL response is in *italic font*. The discussion shows that Reference 3 is applicable to St. Lucie Unit 1.

Section 4.1 of the SE states that licensees seeking to use the methods of the TR will need to perform the following plant-specific calculation in order to confirm that the ferritic portions of the vessels or piping within the scope of the TR will be acceptable for service through the licensed lives of their plants (40 years if the normal licensing basis plant life is used or 60 year is the facility is expected to be approved for extension of the operating license):

1. Calculate the minimum acceptable wall thinning thickness for the ferritic vessel or piping that will adjoin to the MNSA repair or half-nozzle repair.

   ***FPL Response:** 3.144 inches for the hot leg piping as listed in the design calculations.*

2. Calculate the overall general corrosion rate for the ferritic materials based on the calculation methods in the TR, the general corrosion rates listed in the TR for normal operations, startup conditions (including hot standby condition) and cold shutdown conditions and the respective plant-specific times (in-percentages of total plant life) at each of the operating modes.

   ***FPL Response:** 1.34 mil per year using the calculation methods in the TR and St. Lucie Unit 1 generation data from January 1, 1995 to December 31, 2004.*

3. Track the time at cold shutdown conditions to determine whether this time does not exceed the assumptions made in the analysis. If these assumptions are

exceeded, the licensees shall provide a revised analysis to the NRC and provide a discussion on whether volumetric inspection of the area is required.

FPL Response: *In accordance with Section 2.3.4 of the SE, the corrosion rate for CE plants is based on a time split of 88 percent at operating conditions, 2 percent at intermediate temperature startup conditions, and 10 percent at low temperature outage conditions. An assessment of operating data for St. Lucie Unit 1 from January 1, 1995 to December 31, 2004 shows 6.5 percent of plant time at low temperature outage conditions.*

The design thickness of the hot leg piping is 3.75 inches. The minimum acceptable wall thickness is 3.144 inches, which leaves a corrosion allowance of 0.606 inches. The plant license expires on March 1, 2036. There are 35 years of operation from the installation of the first hot leg half-nozzle in April of 2001 to the end of license. Using the corrosion rate in Step 2 of 1.34 mpy for the first 4 years of actual operation and the highest corrosion rate of 19 mpy for the remaining 31 years of future operation results in a maximum corrosion depth of 0.594 inches (31yrs x 0.019 inches/yr + 4yrs x 0.00134 inches/yr). Although it is not realistic to assume this highest corrosion rate that occurs during return to service after a refueling outage (high temperature and high oxygen) for the entire time of operation, this example demonstrates why tracking the time at cold shut down or intermediate temperatures is not required.

4. Calculate the amount of general corrosion based thinning for the vessels or piping over the life of the plant, as based on the overall general corrosion rate calculated in Step 2 and the thickness of the ferritic vessel or piping that will adjoin to the MNSA repair or half nozzle repair.

   FPL Response: *The first half nozzle repair was made in April 2001. The plant license was renewed and it expires on March 1, 2036. The first half nozzle repair can be expected to see 35 more years of service. Applying the corrosion rate from Step 2, 1.34 mils per year, for 35 years results in a material loss of 46.9 mils.*

5. Determine whether the vessel or piping is acceptable over the remaining life of the plant by comparing the worst case remaining wall thickness to the minimum acceptable wall thickness for the vessel or pipe.

   FPL Response: *The design thickness of the hot leg piping is 3.75 inches. Subtracting a material loss of 0.0469 inches, Step 4, from the design thickness results in a wall thickness of 3.7031 inches after 35 years. The wall thickness of 3.7031 inches is greater than the minimum acceptable wall thickness of 3.144 inches, Step 1. Therefore the piping is acceptable over the remaining life of the plant.*

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Section 4.2 of the SE states that licensees seeking to reference this TR for future licensing applications need to demonstrate that:

1. The geometry of the leaking penetration is bounded by the corresponding penetration reported in Calculation Report CN-CI-02-71, Revision 01.

   FPL Response: *Calculation Report CN-CI-02-71, Revision 01, Figure 6-1(c) Sheets 1 and 2 show the details of the hot leg nozzle that was used for the calculation. A review of drawings of the existing nozzles on the hot leg piping shows that the existing nozzles have essentially the same dimensions as were used in Calculation Report CN-CI-02-71, Revision 01.*

2. The plant-specific pressure and temperature profiles in the pressurizer water space for the limiting curves (cooldown curves) do not exceed the analyzed profile shown in Figure 6-2 of Calculation Report CN-CI-02-71, Revision 01, as stated in Section 3.2.2 of this SE.

   FPL Response: *As stated in Section 6.2.1.1 of Calculation Report CN-CI-02-71, Figure 6-2 of the report applies to the pressurizer. During the upcoming Unit 1 refueling outage (SL1-20), the pressurizer will be replaced with a new pressurizer, that has new small bore nozzles manufactured from Alloy 690. The hot leg piping does not see the transients experienced by the pressurizer. The remainder of the reactor coolant system, including the hot leg, is limited to a 100°F per hour by Technical Specifications. Therefore, the evaluation of the pressurizer limiting curves is considered not applicable.*

3. The plant-specific Charpy USE data shows a USE value of at least 70 ft-lb to bound the USE value used in the analysis. If the plant-specific Charpy USE data does not exist and the licensee plans to use Charpy USE data from other plants' pressurizers and hot leg piping, then justification (e.g., based on statistical or lower bound analysis has to be provided.

   FPL Response: *The Charpy USE data supports an Elastic-Plastic Fracture Mechanics (EPFM) analysis of a pressurizer lower shell axial flaw and not the hot leg piping as described in* Calculation Report CN-CI-02-71, Revision 01, *Section 6.3.2.2. Therefore, the evaluation of Charpy USE is considered not applicable for nozzle attachments to the hot leg piping.*

Section 4.3 of the SE states that licensees seeking to implement MNSA repairs or half nozzle replacements may use the WOG's stress corrosion assessment as the bases for concluding that existing flaws in the weld metal will not grow by stress corrosion if they meet the following conditions:

1. Conduct appropriate plant chemistry reviews and demonstrate that a sufficient level of hydrogen overpressure has been implemented for the RCS and that the contaminant concentrations in the reactor coolant have been typically maintained at levels below 10 ppb for dissolved oxygen, 150 ppb for halide ions and 150 ppb for sulfate ions.

   FPL Response: *Hydrogen overpressure is typically maintained in the reactor coolant system between 25 and 35 psig. Contaminant concentrations for dissolved oxygen, halide ions and sulfate are maintained at less than 5 ppb. All of these values are steady state values.*

2. During the outage in which the half nozzle or MNSA repairs are scheduled to be implemented, licensees adopting the TRs stress corrosion crack growth arguments will need to review their plant specific RCS coolant chemistry histories over the last two operating cycles for their plants and confirm that these conditions have been met over the last two operating cycles.

   FPL Response: *The above contaminant limits have been maintained at steady state operation during the past two cycles.*

This relief request applies to all previous repairs to Alloy 600 small bore nozzles on the hot leg reactor coolant piping that have left a remnant nozzle in place and all similar future repairs that will leave a remnant nozzle in place.

In conclusion, the ASME Code requirement, IWB-3132.3, is to replace material containing a flaw. The proposed alternative is to not remove the material containing the flaw, but show by analysis that the material and the presence of the flaw will not be detrimental to the pressure retaining function of the reactor coolant piping. Analyses, References 1 and 3, have shown that allowing the material containing a flaw to remain in place and in service would not result in a reduction of the level of quality or safety.

6. Duration of Proposed Alternative

Relief is requested for the remainder of the inspection interval for St. Lucie Unit 1.

7. References

1. 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.

2. FPL letter to NRC Letter, L-2002-222, *Supplemental Responses to NRC Requests for Additional Information for Review of the St. Lucie Units 1 and 2 License Renewal Application*, dated November 27, 2002.

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3. WCAP-15973-P-A, Revision 0, *Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600I690 Nozzle RepairIReplacement Programs*, Westinghouse Electric Company LLC, dated February 2005.

4 NRC letter to WOG, Final Safety Evaluation for Topical Report WCAP-15973-P, Revision 01, Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Program, dated January 12, 2005.