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

FPL

April 12, 2006

L-2006-100
10 CFR 50.4
10 CFR 50.55a

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

Re: St. Lucie Unit 2
Docket Nos. 50-389
In-Service Inspection Plans
Third Ten-Year Interval
RAI Response for Repair of Alloy 600 Small Bore
Nozzles Without Flaw Removal Unit 2 Relief Request 5 Revision 1

By Florida Power & Light Company (FPL) letter L-2005-263 dated January 4, 2006, FPL requested the extension of the third ten-year in-service inspection (ISI) interval Unit 2 Relief Request 5 via Revision 1 pursuant to 10 CFR 50.55a (a)(3)(ii). FPL determined pursuant to 10 CFR 50.55a (a)(3)(ii) that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The Unit 2 third interval Relief Request 5 was previously submitted by FPL letter L-2003-285 on November 21, 2003, supplemented by FPL letters L-2004-065 on March 24, 2004 and L-2004-100 on April 20, 2004 and approved for one operating cycle by NRC letter dated May 18, 2004.

This letter forwards the FPL response to the request for additional information (RAI) by NRC letter dated March 16, 2006. Approval of the attached revision to the relief request for the remainder of the inspection interval is requested to support the upcoming St. Lucie Unit 2 refueling outage (SL2-16 is currently scheduled to begin in April 2006). Please contact Ken Frehafer at 772-467-7748 if there are any questions about this submittal.

Very truly yours,

Gordon L. Johnston
Acting Vice President
St. Lucie Plant

Attachment

GLJ/KWF

A047

REQUEST FOR ADDITIONAL INFORMATION

FLORIDA POWER AND LIGHT COMPANY

ST. LUCIE NUCLEAR POWER PLANT, UNIT 2

DOCKET NUMBER 50-389

By letter dated January 4, 2006 (L-2005-263), Florida Power & Light company submitted Relief Request No. 5, Revision 1, for the third 10-year inservice inspection interval at St. Lucie Unit 2. To complete its review, the U.S. Nuclear Regulatory Commission (NRC) staff requests the following additional information (The FPL response follows each item. The response is in ***bold italic font***):

1. Page 1, Section 2, identifies the applicable code for this relief request as the 1999 Edition through the 2000 Addenda of the American Society of Mechanical Engineers (ASME) Code. In accordance with the June 8, 2004, NRC staff safety evaluation of Relief Request No. 1 for St. Lucie Unit 2, the code of record for the third 10-year inspection interval at St. Lucie Unit 2 is the 1998 Edition through the 2000 Addenda, with conditions. Please confirm the appropriate code version applicable to this request and correct the submittal, as necessary.

   FPL Response*:*

   The 1998 Edition of ASME Section XI is correct.

2. Page 1, Section 3, requests an alternative to paragraph IWB-3132.2 of the ASME Code, Section XI, which involves the examination and acceptance of the remnant flaws. Based on similar submittals, the NRC staff has found that the following ASME Code paragraphs may also apply to the proposed repair: (A) Section XI, Code Case N-638, which provides requirements for the temper bead welding; (B) Section III, Paragraph NB-4622, which provides requirements for the post-weld heat treatment; (C) Section III, Paragraphs NB-4453, NB-5244, and NB-5245, which provide the nondestructive examinations requirements; and (D) Section XI, Paragraph IWA-4540 (or Section III, Paragraph NB-6111.1), which requires a system hydrostatic test after repairs. Please confirm that the proposed repairs take no exceptions to the above ASME Code requirements, or request relief from the aforementioned requirements.

   FPL Response:

   FPL requests an alternative to the requirements of ASME B&PV Code, Section XI, IWB-3132.2. The repairs take no other exceptions to applicable ASME Code requirements.

3. Page 5. The response to Question 2 in Section 4.1 of the NRC's safety evaluation for Westinghouse Report WCAP-15973-P-A, states that the corrosion rate of 1.06 mils per year (mpy) is applicable only to the half nozzle repair.

   a. Discuss the applicability of the half nozzle corrosion rate to the sleeve repair.

   FPL Response:

   The corrosion rate of 1.06 mils per year is applicable to the carbon and low alloy steel exposed to bulk solutions of boric acid and not to solutions confined in a crevice where the volume of the solution is such that the solution cannot be replenished or refreshed. When corrosion occurs within a crevice, the crevice region will fill with corrosion product. The corrosion products occupy a greater volume than the non-corroded base metal from which they originated. The presence of corrosion products in the crevice will prevent access of the corrodent (borated water) to the carbon and low alloy steel, reducing the corrosion rate. Further corrosion will result in the crevice corrosion product becoming dense and less permeable to the primary coolant. Eventually, the corrosion process will stifle because the steel will become isolated from the coolant.

   The geometry of the "sleeve" repair results in a tight crevice between the alloy 690 sleeve and the base metal of the hot leg piping or pressurizer which is equivalent or even tighter than that evaluated in Reference 1, Section 2.5. Therefore, the corrosion rates shown in Reference 1, Section 2.5 will be used to evaluate the "sleeve" repair.

   b. Since the sleeve repair was first used in 1989, recalculate the corrosion rate using all of the corrosion data from 1989 to December 31, 2004, or justify why the corrosion data from 1989 to 1995 is not applicable to the corrosion rate calculation for the half-nozzle repair.

   FPL Response:

   The sleeves installed in 1989 were seal welded at the internal interface of the sleeve and hot leg piping, thereby preventing contact between the carbon steel pipe and the borated water. These replacements were preventative, not to correct a leaking nozzle. In the unlikely event a leak would develop at the original weld between the nozzle and the pipe internal surface or at the seal weld, the presence of any leaking corrodent within the rolled gap would result in the crevice corrosion discussed above and there would be a minor finite loss of carbon steel wall thickness.

   The first "half-nozzle" repair was made in 1994 and the lifetime corrosion was calculated using that start date and the bulk fluid corrosion rate. Accordingly, it would not be appropriate to extend the corrosion rate for the bulk fluid to a start time based on the seal welded sleeve repair.

c. Discuss why the bounding corrosion rate on Page 2-6 of WCAP-15973-P-A, which is more conservative than the 1.06 mpy, was not applied to St. Lucie Unit 2.

FPL Response:

As stated in Paragraph 4.1.2 of the SER, a plant specific corrosion rate is to be determined and the plant specific corrosion rate is to be used for subsequent calculations. Accordingly the plant specific corrosion rate was used for the calculations, not the more conservative corrosion rate from WCAP-15973-P-A.

4. Page 7. The response to Question 4 in Section 4.1 of the NRC's safety evaluation for WCAP-15973-P-A, states that the corrosion rate for a tight crevice, as discussed in Section 2.5 of the WCAP report, is applicable to the sleeve repairs.

a. The corrosion rate discussed in Section 2.5 of the WCAP report is related to the mechanical nozzle seal assembly (MNSA) repair, not to the sleeve repair. Justify the use of the corrosion rate of the MNSA repair for the sleeve repair.

FPL Response:

The discussion in Section 2.5 of the WCAP addresses corrosion occurring in a tight crevice and describes the mechanisms which differentiate crevice corrosion from corrosion occurring in a bulk fluid environment. The maximum crevice gap discussed is 0.010". When employing the sleeve repair technique, the sleeve is inserted into the nozzle bore and sized to provide a tight crevice with maximum gap of 0.010" before expanding. The sleeve is plastically deformed by rolling to provide a metal to metal fit with the nozzle bore. The gap resulting from installation of the sleeve is comparable to the gap in the discussion in the WCAP and can be less. The corrosion rates discussed in the WCAP are applicable to any tight crevice and are not unique to the design of the MNSA repair.

The sleeve repair represents a crevice geometry bounded by the dimensions in section 2.5 of WCAP-15973-P-A. Therefore the corrosion rates are applicable.

b. On page 2 of the submittal, you stated that sleeves are either rolled in the bore of the nozzle or welded to the interior surface of the piping or pressurizer. For the sleeves that are rolled in the nozzle/penetration bore, the bore may be dilated during certain transients such that the interference fit between the sleeve and the bore could become relaxed. In addition, the sleeve is made of alloy 690 and the piping or pressurizer base metal is carbon steel. The thermal expansion of the two materials is different, which could contribute to the relaxation of the interference fit. A crevice could be generated between the sleeve and the base metal under this scenario. The borated solution could come in contact with the carbon steel of the piping or pressurizer, which would lead to a leakage path and potential flaw initiation. In the absence of an assurance that this scenario would not occur, a crevice should be assumed to exist between the sleeve and piping/pressurizer base metal, which means that the corrosion rate for the sleeve repair would be similar to, if not the same as, the corrosion rate for the half nozzle repair. Address the likelihood of this scenario and, if it is relevant, recalculate the life span of the sleeve repair.

FPL Response:

The alloy 690 sleeve is plastically deformed, at ambient temperature, to the ID of the nozzle bore in the vessel or piping. The coefficient of thermal expansion for alloy 690 base metal is greater than that for the vessel or piping base metal. Therefore, at 600 °F, the Alloy 690 sleeve will have a larger outer diameter than the bore diameter in the vessel or piping and the interference fit imparted at room temperature will be maintained. In the unlikely case that a separation would occur between the sleeve and the nozzle bore, the gap would be expected to be very small and the corrosion rates applicable to a crevice, as discussed above, would apply. The crevice corrosion scenario has a limited material loss, as shown, resulting in a nozzle bore diameter well within the limits of the ASME Code calculations. Accordingly there is no need to recalculate the life span of the sleeve repair.

5. Page 8. The response to Question 2 in Section 4.2 of the NRC's safety evaluation for WCAP-15973-P-A provided the cooldown rate for the pressurizer water space. If the cooldown rate exceeds the specified 75 degrees Fahrenheit per hour, describe what corrective actions will be taken, including whether an analysis would be performed to demonstrate the impact of an out-of-limit event on the structural integrity of the pressurizer base material (given the existence of remnant flaws in the nozzles or heater sleeves).

FPL Response:

If the cooldown rate exceeded the administrative limited rate, this incident would indicate a breakdown in the administrative system or malfunction of equipment. There could be many causes and many corrective actions. If it were to occur, the condition would be evaluated under the FPL corrective action program. Any required analysis would be completed as part of the evaluation.

6. Page 8. The response to Question 3 in Section 4.2 of the NRC's safety evaluation for WCAP-15973-P-A states that ". . . The [elastic-plastic fracture mechanics] analysis was not performed on the upper head [of the pressurizer] because the upper head is not affected by the large in-surge transient or thermal stress which occurs at the lower head and lower shell . . ." Table 1 of the submittal shows that indications were detected on the three pressurizer upper head nozzles at St. Lucie Unit 2 in 1994. Table 1 does not show whether indications were detected in the pressurizer lower head, although they were preventively repaired. The pressurizer upper head is at least as susceptible to cracking as the lower head, even though the upper head may not experience the in-surge transient or high thermal stress as the lower head.

a. Discuss the root cause of the indications found in the upper head nozzles in 1994 and the likelihood of the indications occurring in the replacement alloy 690 nozzles.

FPL Response:

Based on the appearance of a liquid penetrant examination performed of the indications, it was judged that the root cause of the indications was PWSCC. The indications appeared in the 182 weld metal (SMAW weld metal equivalent to alloy 600) that was used to join the nozzle to the head. The weld was made on the inside of the head. The repair was made with the "half-nozzle" technique resulting in the new weld being made on the outside of the head. The new nozzles were welded using ER52 weld metal (GTAW weld metal equivalent to alloy 690). The new half-nozzles were made from Alloy 690. Both ER52 weld metal and alloy 690 base metal are recognized as being resistant to PWSCC and there is little likelihood of the indications reoccurring.

b. The submittal provided conclusions on the acceptability of the upper shelf energy for the pressurizer lower shell and lower head, but not the upper head. Confirm that the upper shelf energy for the pressurizer upper head is also acceptable.

FPL Response:

WCAP-15973-P-A excludes the upper head from the analysis. However, the impact data for the pressurizer upper head is equivalent to that for the pressurizer lower head. Therefore, the discussion for the lower head, shown on page 9 of the submittal, is applicable to the upper head and the discussion concludes " Similarly for the pressurizer bottom head, the absorbed energy at +70 degrees F is 69 ft-lb and the absorbed energy will increase as 100% shear is obtained. It can be reasonably expected that this material will exhibit an USE of at least 70 ft-lb." Accordingly, the upper shelf energy for the pressurizer upper head is also acceptable. The impact data for the upper head has been added to Table 3 of the relief request, titled "Summary of Charpy Impact Data" and is shown below:

TABLE 3 SUMMARY OF CHARPY IMPACT DATA					
Name	Heat No.	Testing temperature °F	*Absorbed energy ft-lb	*% shear	*USE ft-lb
Reactor Vessel Plate	A8490-2	+30	44	25	105
Reactor Vessel Plate	B3416-2	+10	42	20	113
Reactor Vessel Plate	A8490-1	0	49	25	115
Reactor Vessel Plate	B8307-2	+20	33	15	93
Reactor Vessel Plate	A3131-1	+20	47	20	107
Reactor Vessel Plate	A3131-2	+20	52	25	105
Pressurizer Bottom Head	C4754-3	+70	69	60	___
Pressurizer Upper Head	B8618-2	+70	69	60	___
Pressurizer Lower Shell	NR 60 466-2	+20	72	35	___
Pressurizer Lower Shell	NR 61 734-1	+30	54	25	___

c. In light of indications detected in the pressurizer upper head, confirm that the elastic-plastic fracture mechanics analysis performed in WCAP-15973-P-A (as presented in Reference 17 of the report) bounds the pressurizer upper head at St. Lucie Unit 2.

FPL Response:

The base metal of the pressurizer upper head and the dimensions of the pressurizer upper head are essentially equivalent to the values used in the analysis performed in WCAP-15973-P-A (as presented in Reference 17 of the report). Therefore, the St. Lucie Unit 2 pressurizer upper head is bounded by the analysis in WCAP-15973-P-A.

7. Page 10. You state that Relief Request 5, Revision 1, applies to all previous repairs to Alloy 600 small bore nozzles on the reactor coolant hot leg piping and pressurizer that have remaining nozzles in place. Confirm that the previously performed half nozzle repairs utilized the same repair method (i.e., welding, installation, design, corrosion calculations,

flaw evaluation, and qualification tests) as the half nozzle repair described in WCAP-15973-P-A.

FPL Response:

The "half-nozzle" repair technique is described in Section 1.3 and illustrated in Figure 1-1 of WCAP-15973-P-A. All previous half-nozzle repairs at St. Lucie Unit 2 utilized the same repair method as described in WCAP-15973-P-A. The "half-nozzle" repairs were made in 1994 and 2003 which predates WCAP-15973-P-A, dated February 2005. The corrosion calculations, as shown by WCAP-15973-P-A, performed to support this relief request verify the adequacy of the previous repairs. The base metals and the dimensions of the repairs are bounded by flaw evaluations of WCAP-15973-P-A.

8. Page 13. The footnote in Table 1 states that "...*Nozzle welded to a nickel alloy weld pad...". Identify the alloy material and welding process of the weld pad.

FPL Response:

All weld pads were made with the machine GTAW process. The weld pads made in 1989 used ERNiCr-3 filler metal and the remaining weld pads were made with ERNiCrFe-7 filler metal.

CROSS REFERENCE OF NICKEL ALLOY PRODUCTS				
Generic alloy	GTAW weld metal commercial designation	GTAW weld metal ASME SFA-5.14 designation	SMAW weld metal commercial designation	SMAW weld metal ASME SFA-5.11 designation
600	82	ERNiCr-3	182	ENiCrFe-3
690	52	ERNiCrFe-7	152	ENiCrFe-7

9. Page 2-10 of WCAP-15973-P-A, provides a brief discussion of the inspection results of the repaired nozzles at St. Lucie Unit 2.

   a. Provide a detailed discussion of the examination technique used, the inspection scope (which areas of the repair were examined and which nozzles were inspected), and inspection results of the nozzle and sleeve repairs made on the hot leg nozzles and pressurizer upper and lower heads since 1989. If a visual examination was performed, identify whether it was a VT-1, VT-2, or VT-3 examination.

FPL Response:

A UT examination was performed on the 4 steam space nozzles for 3 periods following the repair. The UT procedure examines the pressurizer base metal for extension of the

postulated ID flaw at the internal "J-groove" weld. The UT was performed in 1995, 1997, & 2001 with no relevant indications. The only relevant VT for a previously repaired nozzle location is the most recent. A VT-1 inspection was performed on all the pressurizer instrument nozzles in 2005 with no leaks identified.

The equivalent of a bare metal visual was performed, on eight of the nine hot leg nozzles repaired in 1995, during the 2003 refueling outage. No indications of leakage were noted during the 2003 outage.

The pressurizer instrument nozzles are routinely inspected for leakage during refueling outages. The hot leg RTD nozzles are also routinely inspected for leakage during refueling outages. No leakage has been observed on any of the repaired nozzles.

b. Describe the inservice inspection strategy for the future nozzle and heater sleeve repairs.

FPL Response:

As stated on page 3 of the Relief Request "The remnant material (weld metal, nozzles and heater sleeves) will not receive additional examination. The new pressure boundary welds, on the exterior surface of the piping and pressurizer, will be examined in accordance with the applicable requirements of the ASME Boiler and Pressure Vessel Code Sections III and XI."

10. Please confirm that the external welds of the 26 half-nozzle and sleeve repairs listed in Table 1 have been evaluated for mechanical and thermal fatigue in accordance with ASME Section III Class 1 design requirements, and that the Class 1 stress and fatigue criteria are met for the life of the plant.

FPL Response:

The external welds of the 26 half-nozzle and sleeve repairs listed in Table 1 of the St. Lucie Plant Unit 2 Relief Request No. 5, Rev. 1, have been evaluated for mechanical and thermal fatigue in accordance with ASME Section III Class 1 design requirements. The Class 1 stress and fatigue criteria were met for the life of the plant.

The analysis was based on a 40 year life. In support of the St. Lucie License Renewal Activity, it was shown that the various 40 year analyses, which were performed for the plant, were still valid for the 60 year extended life. The St. Lucie License Renewal Activity resulted in an extended license for the St. Lucie plant.