FPL

August 1, 2014

L-2014-252
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
Fourth Ten-Year Interval
Unit 2 Relief Request 2

Pursuant to 10 CFR 50.55a(a)(3)(ii) FPL requests an alternative to the requirements of ASME Boiler & Pressure Vessel Code, Section XI, paragraph IWB-3132.2, "Acceptance by Repair/Replacement Activity." The original alloy 600 small bore nozzles and pressurizer heater sleeves in the St. Lucie Unit 2 reactor coolant system (RCS) have been replaced with alloy 690 nozzles and heater sleeves. The nozzle welds and pressurizer heater sleeves have been repaired using the "half-nozzle" technique or the "sleeve" technique. The bases and justification for the "half-nozzle" and "sleeve" repair techniques are within the Attachment to this letter.

Please contact Ken Frehafer at 772-467-7748 if there are any questions about this submittal.

Sincerely,

Steven Catron
Licensing Manager
St. Lucie Plant

Attachment

SC/KWF

cc: USNRC Regional Administrator, Region II
USNRC Senior Resident Inspector, St. Lucie Units 1 and 2

A047
NRR

ST. LUCIE UNIT 2
FOURTH INSPECTION INTERVAL
RELIEF REQUEST NUMBER 2, REV. 0

Proposed Alternative
In Accordance with 10CFR 50.55a(a)(3)(ii)

--Hardship or Unusual Difficulty without Compensating
Increase in Level of Quality or Safety--

1. ASME Code Component(s) Affected

Small bore alloy 600 nozzles welded to the reactor coolant piping hot legs and pressurizer and alloy 600 heater sleeves welded to the pressurizer

St. Lucie (PSL) Unit 2
Reactor Coolant Piping Nozzle Details
FPL Drawing Numbers: 2998-18705 Rev. 2, 2998-18706 Rev. 2

Pressurizer Nozzle Details
FPL Drawing Numbers: 2998-19321 Rev. 0, 2998-19466 Rev. 0, 2998-19467 Rev. 0

Pressurizer Heater Sleeves
FPL Drawing Numbers: 2998-16985 Rev. 5

2. Applicable Code Edition and Addenda

The Code of record for St. Lucie Unit 2 (PSL-2) is the 2007 Edition with 2008 Addenda of ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components."

3. Applicable Code Requirement

Pursuant to 10 CFR 50.55a (a)(3)(ii) FPL requests an alternative to the requirements of ASME Boiler & Pressure Vessel Code, Section XI, paragraph IWB-3132.2 "Acceptance by Repair/Replacement Activity. " A component whose volumetric or surface examination detects flaws that exceed the acceptance standards of Table IWB-3410-1 is unacceptable for continued service until the additional examination requirements of IWB-2430 are satisfied and the component is corrected by a repair/replacement activity to the extent necessary to meet the acceptance standards of IWB-3000. "

FPL requests an alternative to the requirements of ASME Boiler & Pressure Vessel Code, Section XI, IWB-3132.2 and the repairs take no other exceptions to applicable ASME Code requirements.

4. Reason for Request

Small bore nozzles were welded to the interior of the hot leg of the reactor coolant piping and pressurizer and heater sleeves were welded to the interior of the pressurizer during original fabrication of the piping and pressurizer. Industry experience has shown that cracks may develop in the alloy 600 nozzle base metal, heater sleeve base material, or in the weld metal joining the nozzles or heater sleeves to the reactor coolant pipe or pressurizer, resulting in leakage of the reactor coolant. The cracks are believed to be caused by primary water stress corrosion cracking (PWSCC). The potential flaws, through the weld, base material, or both, cannot be determined.

To remove all possible potential flaws requires accessing the internal surface of the component to grind out the attachment weld and any remaining nozzle base metal. Such an activity would result in high radiation exposure to the personnel involved, which is considered a hardship. Grinding within the components also exposes personnel to safety hazards. Additionally, grinding inside the reactor coolant piping or pressurizer increases the possibility for the introduction of foreign material that could damage the fuel cladding. The NRC approved topical report (TR) in WCAP-15973-P-A, Rev 0 "Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Programs" [1], and the following section, "Proposed Alternative and Basis for Use", support the conclusion that there is no compensating increase in the level of quality or safety as a result of removal of the flawed metal.

5. Proposed Alternative and Basis for Use

Proposed Alternative

The alloy 600 small bore nozzles and pressurizer heater sleeves in the PSL-2 Reactor Coolant System (RCS) have been replaced with alloy 690 nozzles and heater sleeves. The nozzle welds and Pressurizer heater sleeves have been repaired using the "half-nozzle" technique or the "sleeve" technique. The original nozzles and heater sleeves were repaired by relocating the attachment weld from the inside surface of the pipe or pressurizer to the outside surface of the pipe or pressurizer. The alloy 600 small bore nozzle repairs at PSL-2 are shown in Table 1. Note that twenty-two (22) of the twenty-six (26) nozzle replacements

and all heater sleeve replacements were performed preventatively without the presence of a flaw or leak.

In the "half-nozzle" technique, Figure 1, design A and B, the components are cut outboard of the partial penetration weld between the nozzles and pipe or pressurizer wall for the nozzles or between the heater sleeves and pressurizer wall for the heater sleeves, approximately midwall. The cut sections of the alloy 600 nozzles and heater sleeves are replaced with short sections (half-nozzles) of alloy 690, which are then welded to the outside surfaces of the pipe or pressurizer. The remainders of the alloy 600 nozzles and heater sleeves, including the partial penetration welds, remain in place without correction.

In the "sleeve" technique, Figure 1, design C and D, the entire nozzle is removed by machining and the bore diameter is slightly enlarged. Subsequently an alloy 690 sleeve is inserted into the bore and rolled into place. The end of the sleeve at the interior surface of the piping or the pressurizer is either roll expanded or welded to the interior surface of the piping or pressurizer, essentially eliminating corrosion of the carbon steel by stopping the replenishment of borated solution in contact with the carbon steel. An alloy 690 nozzle is inserted into the sleeve and the nozzle and sleeve are welded to the exterior of the piping or pressurizer.

The weld joint configurations shown in Figure 1 are illustrative only. Twelve (12) of the twenty-six (26) repaired alloy 600 nozzles and all of the pressurizer heater sleeves are welded to pads deposited on the exterior surface of the pressurizer or piping using a temper bead technique or directly to the piping surface.

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

<u>Basis For Use</u>

Section 2.3 of the TR in Reference 1 evaluates the effect of component corrosion resulting from primary coolant in the “half-nozzle” crevice region between the remnant alloy 600 nozzles and replacement alloy 690 nozzle. In addition, Section 2.5 of the TR in Reference 1 evaluates the effect of component corrosion resulting from primary coolant in a confined crevice, like the “sleeve” repair, where the volume of the solution is such that the solution cannot be replenished.

In the "half-nozzle" repair, a small gap remains between the remnant of the original alloy 600 component and the new alloy 690 component. As a result,

primary coolant (borated water) will fill the crevice between the nozzle or heater sleeve and the pipe or the pressurizer wall. Low alloy and carbon steels used for reactor coolant systems components are clad with stainless steel to minimize corrosion resulting from the exposure to borated primary coolant. Since a crevice exists, the low alloy and carbon steels are exposed to borated water. Therefore, the corrosion rates addressed in the "half-nozzle" repair is based on the corrosion analysis in Section 2.3 of the TR of Reference 1.

The "sleeve" repair was not specifically evaluated in the TR of Reference 1. However, Section 2.5 of the TR [1] provides an alternate estimate of carbon and low alloy steel corrosion. The corrosion rate previously described 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. 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 the pressurizer, which is equivalent or even tighter than the crevice evaluated in Section 2.5 of the TR [1]. Therefore, the corrosion rate shown in Section 2.5 of the TR in Reference 1 is used to evaluate the "sleeve" repair.

Reference 1, demonstrates that the carbon and low alloy steel RCS components at PSL-2 will not be unacceptably degraded by general corrosion as a result of the implementation of replacement of small diameter alloy 600 nozzles and heater sleeves. Although some minor corrosion may occur in the crevice region of the replaced nozzles and heater sleeves, the degradation will not proceed to the point where ASME Boiler & Pressure Vessel Code requirements will be exceeded before the end of plant life, including the period of extended operation. 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.

Additionally, Reference 1 evaluates the effects of propagation of the flaws, left in place from the previous nozzles and welds, by fatigue crack growth and stress corrosion cracking mechanisms. Postulated flaws were assessed for flaw growth and flaw stability as specified in the ASME Boiler & Pressure Vessel Code, Section XI and the results demonstrate compliance with the requirements of the ASME Boiler & Pressure Vessel Code, Section XI.

Reference 2 (NRC letter dated January 12, 2005, Final Safety Evaluation for Topical Report WCAP-15973-P, Rev 1) states "The staff has found that WCAP 15973-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 Safety Evaluation (SE) in Reference 1 present additional conditions to assess the applicability of the TR in Reference 1. The FPL assessment for each additional condition is provided below. The FPL assessment is in *italic* font. The discussion shows that Reference 1 is applicable to PSL-2.

A. Section 4.1 of the SE in Reference 1 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 years if 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 Assessment: Based on Item 4 in Reference 3, the corrosion calculations herein will address the Limiting Allowable Diameter, as described in Reference 4, in lieu of the minimum acceptable wall thickness for the vessel or piping. The Limiting Allowable Diameters, as described in Reference 4, for the various nozzles under evaluation are shown in Tables 2A and 2B and the associated weld joint configurations are shown in Figure 1 herein.

   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 (in-percentages of total plant life) at each of the operating modes."

      FPL Assessment: The overall general corrosion rate was determined using the calculation methods in Section 2.3 of the TR in Reference 1 and PSL-2 generation data from 1/1/1995 to 2/28/2014. The percentage of total plant time spent at each of the temperature conditions follows:

High temperature conditions	*90.5%*

Intermediate temperature conditions	*2.0%*
Low temperature conditions	*7.5%*

The corrosion rate for each temperature condition is taken from the TR [1] and is shown as follows:

High temperature conditions	*0.4 mpy*
Intermediate temperature conditions	*19.0 mpy*
Low temperature conditions	*8.0 mpy*

The overall corrosion rate was determined using the above time at temperature data, corrosion rate at temperature data, and formula 1 of the TR [1] as follows:

CR = 0.90.5 X 0.4 mpy + 0.02 X 19 mpy + 0.075 X 8 mpy

Resulting in an overall corrosion rate of 1.34 mpy. This corrosion rate is applicable only to the" half-nozzle" repair.

The overall general corrosion rate for the "sleeve" repair is based on Section 2.5 of the TR in Reference 1, which addresses corrosion occurring in a tight crevice and describes the mechanism that differentiate crevice corrosion from corrosion occurring in the bulk fluid environment. The corrosion rate discussed in Section 2.5 of the TR [1] is applicable to any tight crevice geometry within the bounds of the evaluation of Section 2.5 of the TR [1]. 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 the crevice evaluated in Section 2.5 of the TR [1]. Therefore, the overall corrosion rate for the "sleeve" repair is bounded by the corrosion rate discussed in Section 2.5 of the TR in Reference 1.

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 Assessment: In accordance with section 2.3.4 of the SE in Reference 1, 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 PSL-2 from 1/1/1995 through 2/28/2014 shows a time split of 90.5 percent at operating conditions, 2.0 percent at intermediate temperature startup conditions, and 7.5 percent of plant time at low temperature outage conditions. Therefore, the time at cold shutdown does not exceed the assumptions made in the analysis.

The plant operating conditions will be reassessed for the resubmittal of this relief request at the start of the next inspection interval, which begins in August 2023. There is no need to track plant operating conditions during the remainder of the current inspection interval, as there is sufficient wall thickness in the more limiting hot leg piping to maintain the limiting allowable diameter until this reassessment is made. As shown in the TR of Reference 1, the most severe corrosion rate for steady state conditions, i. e. at power or shutdown, would occur during outage or shutdown conditions with a corrosion rate of 8 mpy. Using the calculated corrosion rate of 1.34 mpy, from 2013 for one year, the wall would have experienced a radial loss of 0.001 in. to date. If the plant remained shut down for the remainder of the inspection interval, approximately 9 years, and experienced corrosion of the steel at the rate shown in the TR [1], approximately 8 mpy, there would be an additional loss of 0.072 in. of wall thickness. The total loss, 0.001 in. plus 0.072 in., would equal 0.073 in. Doubling the loss to account for a diametrical change and adding the diameter of 1.063 in. from Table 2A results in a diameter of 1.210 in. at the start of the next inspection interval. A diameter of 1.210 in. is less than the limiting diameter of 1.270 in. identified in Reference 12 of WCAP-15739-P-A, Rev. 0. This calculation was performed for a "half-nozzle" repair only. As shown below the corrosion rate for the "sleeve" repair has a lifetime diametrical loss of 0.025 in. and therefore is bounded by the calculation for the "half-nozzle" repair.

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 Assessment: The amount of corrosion will be determined for two cases; 1) the overall general corrosion rate that is applicable to the "half-nozzle" repairs and 2) the corrosion rate for tight crevices that is applicable to the "sleeve" repairs.

Table 1 shows the first "half-nozzle" repair and first "sleeve" repair to the piping and to the pressurizer. For the piping, the first "half-nozzle" repair was made in 2003 and the first "sleeve" repair was made in 1989. For the pressurizer, the first "half-nozzle" repair was made in 1994, and the first "sleeve" repair was made in 1995. The pressurizer heater sleeves used the "half-nozzle" repair in 2011.

The plant license was renewed and it expires on April 6, 2043. The first "half-nozzle" repairs, made in 1994, can expect to see 49 more years of service from the year of the repair to the year the plant license expires. Applying the "half-nozzle" corrosion rate from step 2, 1.34 mils per year, for 49 years results in a radial material loss of 65.6 mils (diametrical loss of 131 mils) for the "half-nozzle" repairs. "The material loss at the end of the plant life for "half-nozzle" repairs performed after 1994 are bounded by the calculated material loss for the first "half-nozzle" repair because repairs made after 1994 will have less years of service than the first "half-nozzle repair".

For the pressurizer heater sleeves repair, the "half-nozzle" repairs made in 2011 can expect to see 32 more years of service from the year of the repair to the year the plant license expires. Applying the "half-nozzle" corrosion rate from step 2, 1.34 mils per year, for 32 years results in a radial material loss of 42.9 mils (diametrical loss of 86 mils) for the heater sleeve repairs. Therefore, the pressurizer heater sleeve repairs are bounded by the calculated material loss for the first "half-nozzle" repair because the heater sleeve repairs will have less years of service than the first "half-nozzle repair".

The first "sleeve" repairs were made in 1989 and can expect to see 54 more years of service from the year of the repair to the year the plant license expires. As shown in Section 2.5 of the TR in Reference 1, a reasonable estimate of the lifetime corrosion resulting from a tight crevice will be a radial material loss of 12.5 mils (diametrical loss of 25 mils) which is considered applicable to the "sleeve" repairs.

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 Assessment: In Tables 2A and 2B, the third column from the left lists the nozzle bore in the piping or pressurizer resulting from the

replacement of the Alloy 600 nozzles and heater sleeves. Also in Tables 2A and 2B, the radial material loss, from Step 4 above, is doubled and added to the repair bore diameter. The resultant nozzle repair bore diameter is compared to the Limiting Allowable Diameter, from Step 1. For the nozzle locations shown, the resultant diameter is less than the Limiting Allowable Diameter.

Therefore, the hot leg piping and the pressurizer are acceptable for the remaining life of the plant.

B. Section 4.2 of the SE in Reference 1 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 Assessment: Plant specific calculations to evaluate fatigue crack growth associated with small diameter nozzles have been performed and are reported in Reference 5. The calculations and results are equivalent to Calculation Report CN-CI-02-71, Revision 01. The calculations of Reference 5 do not address the pressurizer heater sleeves. However, the geometry of the PSL-2 pressurizer heater sleeves is equivalent to that shown in Calculation Report CN-CI-02-71, Rev. 1. Therefore, the geometry of the nozzles on PSL-2 are bounded by Calculation Report CN-CI-02-71, Rev. 1. Reference 5 was submitted to the NRC as part of the St. Lucie License Renewal activity, which resulted in an extended license for PSL-2.

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 Assessment: The TR in Reference 1 indicates that the pressurizer cool down profile analyzed is a 200 degree F per hour cooldown rate from 653 degrees F to 200 degrees F followed by a 75 degree F per hour rate to 120 degrees F. The TR [1] indicates that the fatigue evaluation results are not affected by the choice of cooldown rate from 653 degrees F to 200 degrees F and that the only concern is when the metal temperature is less than 200 degrees F, which is when the material toughness begins to significantly decrease.

Cooldown of the pressurizer water space is administratively controlled by a plant procedure to a maximum rate of 75 degrees F per hour for normal operation, which is within the rates shown in Figure 6-2 of CN-CI-02-71. Additionally, the pressurizer water temperature is recorded during cooldown until the water temperature is less than 120 degrees F.

Therefore, the temperature profile in the pressurizer water space does not exceed the analyzed profile shown in Figure 6-2 of CN-CI-02-71.

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 Assessment: Charpy USE value of 70 ft-lb was used to support an EPFM analysis of the pressurizer lower shell and the pressurizer lower head. The analysis was not performed on the upper head because the upper head is not affected by the large in-surge transient or thermal stress that occurs at the lower head and lower shell. When the pressurizer was built, Charpy USE data for the pressurizer was not required and was not determined. The Charpy impact data for the two (2) lower shell plates, the upper head, and the bottom head of the pressurizer is summarized in Table 3. The summarized data is the average of the impact test data reported in the materials certification reports.

   The Charpy impact data and USE for six (6) plates in the reactor vessel (RV) shell is summarized in Table 3. The summarized data is the average of the impact test data included in the material certification reports for the RV plates and were chosen at temperature and shear levels comparable to those used for testing the pressurizer materials.

   The two (2) lower shell plates, the upper head, and the bottom head of the pressurizer are similar to the six (6) RV plates. All ten (10) items were made to the same alloy specification, SA-533 Gr. B Cl.1, have similar chemistry, and received similar heat treatment. Lukens Steel supplied the pressurizer upper and bottom heads, and the six (6) RV plates. Marrel Freres supplied the two (2) pressurizer lower shells plates. Since the ten (10) items are similar, it can be reasonably expected that the USE data for the two (2) lower shell plates, the upper

head, and the bottom head of the pressurizer should be comparable to that of the RV plates, as discussed below.

From Table 3, the pressurizer lower shell plate, Heat No. NR 60 466-2, exhibited an absorbed energy of 72 ft-lb and 35% shear at a testing temperature of +20 degrees F. The USE value is the absorbed energy at 100% shear and this shear state is obtained by testing at progressively higher temperatures. As the testing temperature is increased, the absorbed energy increases and the percent shear increases. Since this material already exhibits the required 70 ft-lb at low temperatures, it will continue to exhibit and exceed the required value of 70 ft-lb while approaching full shear.

Similarly for the pressurizer bottom head, Heat No. C4754-3, and upper head,B8618-2, 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 these materials will exhibit an USE of at least 70 ft-lb.

The pressurizer lower shell plate, Heat No. NR 61 734-1, exhibited absorbed energy and % shear comparable to that of the six (6) RV plates at a testing temperature lower than the testing temperature of the RV plates. From Table 3, the testing temperature for Heat No. NR 61 734-1 is +30 degrees F and for the RV plates is +60 degree F. Since all seven items have similar chemistry, experienced similar heat treatment, and the pressurizer lower shell exhibited impact properties similar to the RV plates at a lower testing temperature, it is reasonable to expect the USE of the pressurizer lower shell plate, Heat No. NR 61 734-1, to be comparable to that of the RV plates, which exhibit USE well in excess of 70 ft-lb.

Therefore, it is reasonable to expect that the two (2) lower shell plates, the upper head, and the bottom head of the pressurizer would exhibit USE well in excess of 70 ft-lb and that PSL-2 is bounded by the analysis.

C. The concluding requirement of section 4.2 of the SE in Reference 1 states, "Based on the above evaluation, the staff has determined that the crack can be left in the J-groove weld at small-bore locations for a plant life of 40 years. However, if the licensee plans on using this alternative beyond the 40 years and through the license renewal period, the thermal fatigue crack growth analysis shall be re-evaluated to include the extended period, as applicable,

and submitted as a time limited aging analysis in their license renewal application as required by 10 CFR 54.21(c)(1)."

FPL Assessment: As stated above, in response to 4.1.4 of the SE in Reference 1, the first small bore alloy 600 nozzle repair can be expected to see 54 more years of service, which extends beyond the original plant life of 40 years and into the license renewal period. The St. Lucie plant has received an extended license for both Units 1 and 2. Chapter 18 of the FSAR for Unit 2, Reference 6, describes the aging management programs and time limited aging analysis activities for license renewal. Section 18.3.7 in Chapter 18 of the FSAR [6], specifically addresses alloy 600 instrument nozzle repairs. This section concludes "The flaw growth analysis of the Unit 2 pressurizer steam space alloy 600 instrument nozzle repairs has been evaluated and determined to remain valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i)."

D. Section 4.3 of the SE in Reference 1 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 Assessment: PSL-2 follows the Reactor Coolant System (RCS) chemistry practices and limits recommended under the EPRI PWR Primary Chemistry Guidelines for shutdown and operation conditions with no program exceptions noted in the station's Primary Chemistry Strategic plan. Chemistry data was reviewed for the period from June 2005 to March 2014.

   Chemistry procedures state that hydrogen levels shall be >15 cc/kg but may be < 25 cc/kg for up to 24 hours after reaching reactor critical without instituting Action Level 1. Hydrogen levels may be reduced to 15 cc/kg 24 hours before shutdown without instituting Action Level 1. Hydrogen concentration never went below 15 cc/kg while critical during the reviewed period and is typically maintained between 25 and 50 cc/kg. During the reviewed period:

- *the dissolved oxygen never exceeded 10 ppb, typically maintained at less than of 5 ppb, and*
- *the concentration of fluoride, chloride and sulfate never exceeded 150 ppb, typically maintained at less than 5 ppb.*

The above values are at power and are for the reviewed period.

The reactor coolant system water is analyzed for dissolved oxygen and halides three times per week with no interval between analysis to exceed 72 hours. Analysis for dissolved oxygen is not required when the reactor coolant system Tavg is less than or equal to 250 degrees F. Analysis for halides is not required when all fuel is removed from the reactor vessel and the reactor coolant system Tavg is less than 140 degrees F. The reactor coolant system water is analyzed for sulfate ions at least once per 7 days.

2. "During the outage in which the half-nozzle or MNSA repairs are scheduled to be implemented, licensees adopting the TR's 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 Assessment: The contaminant limits, as stated in response to paragraph 1, immediately above, have been maintained at power during the review period of June 2005 to March 2014. No transients that exceed the contaminant concentration limits of paragraph 1 were identified for the reviewed period.

This Relief Request applies to all previous repairs to alloy 600 small bore nozzles and heater sleeves on the hot leg reactor coolant piping and pressurizer that have left a remnant nozzle or heater sleeve in place.

In conclusion, the ASME Boiler & Pressure Vessel Code Section XI requirement, IWB-3132.2, is to correct a component containing a flaw. The proposed alternative is to relocate the pressure boundary weld and not correct the component 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 and pressurizer. Analyses, Reference 1, 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

The proposed alternative is for the fourth 10-year Inservice Inspection interval at PSL-2, which began August 8, 2013 and ends August 7, 2023.

7. Precedent

FPL Relief Request #5, approved by NRC SE Dated May 26, 2006, "St. Lucie Nuclear Plant, Unit 2 - Regarding Request for Relief from the Requirements of the ASME Code (TAC No. MC9502)" (ML061290056).

8. References

1) WCAP-15973-P-A, Rev 0 (NRC approved version of WCAP-15973-P, Revision 1 with enclosed NRC Safety Evaluation) "Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Programs", Westinghouse Electric Company LLC, February 2005 (ML050700431 for NP version)

2) NRC letter dated January 12, 2005, "Subject: Final Safety Evaluation for Topical Report WCAP-15973-P, Rev 01 "Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Program" (TAC No. MB6805)" (ML050180528)

3) NRC letter to Mr. J. A. Stall dated August 11, 2005 "St. Lucie Nuclear Plant, Unit 1 - Request for Additional Information Regarding Relief Request No. 26 - Repair of Alloy 600 Small Bore Nozzles Without Flaw Removal (TAC No. MC6944)" (ML052210368)

4) A-CEOG-9449-1242 Rev. 00 (Task 1131) "Evaluation of the Corrosion Allowance for Reinforcement and Effective Weld to Support Small Alloy 600 Nozzle Repairs"

5) Westinghouse Calculation Note Number CN-CI-02-69, Rev. 0 "Evaluation of Fatigue Crack Growth Associated with Small Diameter Nozzles for St. Lucie 1 & 2" (Non Proprietary Version – ML023380149)

6) St. Lucie Unit 2 Updated Final Safety Analysis Report through Amendment No. 21

TABLE 1
PSL-2 Alloy 600 Small Bore Nozzles Repair Status

Location	Tag ID	Repair Date	Repair Method (Figure 1 Design)	Reason for Repair	Flaw Left
PZR Stm Space Upper Head	A	1994	1/2 Nozzle Repair* (B)	Linear Indications	Yes
PZR Stm Space Upper Head	B	1994	1/2 Nozzle Repair* (B)	Linear Indications	Yes
PZR Stm Space Upper Head	C	1994	1/2 Nozzle Repair* (B)	Leakage / Linear Indications	Yes
PZR Stm Space Upper Head	D	1994	1/2 Nozzle Repair* (B)	Preventative	No
PZR Wtr Space Lower Head	RC-105	1995	Sleeve Repair* (C)	Preventative	No
PZR Wtr Space Lower Head	RC-130	1995	Sleeve Repair* (C)	Preventative	No
PZR Wtr Space Side Shell	TE-1101	1995	Sleeve Repair* (C)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1112HA	1989	Sleeve Repair* (C)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1111X	1989	Sleeve Repair* (C)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1122HC	1989	Sleeve Repair* (C)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1122HD	1989	Sleeve Repair* (C)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1121X	1989	Sleeve Repair* (C)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1112HB	2003	1/2 Nozzle Repair (A)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1112HC	2003	1/2 Nozzle Repair (A)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1112HD	2003	1/2 Nozzle Repair (A)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1122HA	2003	1/2 Nozzle Repair (A)	Preventative	No
RCS Hot Leg RTD Nozzle	TE-1122HB	2003	1/2 Nozzle Repair (A)	Preventative	No

TABLE 1
PSL-2 Alloy 600 Small Bore Nozzles Repair Status

Location	Tag ID	Repair Date	Repair Method (Figure 1 Design)	Reason for Repair	Flaw Left
RCS Hot Leg Flow Nozzle	PDT-1121B	1995	Sleeve Repair (D)	Leakage	Yes
RCS Hot Leg Flow Nozzle	PDT-1111A	1995	Sleeve Repair (D)	Preventative	No
RCS Hot Leg Flow Nozzle	PDT-1111B	1995	Sleeve Repair (D)	Preventative	No
RCS Hot Leg Flow Nozzle	PDT-1111C	1995	Sleeve Repair (D)	Preventative	No
RCS Hot Leg Flow Nozzle	PDT-1111D	1995	Sleeve Repair (D)	Preventative	No
RCS Hot Leg Flow Nozzle	PDT-1121A	1995	Sleeve Repair (D)	Preventative	No
RCS Hot Leg Flow Nozzle	PDT-1121C	1995	Sleeve Repair (D)	Preventative	No
RCS Hot Leg Flow Nozzle	PDT-1121D	1995	Sleeve Repair (D)	Preventative	No
RCS Hot Leg Flow Nozzle	Sample Line	1995	Sleeve Repair (D)	Preventative	No
PZR Heater Sleeves	30	2011	1/2 Nozzle Repair* (B)	Preventative	No

* Nozzle welded to a nickel alloy weld pad.

TABLE 2A
SUMMARY OF LIMITING ALLOWABLE DIAMETER CALCULATIONS FOR HALF-NOZZLE REPAIRS

Nozzle Location	Weld Joint Design (Figure 1)	Nozzle Repair Bore Diameter (inch)	Diameter Corrosion Loss After 49 Years (inch)	Repair Bore Diameter After 49 Years (inch)	Limiting Allowable Diameter (inch)
Hot Leg Piping	A	1.063	0.1313	1.194	1.27
Pressurizer Upper Head	B	1.325	0.1313	1.456	2.26
Pressurizer Heater Sleeve	B	1.693	0.1313	1.824	2.26

TABLE 2B
SUMMARY OF LIMITING ALLOWABLE DIAMETER CALCULATIONS FOR SLEEVE REPAIRS

Nozzle Location	Weld Joint Design (Figure 1)	Nozzle Repair Bore Diameter (inch)	Diameter Corrosion Loss After 54 Years (inch)	Repair Bore Diameter After 54 Years (inch)	Limiting Allowable Diameter (inch)
Hot Leg Piping	C	1.129	0.025	1.154	1.27
	D	1.178	"	1.203	1.27
Pressurizer Side Shell Lower Head	C	1.5	0.025	1.525	1.62
	C	1.325 and	"	1.350	2.26
		1.5	"	1.525	2.26

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	+60	44	23	105
Reactor Vessel Plate	B3416-2	+60	37	20	113
Reactor Vessel Plate	A8490-1	+60	58	28	115
Reactor Vessel Plate	B8307-2	+60	49	22	93
Reactor Vessel Plate	A3131-1	+60	47	22	107
Reactor Vessel Plate	A3131-2	+60	52	23	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	____

* Average of three tests reported in the material certification.

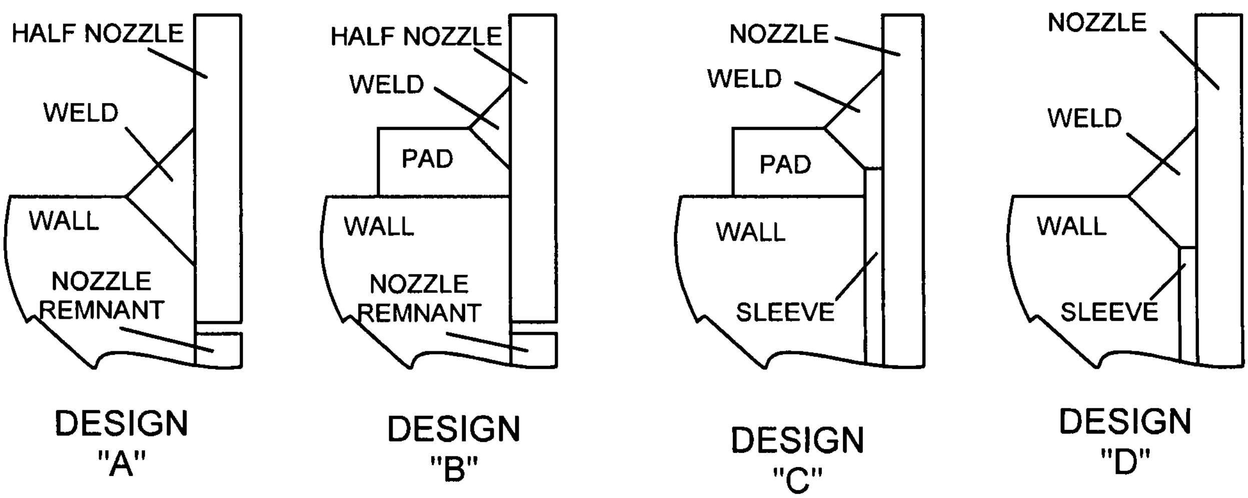

FIGURE 1

REPLACEMENT NOZZLE CONFIGURATIONS