UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 13, 2013

Mr. George Hamrick
Vice President
Shearon Harris Nuclear Power Plant
Progress Energy Carolinas, Inc.
Post Office Box 165, Mail Code: Zone 1
New Hill, NC 27562-0165

SUBJECT: SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1 – RELIEF REQUEST I3R-11 FOR REACTOR VESSEL CLOSURE HEAD PENETRATION NOZZLES REPAIR INSERVICE INSPECTION PROGRAM – THIRD 10-YEAR INTERVAL (TAC NO. MF1876)

Dear Mr. Hamrick:

By letter dated May 22, 2013, to the U.S. Nuclear Regulatory Commission (NRC) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13143A167) as supplemented by letter dated May 29, 2013 (ADAMS Accession No. ML13150A104), Carolina Power and Light (the licensee) submitted Relief Request (RR) I3R-11 for Shearon Harris Nuclear Power Plant, Unit 1. The licensee requested to use of alternatives for certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, related to the repair of degraded reactor vessel closure head (RVCH) penetration nozzle No. 49.

During the May 2012 refueling outage, the licensee detected flaw indications during the inservice inspection (ISI) examination of the RVCH nozzle penetration tubes, and repair of the degraded nozzles was required. RR I3R-11 was requested for the third 10-year ISI interval, which commenced on May 2, 2007, and will end on May 1, 2017.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations,* Section 50.55a(a)(3)(i), the licensee proposed alternatives to the requirements of the ASME Code, Section XI, Article IWA-4000, "Repair/Replacement Activities," on the basis that the alternatives provide an acceptable level of quality and safety.

The NRC staff reviewed the licensee's submittals and determined that the proposed alternatives are technically justified and provide an acceptable level of quality and safety. On May 29, 2012, the NRC staff verbally authorized the use of RR I3R-11. The script for the verbal authorization was issued on May 31, 2013 (ADAMS Accession No. ML13150A071).

The enclosed safety evaluation documents the NRC staff's detailed technical basis for the verbal authorization.

Sincerely,

Farideh E. Saba

for Douglas A. Broaddus, Acting Branch Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-400

Enclosure:
Safety Evaluation

cc w/enclosures: Distribution via ListServ

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST I3R-11: REACTOR VESSEL CLOSURE HEAD PENETRATION NOZZLE REPAIR

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1

DOCKET NUMBER 50-400

1.0 INTRODUCTION

By letter dated May 22, 2013, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13143A167) as supplemented by letter dated May 29, 2013 (ADAMS Accession No. ML13150A104), Carolina Power and Light (the licensee) requested relief from certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, related to the repair of degraded reactor vessel closure head (RVCH) penetration nozzle No. 49 at Shearon Harris Nuclear Power Plant, Unit 1 (Harris). The licensee submitted for U. S. Nuclear Regulatory Commission (NRC) review and approval Relief Request (RR) I3R-11 for the third 10-year Inservice Inspection (ISI) interval, which commenced on May 2, 2007, and will end on May 1, 2017.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i), the licensee proposed alternatives to the requirements of various articles in the ASME Code, Sections III and XI, and ASME Code Cases N-638-1 and N-729-1 on the basis that the alternatives in RR I3R-11 provide an acceptable level of quality and safety.

The NRC staff reviewed the licensee's submittals and determined that the proposed alternatives are technically justified and provide an acceptable level of quality and safety. On May 30, 2013, the NRC staff verbally authorized the use of RR I3R-11. The NRC staff issued the script for the verbal authorization on May 31, 2013 (ADAMS Accession No. ML13150A071). This safety evaluation documents the NRC staff's detailed technical basis for the verbal authorization.

In addition, by letters dated May 3, and May 18, 2012 (ADAMS Accession Nos. ML12131A663 and ML12139A407, respectively), the licensee submitted RR I3R-09 for the similar repair of RVCH nozzle penetration Nos. 5, 17, 38, and 63. By letter dated October 2, 2012 (ADAMS Accession No. ML12270A258), the NRC staff approved RR I3R-09.

2.0 REGULATORY EVALUATION

Section 50.55a(g)(4) of 10 CFR specifies that ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the preservice inspection (PSI) requirements, set forth in the ASME Code, Section XI, "Rules for

Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code, incorporated by reference in 10 CFR 50.55a(b), 12-months prior to the start of the 120-month interval, subject to the conditions listed therein.

Pursuant to 10 CFR 50.55a(g)(6)(ii), the Commission may require the licensee to follow an augmented ISI program for systems and components for which the Commission deems that added assurance of structural reliability is necessary.

Section 50.55a(g)(6)(ii)(D) of 10 CFR, *Reactor vessel head inspections,* requires licensees of pressurized water reactors to augment their ISI of the RVCH with ASME Code Case N-729-1, "Alternative Examination Requirements for PWR [Pressurized-Water Reactor] Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds, Section XI, Division 1," with conditions.

Section 10 CFR 50.55a(a)(3) of 10 CFR states that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used, when authorized by the NRC, if the licensee demonstrates (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the Commission to authorize the alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected

RVCH penetration nozzle 49, for which a relief is requested, is made of Inconel SB-167 with nominal outside diameter of 4 inches.

3.2 Applicable Code Edition and Addenda

The Code of Record for the third 10-year ISI interval at Harris is Section XI of the 2001 Edition through 2003 Addenda of the ASME Code. The 1971 Edition through Winter 1971 Addenda of the ASME Code, Section III, is the Construction Code for the RVCH at Harris.

3.3 Applicable Code Requirement

The ASME Code, Section III, NB-5245, requires incremental surface examination of partial penetration welds.

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWA-4221(b), states that, "An item to be used for repair/replacement activities shall meet the Construction Code specified in accordance with (1), (2), or (3) below."

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWA-4221(c), states that, in part, "As an alternative to (b) above, the item may meet all or portions of the requirements of different Editions and Addenda of the Construction Code, or Section III when the Construction Code was not Section III, provided the requirements of IWA-4222 through IWA-4226, as applicable, are met."

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWA-4400, provides welding, brazing, metal removal, and installation requirements related to repair/replacement activities.

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWA-4411, states that, "Welding, brazing, and installation shall be performed in accordance with the Owner's Requirements and, except as modified below, in accordance with the Construction Code of the item."

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWA-4411(a), states, in part, that "Later editions and addenda of the Construction Code, or a later different Construction Code, either in its entirety or portions thereof, and Code Cases may be used, provided the substitution is as listed in IWA-4221(c)."

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWA-4610(a), states, in part, that "Thermocouples and recording instruments shall be used to monitor the process temperatures."

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWA-4611.1(a), states that, "Defects shall be removed in accordance with IWA-4422.1; a defect is considered removed when it has been reduced to an acceptable size."

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWA-3300, specifies requirements for characterization of flaws detected by inservice examination.

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWB-3420, states that, "Each detected flaw or group of flaws shall be characterized by the rules of IWA-3300 to establish the dimensions of the flaws; these dimensions shall be used in conjunction with the acceptance standards of IWB-3500."

The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, IWB-3132.3, states that, "A component whose volumetric or surface examination detects flaws that exceed the acceptance standards of Table IWB-3410-1 is acceptable for continued service without a repair and/or replacement activity if an analytical evaluation, as described in IWB-3600, meets the acceptance criteria of IWB-3600; the area containing the flaw shall be subsequently reexamined in accordance with IWB-2420(b) and (c)."

ASME Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temperbead Technique, Section XI, Division 1," provides requirements for automatic or machine gas-tungsten arc welding (GTAW) of ASME Code Class 1 components without the use of preheat or postweld heat treatment.

ASME Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds," as conditioned in 10 CFR 50.55a(g)(6)(ii)(D), requires RVCH penetration nozzles be examined.

3.4 Licensee's Reason for Relief

The licensee detected a flaw indication on RVCH nozzle penetration No. 49 during a followup review of results for the spring 2012 examination of the RVCH nozzles. The flaw is in the tube outside diameter surface extending inward toward the tube inside diameter and is approximately parallel with the nozzle axis (axially oriented) at the lower toe side of the J-groove weld. Figure 10 of RR I3R-11 shows the location of the axial indication and Figure 11 shows the relative location of the nozzle on the RVCH. Table 1 of RR I3R-11 provides flaw sizing and characterization.

The licensee stated that it is not feasible to repair the subject nozzle in accordance with the requirements of the original Construction Code because the postweld heat treatment required by the Construction Code may damage the RVCH material properties and dimensions. As an alternative to the requirements of the Construction Code, the licensee proposed to repair nozzle No. 49 using the Inside Diameter Temper Bead (IDTB) welding method to restore the pressure boundary of the degraded nozzle. The IDTB welding method is performed with a remotely operated weld tool, using the machine GTAW process and the ambient temperature temperbead method with 50 degrees Fahrenheit (°F) minimum preheat temperature and no postweld heat treatment.

3.5 Licensee's Request for Relief, Proposed Alternative, and Basis for Use

The licensee proposed to repair and inspect nozzle No. 49 in accordance with requirements of the 2001 Edition through 2003 Addenda of the ASME Code, Section XI, ASME Code Case N-638-1, and ASME Code Case N-729-1 with certain deviations as discussed below.

The licensee requested relief from requirements of the ASME Code, Section XI, IWA-4610(a), and ASME Code Case N-638-1, paragraph 3.0(d), specifically related to use of the thermocouples and recording instruments to monitor welding process temperatures because the direct interpass temperature measurement is impractical to perform during welding operations from inside RVCH nozzle penetration bore. As an alternative, the licensee proposed that the maximum interpass temperature be determined by heat-flow calculations.

The licensee requested relief from requirements of ASME Code Case N-638-1, paragraph 4.0(b), specifically related to the surface and volumetric examinations of the final weld surface and the band around the area defined in paragraph 1.0(d) of the code case. The licensee requested relief because the required area defined in paragraph 1.0(d) of the code case cannot be examined due to the physical configuration of the partial penetration weld. As an alternative, the licensee proposed that the new weld and immediate surrounding area within

the bore identified in Figure 3 of RR I3R-11 receives liquid penetrant testing (PT) and ultrasonic testing (UT) examination.

The licensee requested relief from the incremental surface examination of partial penetration welds of the ASME Code, Section III, NB-5245, of the 2001 Edition through 2003 Addenda because it cannot perform incremental surface examinations due to the welding layer deposition sequence (i.e., each layer is deposited parallel to the penetration centerline). As an alternative, the licensee proposed to volumetrically examine the new weld, with the exception of the taper transition, and to examine the surface of the completed weld by PT.

The licensee requested relief from requirements of ASME Code Case N-638-1, paragraph 4.0(b), specifically related to commencing the 48-hour hold period when the weld reaches ambient temperature. As an alternative, the licensee proposed that the 48-hour hold period will commence upon completion of the third weld layer.

The licensee requested relief to permit anomalies at the triple point area to remain in service. The licensee stated that an artifact of ambient temperature temperbead welding is an anomaly in the weld at the triple point. The triple point is the point in the repair weld where the low alloy steel RVCH base metal, the Alloy 600 nozzle, and the Alloy 52M weld intersect. As an alternative, the licensee performed a flaw evaluation to accept the triple point anomaly.

The licensee requested relief from the flaw characterization requirements of the ASME Code, Section XI, IWB-3420 and the subsequent examination requirement of IWB-3132.3 because it is impractical to characterize and examine the flaw geometry due to nozzle penetration configuration. As an alternative, the licensee evaluated a worst-case flaw in the J-groove weld in accordance with IWB-3132.3.

The licensee stated that ASME Code Case N-729-1, Table 1, Item 4.20, permits either surface or volumetric examination. Figure 9 of RR I3R-11 will be used to establish the area for the preservice and inservice examinations following the nozzle repair.

The licensee analyzed general corrosion of a small portion of low alloy steel in the RVCH nozzle penetration bore that will be exposed to primary coolant as a result of the nozzle repair. The licensee stated that the corrosion of the exposed base metal has negligible impact on the RVCH and is acceptable for 40 years from the time the repair is completed.

The licensee stated that the provisions of this relief are applicable to the third 10-year ISI interval for Harris, which commenced on May 2, 2007 and will end on May 1, 2017. The license further stated that the proposed repairs shall remain in place for the design life of the repair, until another alternative is approved by the NRC, or until the RVCH is replaced.

4.0 STAFF EVALUATION

As discussed above, when repairing nozzle No. 49, the licensee will deviate from certain requirements of the 2001 Edition through 2003 Addenda of the ASME Code, Section XI, ASME Code Case N-638-1, and ASME Code Case N-729-1. For each deviation, the licensee proposed an alternative as discussed above. RR I3R-09 and RR I3R-11 are similar and the NRC staff has approved RR I3R-09. The NRC staff's technical basis to accept the proposed

alternatives in RR I3R-11 will be based on the same technical basis that the NRC staff used to accept RR I3R-09.

The ASME Code, Section III, Subarticle NB-4600, "Heat Treatment," requires preheat and postweld heat treatment when performing welding. ASME Code Case N-638-1 does not require preheat or postweld heat treatment when using the ambient temperature temperbead welding technique. The NRC staff noted that NRC Regulatory Guide 1.147, Revision 16, has approved ASME Code Case N-638-4. However, the NRC has approved the licensee to use ASME Code Case N-638-1 for the third 10-year ISI inspection program in the safety evaluation for RR I3R-09.

The proposed IDTB welding method is the same between the RR I3R-09 and I3R-11. The repair procedure in RR I3R-11 is similar to RR I3R-09 except that RR I3R-09 specified welding a new lower thermal sleeve assembly at applicable nozzle locations whereas RR I3R-11 did not mention welding of a lower thermal sleeve. In the May 29, 2013, letter, the licensee clarified that nozzle No. 49 is an open penetration and a thermal sleeve assembly will not be welded to this nozzle.

The licensee stated that its vendor, AREVA, in support of 128 similar repairs, has qualified the IDTB welding technique in repairing RVCH nozzles using mockups since 2001. During these repair evolutions, the site crew performs training on mockups for each of their respective specialties (i.e., machinists trained on machining mockups, welders trained on welding mockups, and non-destructive examination (NDE) personnel trained on NDE mockups).

The NDE mockup contains a series of electrical-discharge machining notches at the triple point to simulate the triple point anomaly at various depths into the nozzle wall and cracking at the new weld to low alloy steel interface. The mockup also contains flat bottom holes drilled from the mockup outer diameter so that the hole is normal to the surface to simulate fabrication defects such as under bead cracking, lack of bond, and lack of fusion.

The NRC staff finds that the use of the machining, welding, and NDE mockups will aid in assuring quality fabrication and examinations of the repair. ASME Code Case N-638-1, paragraph 3.0(d), requires the maximum interpass temperature for field applications be 350 °F regardless of the interpass temperature during qualification. All other requirements of the ASME Code, Section XI, IWA-4000, must be met when using this code case. The ASME Code, Section XI, IWA-4610(a), requires, in part, the use of thermocouples and recording instruments to monitor welding process temperatures.

By letter dated May 29, 2013, the licensee clarified that heat flow calculations will be used to determine a conservative maximum anticipated interpass temperature to ensure interpass temperature limits are not exceeded. The NRC staff finds that the licensee's heat flow calculations and previous repair experience will provide reasonable assurances that the required interpass temperature limit is not exceed.

ASME Code Case N-638-1, paragraph 4.0(b), requires the final weld surface and the band around the area defined in paragraph 1.0(d) of the code case be examined by surface and ultrasonic methods when the temperature of the completed weld has been at ambient temperature for at least 48 hours. The ASME Code, Section III, NB-4622.11(d)(2), requires

surface examination after the completed repair weld has been at ambient temperature for a minimum of 48 hours. The volumetric examination is required, if practical.

The NRC staff finds that the licensee proposed an alternative allowing the 48-hour hold period commences upon completion of the third temperbead is the same as that of RR I3R-09 with the same technical basis. The NRC staff finds that the proposed alternative for the 48-hour hold time acceptable on the same basis as it was accepted in the NRC's safety evaluation for RR I3R-09, i.e. this approach is permitted by ASME Code Case N-638-4 for austenitic materials and the NRC has conditionally approved the use of this code case in RG 1.147, Rev. 16. In addition, this approach was approved by the NRC for DM weld overlays for Harris Relief Request I3R-1 (ADAMS Accession No. ML072760737).

ASME Code Case N-638-1, Paragraph 4.0(b) requires, in part, that surface and volumetric examinations be performed of the final weld and the band around the area defined in paragraph 1.0(d) of the code case. Paragraph 1.0(d) defines the examination area as the area to be welded and a band around the area of at least 1½ times the component thickness or 5 inches, whichever is less. As an alternative, the licensee proposed to perform surface examination using PT on the band around the area to be welded, which includes the exposed surface area of RVCH base metal as presented on Figure 3 of RR I3R-11.

The proposed UT examination will extend from at least 1-inch above the new weld and into the RVCH low alloy steel base metal beneath the new weld, to at least 1/4-inch depth. The PT examination area includes the new weld surface and extends upward on the nozzle inside surface to include the area required by ASME Code Case N-729-1, Figure 2, and at least 1/2-inch below the new weld. The weld taper transition region will be excluded from UT examination because the UT transducer cannot be positioned to examine the taper transition region. However, the licensee will examine the surface of the taper transition region by PT.

The licensee requested to deviate from the requirement of NB-5245 of the ASME Code, Section III, the 2001 Edition through 2003 Addenda, related to incremental surface examinations of partial penetration welds. The licensee stated that it cannot meet this requirement because the welding layer deposition sequence (i.e., each layer is deposited parallel to the penetration centerline). As an alternative, the licensee proposed to perform surface and UT examinations of the final weld to the extent possible.

The NRC staff finds the licensee's proposed postweld examination acceptable because the UT examination of new weld and heat affected zone will be performed to the maximum extent possible. Incremental surface examinations are used when volumetric examinations are not practical when the weld is completed. The UT examination is a volumetric examination technique that is capable of detecting flaws throughout the entire depth of the weld. All portions of the weld volume will receive at least a single-direction ultrasonic coverage. In addition, the entire exposed weld taper transition area and the new weld will receive a surface examination by PT. The NRC staff finds that the proposed PT and UT examinations will provide reasonable assurance of structural integrity of the new weld and associated nozzle penetration region.

ASME Code Case N-729-1, Table 1, Item 4.20, permits either surface or volumetric examination of all RVCH nozzles and J-groove welds for ISI. Figure 2 of ASME Code Case N-729-1 specifies the required area and volume of the nozzle and J-groove weld that need to be

examined. Figure 9 of RR I3R-11 specifies the examination area or volume for the preservice and inservice inspections following the repair. The proposed examination area or volume is slightly different from the required examination region in ASME Code Case N-729-1 because the licensee proposed not to examine the remnant J-groove weld.

In accordance with ASME Code Case N-729-1, the licensee will perform the surface or volumetric examination of the new weld including weld taper transition extending up to at least the "a" distance above the top edge of the weld taper on the nozzle inside surface, where "a" includes the surface area and volume required by ASME Code Case N-729-1, Figure 2, which defines the distance "a" as equal to 1.5 inches for nozzle incidence angle less than or equal to 30° to the horizontal plane, or 1 inch for incidence angle greater than 30° to the horizontal plane. The incident angle with respect to the RVCH for nozzle 49 is greater than 30 degrees. As such, the licensee will use 1 inch as the "a" distance for examination. The NRC staff finds that the licensee's proposed preservice and inservice examinations acceptable because the extent of examination area and volume specified in Figure 9 of RR I3R-11 satisfies the examinations required by Figure 2 of ASME Code Case N-729-1.

Section 50.55a(g)(6)(ii)(D)(5) of 10 CFR requires that, if flaws attributed to primary water stress corrosion cracking (PWSCC) have been identified, whether acceptable or not for continued service under paragraphs 3130 or 3140 of ASME Code Case N-729-1, the re-inspection interval must be each refueling outage instead of the re-inspection intervals required by Table 1, Note (8) of ASME Code Case N-729-1. Thus, 10 CFR 50.55a(g)(6)(ii)(D)(5) requires all RVCH nozzles, including nozzle No. 49, to be examined every refueling outage. The NRC staff finds that the licensee satisfies the re-inspection frequency requirement of 10 CFR 50.55a(g)(6)(ii)(D)(5).

As stated above, the licensee requested relief to permit anomalies at the triple point area to remain in service. The NRC staff noted that the triple point is a location in the repaired nozzle where the RVCH low alloy steel, the Alloy 600 nozzle, and the Alloy 52 new attachment weld intersect. An anomaly may be formed in the new attachment weld at the triple point location due to the joint configuration. The 2001 Edition through 2003 Addenda of the ASME Code, Section III, NB-5330(b), prohibits the existence of indications that are characterized as cracks, lack of fusion, or incomplete penetration regardless of length. As an alternative to NB-5330(b), the licensee analyzed a postulated crack-like anomaly at the triple point in accordance with the ASME Code, Section XI, IWB-3600, to justify operating with the anomaly left in service. The licensee modeled this anomaly as a 0.10-inch deep circular crack-like defect extending 360° around the circumference of the nozzle tube at the weld triple point location in the most susceptible material. The results of the licensee's analyses demonstrate that the 0.10-inch weld anomaly is acceptable for a 40-year design life of the nozzle repair.

The NRC staff finds that the licensee has adequately demonstrated by analysis in accordance with the ASME Code, Section XI, IWB-3600, that the triple point weld anomaly is acceptable to remain in service for 40 years without affecting structural integrity of the repaired nozzle.

The licensee requested relief from subsequent reexaminations of the remnant J-groove weld in accordance with the ASME Code, Section XI, IWB-3132.3, on the basis that any "as-left" flaws in the J-groove weld cannot be sized with reasonable confidence by the currently available NDE examination techniques. As an alternative, the licensee analyzed a postulated flaw in

accordance with the ASME Code, Section XI, IWB-3132.3. The licensee postulated the worst-case flaw where the entire J-groove weld is cracked and the crack tip has reached the interface between the butter and the RVCH base metal. The flaw is postulated to propagate into the RVCH base metal by fatigue. The licensee's flaw evaluation result shows that the flaw is acceptable for 30 years of operation.

The NRC staff finds the licensee's flaw evaluation acceptable because the licensee followed the requirements of the ASME Code, Section XI, IWB-3132.3 in determining the "as-left" flaw in the RVCH is acceptable for 30 years.

As part of the nozzle repair, the licensee evaluated the potential for fragments of the J-groove weld falling into the reactor and becoming loose parts. The licensee postulated the radial cracks to occur in the J-groove weld due to the dominance of hoop stresses at this weld location. The licensee determined that the possibility of occurrence of transverse cracks that could intersect the radial cracks is remote because there are no forces that would drive a transverse crack, and the radial cracks would relieve the potential transverse crack driving forces. The licensee stated that it is unlikely that a series of transverse cracks could intersect a series of radial cracks resulting in any fragments becoming dislodged from the remnant J-groove weld. The NRC staff finds that the licensee has adequately demonstrated that the fragments from the remnant of the J-groove weld will not likely fall into the reactor to become loose parts.

As a result of the nozzle repair, the area between the new weld and the J-groove weld of the RVCH nozzle penetration bore is exposed to primary coolant. The licensee determined that general corrosion of the exposed RVCH base metal will most likely occur in the wetted surface of the bore area. The licensee estimated the general corrosion rate to be 0.0036-inch per year in the area, and determined that the RVCH will be acceptable for 40 years following the nozzle repair. By letter dated July 3, 2003 (ADAMS Accession No. ML031840237), the NRC staff approved the use of Westinghouse topical report, WCAP-15987-P, Revision 2, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations" (proprietary). The licensee's corrosion rate is comparable to the corrosion rates discussed in the Westinghouse topical report. The NRC staff finds that the general corrosion of the exposed RVCH base metal is acceptable because the licensee's evaluation considered a reasonable corrosion rate of RVCH base metal.

The licensee indicated in Figure 11 of RR I3R-11 that nozzle Nos. 5, 17, 29, 35, 38, 49, 59, and 63 contain indications. The licensee has repaired nozzle Nos. 5, 17, 38, and 63 in accordance with NRC-approved RR I3R-09 in 2012. Nozzle No. 49 will be repaired in accordance with RR I3R-11 in 2013. Although not related to the subject nozzle of RR I3R-11, the NRC staff questioned how the indications in nozzle Nos. 29, 35, and 59 would be dispositioned. In the May 29, 2013, letter, the licensee stated that nozzle Nos. 29, 35, and 59 contain fabrication indications that are not surface connected. The licensee explained that indications that are not surface connected are not susceptible to PWSCC and are not required to be repaired provided that they meet construction code acceptance criteria of surface examinations. The licensee noted that the Performance Demonstration Initiative (PDI) technique qualification demonstrates that the methodology and analysts can discern fabrication-induced indications from service induced indications that are not close to the nozzle wall surface. The licensee stated that in the event that indications are close to the surface such that the PDI volumetric examination is

indeterminate, surface examinations are used to determine whether indications are surface connected, and, therefore susceptible to PWSCC.

The licensee evaluated the indications identified by the PDI examination in nozzle Nos. 29, 35, and 59, and determined that they are not service-induced flaws indicative of PWSCC. The licensee stated that repairs are not required. The licensee further stated that it is committed to implementing the requirements of ASME Code Case N-729-1, including examinations in the next refueling outage, which provides confidence that flaws resulting from PWSCC are identified and repaired to assure public health and safety. The NRC staff determines that nozzle Nos. 29, 35, and 59 are not surface connected and they are not required to be repaired. The requirement to examine all RVCH nozzles includes these three nozzles in accordance with ASME Code Case N-729-1 as conditioned by 10 CFR 50.55a(g)(6)(ii)(D)(5), to monitor their structural integrity. Therefore, the NRC staff finds the licensee manages these three nozzles satisfactorily.

In summary, the NRC staff determines that the licensee's proposed nozzle repair as presented in RR I3R-11 provided acceptable level of quality and safety because:

a) The licensee has performed necessary flaw analyses to demonstrate the adequacy of the triple point anomaly in the new weld and the worst-case "as-left" flaw in the remnant J-groove weld,
b) The nozzle repair is performed in accordance with the ASME Code, Sections III and XI, Code Case N-638-1 with deviations. The licensee has satisfactorily addressed deviations from the requirements of these documents, and
c) The licensee will examine all RVCH nozzles including the repaired nozzle No. 49 every refueling outage in accordance with ASME Code Case N-729-1 as conditioned by 10 CFR 50.55a(g)(6)(ii)(D). The periodic condition monitoring by examinations will provide reasonable assurance of the continued structural integrity of RVCH nozzle No. 49.

5.0 CONCLUSION

As set forth above, the NRC staff has determined that the alternative method proposed by the licensee in RR I3R-11 will provide an acceptable level of quality and safety for the repair of the degraded RVCH penetration nozzle No. 49. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(i) and is in compliance with the requirements of the ASME Code, Section XI, ASME Code Case N-638-1, ASME Code Case N-729-1, as conditioned by 10 CFR 50.55a(g)(6)(ii)(D), from which relief was not requested. Therefore, the NRC staff authorizes the use of RR I3R-11 at Harris for the third 10-year ISI interval, which commenced on May 2, 2007, and will end on May 1, 2017.

All other requirements of the ASME Code, Section XI, and 10 CFR 50.55a(g)(6)(ii)(D) for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: John Tsao

Date: September 13, 2013

The enclosed safety evaluation documents the NRC staff's detailed technical basis for the verbal authorization.

Sincerely,

/RA by FSaba for/

Douglas A. Broaddus, Acting Branch Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-400

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Safety Evaluation

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