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LR-N04-0587

PSEG
Nuclear LLC

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

REQUEST FOR ADDITIONAL INFORMATION REGARDING
RELIEF REQUEST HC-RR-I2-W01
PROPOSED ALTERNATIVE REPAIR METHOD
HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NO. NPF-57
DOCKET NO. 50-354

Reference: LR-N04-0533, RELIEF REQUEST HC-RR-I2-W01, PROPOSED ALTERNATIVE REPAIR METHOD, HOPE CREEK GENERATING STATION, dated December 1, 2004

The referenced letter requested approval of Relief Request HC-RR-I2-W01 that proposed an alternative repair method for reactor recirculation inlet nozzle N2K. This proposed alternative would permit the use of a full structural weld overlay repair for an indication identified in the N2K recirculation inlet nozzle safe-end to nozzle weld joint. On December 14, 2004 the NRC provided a draft request for additional information. Attachment 1 to this letter contains the NRC questions and PSEG's response.

The indication on the N2K recirculation inlet was discovered on November 14, 2004. Prompt notification was made to NRC project manager indicating that a relief request would be required to affect a repair. Documentation and calculations were developed followed by the preparation of two relief requests, one for the repair and one for the post repair UT inspection. Due to the time necessary for preparation and review, the relief requests were submitted on December 1, 2004, requesting approval by December 24, 2004.

If you have any questions, please contact Michael Mosier at (856) 339-5434.

Sincerely,

FOR

Christina L. Perino
Director – Licensing and Nuclear Safety

Attachment

A047

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REQUEST FOR ADDITIONAL INFORMATION
REGARDING RELIEF REQUEST TO
PERFORM NON-ASME CODE REPAIR
HOPE CREEK GENERATING STATION
DOCKET NO. 50-354

By letter dated December 1, 2004, PSEG Nuclear, LLC (PSEG) submitted relief request HC-RR-I2-W01 for the Hope Creek Generating Station (Hope Creek), seeking U.S. Nuclear Regulatory Commission approval of proposed alternative. Specifically, the proposed change would allow an alternative to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code requirements in the repair (full structural weld overlay) of the N2K recirculation inlet nozzle safe-end to nozzle weld joint. The NRC has developed the following draft questions during its review of the application.

NRC Question 1:

In the enclosure of your submittal, you stated that the root cause evaluation has not been completed. Describe the plan and schedule for completion of your root cause evaluation?

PSEG Response to Question 1:

An Apparent Cause Evaluation (ACE) was completed on 12/14/04 in accordance with PSEG Nuclear's Corrective Action Program. The N2K weld flaw is attributed to stress corrosion cracking. A cause and effect analysis, review of operating experience (OE), and summary of the well documented BWR industry history relative to BWR pipe cracking was used to determine this apparent cause.

NRC Question 2:

When was hydrogen water chemistry and NobleChem implemented at Hope Creek? In view of the detected flaw at the subject weld (N2K), discuss its effectiveness in mitigating intergranular stress corrosion cracking (IGSCC) initiation and propagation.

PSEG Response to Question 2:

Noble Chemical Addition has not been implemented at Hope Creek, however, it is being considered for implementation in the near future. Hydrogen Water Chemistry (HWC) has been implemented since 1991 at about 21 scfm. Hydrogen injection levels were increased in 1999 to about 35 scfm in order to mitigate IGSCC initiation and propagation with the belief that full mitigation was achieved for recirculation piping. However, ongoing evaluations of Hope Creek operating data and industry experience

suggest that the current hydrogen injection levels at Hope Creek may not be high enough to fully mitigate IGSCC in recirculation piping.

NRC Question 3:

Provide ultrasonic testing (UT) inspection history of weld N2K. Was IGSCC detected in any other dissimilar metal welds at Hope Creek?

PSEG Response to Question 3:

The N2K nozzle to safe-end weld was examined using automated UT techniques in Refueling Outages 2, 4, 6, 8, 9, and 12. The results of these exams are summarized in Table 1. The UT data was reviewed by the Electric Power Research Institute (EPRI) Non Destructive Examination (NDE) Center. The axial flaw detected during RFO 12 was not seen in the previous UT results.

Table 1 – N2K Nozzle-Safe-End Weld Ultrasonic Examination History

Examination Date	Type of Examination (Automated/Manual)	Results
1985 Note 1	Automated SWRI (Amdata Introspect)	Acoustic Interface
1989 (RFO 2)	Automated (Axial Scans) SWRI (Amdata I/PC-2)	Interface and Counterbore
1989 (RFO 2)	Manual (Circ Scans) SWRI (Amdata I/PC-2)	No Recordable Indications
1992 (RFO 4)	Automated (GE Smart 2000)	Acoustic Interface, Root Geometry, and Non-Relevant Indications
1995 Note 2 (RFO 6)	Automated (GE Smart 2000)	Acoustic Interface and Non-Relevant Indications
1999 Note 3 (RFO 8)	Automated (Framatome Accusonex)	Acoustic Interface, Non-Relevant Indications, and two Fabrication Type Indications Outside Inner 1/3T Note 4
2000 (RFO 9)	Automated (Framatome Accusonex)	Acoustic Interface, Non-Relevant Indications, and three Fabrication Type Indications Outside Inner 1/3T Note 4
2004 Note 5 (RFO 12)	Automated (by Framatome) RD Tech's Tomoscan System	Acoustic Interface, Clad Roll, Non-Relevant Indications, Non-geometric (Axial Flaw)

Note 1. Preservice ultrasonic examination.
Note 2. Pre-Mechanical Stress Improvement Process (MSIP) ultrasonic examination.
Note 3. Post-MSIP ultrasonic examination.
Note 4. Indications evaluated as weld noise/interface in 2004 with PDI qualified procedure. Also, in different circumferential location as 2004 axial.

Note 5. RFO 12 examination using PDI qualified procedures.

A through wall flaw was detected in 1997 in the N5B core spray nozzle to safe-end dissimilar metal weld. This flaw was attributed to IGSCC.

NRC Question 4:

You stated that the N2K weld was examined, in part, in accordance with Risk Informed classification RA. Describe the Risk Informed classification RA and the inspection frequency associated with this weld classification.

PSEG Response to Question 4:

The alternative risk-informed inservice inspection (RI-ISI) program for piping was described in PSEG Nuclear's Relief Request (LR-N04-0036) titled, "Request For Authorization To Use A Risk-Informed Inservice Inspection Alternative To The ASME Boiler And Pressure Vessel Code Section XI Requirements For Class 1 And 2 Piping At Hope Creek Generating Station". The relief request was prepared in accordance with EPRI Report TR-112657, "Revised Risk-Informed Inservice Inspection Evaluation Procedure", that provides the requirements for defining the relationship between the RI-ISI Program and the remaining unaffected portions of ASME Section XI. The NRC granted this relief on December 8, 2004 (TAC NO. MC2221).

The EPRI TR-112657 describes the RI-ISI process for identification and selection of RI-ISI components. ASME Code Case N-578 was the mechanism used to assign the ASME XI RI-ISI category (R-A) and item number to remain consistent with ASME XI ISI Program practices and assist calculating Inspection Program B percentage requirements for ASME XI tables IWB-2412-1 and IWC-2412-1.

The N2K weld RI-ISI classification is:

Exam Category: R-A
Item No. R1.14-2

Failure Mechanism	Risk Ranking	Failure Potential	Consequence	Risk Category
CC IGSCC	High/High	Medium	High	2

Hope Creek Generating Station incorporated the guidance contained in BWR Vessel and Internals Project (BWRVIP) Report No. BWRVIP-75. BWRVIP-75 provides alternative criteria to NRC Generic Letter 88-01 for the examination of welds susceptible to intergranular stress corrosion cracking (IGSCC). Both Generic Letter 88-01 and BWRVIP-75 specify examination extent and frequency requirements for austenitic stainless steel welds that are classified as Categories "A" through "G", dependent upon their susceptibility to IGSCC. In accordance with EPRI TR-112657, piping welds

identified as Category "A" were considered resistant to IGSCC and are assigned a low failure potential provided no other damage mechanisms are present. As such, the examination of welds identified as Category "A" inspection locations is subsumed by the RI-ISI Program. The existing plant augmented inspection program for the other piping welds such as the N2K nozzle to safe-end weld susceptible to IGSCC at the Hope Creek Generating Station (Categories "C" and "E") remained unaffected by the RI-ISI Program submittal.

The inspection frequency for the N2K weld is once every 10 years.

NRC Question 5:

You stated in page 3 of your submittal and page 4 of its attachment that an Alloy 152 electrode may also be utilized for local repairs to the underlying weld metal. Please confirm that ASME Code Case N638 will not be applied to the repair welding using Alloy 152 since the subject Code Case is limited to the welding using gas tungsten arc welding (GTAW) temper bead technique.

PSEG Response to Question 5:

Any localized repair using manual shielded metal arc welding (SMAW) temper bead welding would have been done with preheat in accordance with the rules of ASME Section XI. This was planned as a contingency in the unlikely case of a through wall defect. SMAW would have only been used to seal any defect if it were greater than 0.125 inch from the P-3 nozzle material before beginning the structural weld overlay using GTAW. This contingency as well as the aforementioned limitations was noted on the AREVA job traveler. This contingency was not needed.

NRC Question 6:

Clarify the acceptance criteria in ASME Section XI Nonmandatory Appendix P that you propose to use for UT examination of weld overlay. It should be noted that Appendix P has not been incorporated in ASME Code nor endorsed by NRC.

PSEG Response to Question 6:

The acceptance criteria in paragraph P-4100(c) of proposed ASME Code Section XI; Appendix P will be used for UT inspection of the weld overlay. Any laminar flaws in the weld overlay will be evaluated in accordance with P-4100(c). As allowed by IWB-3132.3, any flaws that exceed the acceptance standards of Table IWB-3514 (per Table

IWB-3410-1) will be evaluated per IWB-3600 to determine if they are acceptable for continued operation without additional repairs having to be made to the completed structural overlay.

NRC Question 7:

For the relief from system hydrostatic test, you referenced Code Case N416-1. Please confirm that you will not take any exception to the subject Code Case such as in item (b) which states that NDE is required to be performed in accordance with that of the applicable Subsection of the 1992 Edition of Section III.

PSEG Response to Question 7:

Code Case N-416 is noted within the relief request only as a reference for clarification purposes and to denote that the provisions of this Code Case had been incorporated into the 1998 Edition with 2000 Addenda of ASME Section XI, specifically IWA-4540. Included in IWA-4540 are all of the limitations of the original Code Case, including which editions of ASME Section III shall be used for the selection of NDE methodology and acceptance criteria, prior to the conduct of a system leakage test. The Hope Creek ISI program is based upon the 2000 Addenda of ASME XI and the planned repair for the N2K nozzle also is based upon the 2000 Addenda. Consequently, the provisions of the Code Case and its attendant limitations are already contained within IWA-4540, which is planned to be used for the post overlay pressure-testing requirements.

NRC Question 8:

In support of the exception to Code Case N-638 Paragraph 1.0(a) regarding the maximum allowable weld area, you referenced the conclusion of an EPRI Technical Report 1008454. Please provide a summary description of how the conclusion was reached including any testing data or analytical evaluation being performed.

PSEG Response to Question 8:

The draft Code Case prepared by EPRI is found in the referenced EPRI Technical Report 1008454. The technical basis that justifies exceeding of the 100 square inches surface area for repair welds is found in EPRI Technical Report, 1003616, Additional Evaluations to Expand Repair Limits for Pressure Vessels and Nozzles. The conclusion described in the RAI and this technical report was reached by using an ANSYS Finite Element Analysis (FEA) conducted on the Nine Mile Point 2 feedwater nozzle weld overlay repair. The analysis consisted of modeling the welding processes for both thermal and mechanical respects. Two overlays were modeled, one was 100 square inches, the other was extended to blend into the nozzle radius to achieve greater than the 100 square inches surface area repair currently permitted by ASME Code requirements. Comparison of the residual stresses of the two overlays showed that the affect of extending the overlay to the nozzle radius minimally impacted the residual stress profile and in some cases slightly increased the beneficial compressive stresses on the nozzle inner diameter.

NRC Question 9:

To support the exception to Code Case N-638 Paragraph 2.0(i), which requires that the average lateral expansion of the three heat affected zone (HAZ) impact, tests shall be equal to or greater than the average of the three unaffected base metal tests, please provide the following additional information:

a. What is the RT_{NDT} value for the N2K nozzle base material?

b. Provide justification for your assumption that the nozzle bass material initial RT_{NDT} value is consistent with the initial RT_{NDT} value of the low alloy steel material used in the core region pressure boundary. Is there test data to support the assumption?

c. Provide reasons for why the referenced requirement in Paragraph 2.0(i) can not be met. Please identify any precedents of this exception that NRC has approved.

PSEG Response to Question 9:

The N2K nozzle is not within the reactor vessel beltline region, where neutron fluence can affect the material toughness properties. Accordingly, there is no RT_{NDT} value specifically assigned to the N2K nozzle base material.

The Hope Creek reactor pressure vessel (RPV) and nozzles were constructed from low alloy, high strength steel plate and forgings respectively using the same Code and manufacturing requirements. The N2K nozzle was manufactured from an SA-508, Class 2 forging. The material test reports indicate that it was manufactured using a fine grain practice and supplied in the quenched and tempered condition. Fracture toughness properties were measured and controlled in accordance with ASME Section III, through the performance of drop weight tests at +40°F and test energy of 300 ft-lbs in accordance with ASTM E-208.

The provisions for an adjustment temperature for procedure qualification records (PQR) HAZ toughness testing were incorporated into ASME Section III as far back as the Winter 1974 Addenda, specifically NB-4335. These provisions take into account the fact that newer materials generally available for PQR testing are superior in toughness due to the improved steel making practices compared to those available for materials used in the US reactor fleet construction. These new materials exceed the minimum design requirements for toughness with superior margin and in fact they are so superior that the industry has had difficulty matching the HAZ toughness because the base materials have been so optimized. As such, even though the HAZ mils lateral expansion results did not meet the unaffected base material properties in the applicable AREVA PQR, the

HAZ toughness is comparable to or likely better than the actual in situ material of the N2K nozzle at a given minimum service temperature. Various reactor vessel closure

heads (RVCH) control rod drive mechanism (CRDM) nozzle repairs conducted in the industry by AREVA using welding procedures qualified by PQRs with adjustment temperature provisions have been approved by the NRC. Five sites that used this supporting PQR for nozzle repairs are Palisades, Point Beach, ANO, Millstone, and St. Lucie.

NRC Question 10:

In page 8 of the Attachment under IWA-461 0(a), you stated that AREVA Framatome ANP welding procedure qualification have been successfully performed using Alloy 52 Alloy welds on P-No. 3 Group No. 3 base material using the ambient temperature temper bead technique. However, in your submittal you are seeking exception to Code Case N-638 Paragraph 2.0(i) because the results of welding procedure qualification failed to meet the requirement specified in the subject paragraph. Please clarify this apparent discrepancy.

PSEG Response to Question 10:

See response to Question 9.

NRC Question 11:

Provide technical justification to support the acceptance of not performing UT of the band area as required in Code Case N-638 Paragraph 4.0(b).

PSEG Response to Question 11:

The weld overlay will extend into the blend radius of the nozzle beyond the length required by Code Case N-504-2 for structural reinforcement. This extension into the blend radius is for the purpose of eliminating a stress raiser on the nozzle and providing additional outside diameter (OD) surface area for UT examination of the defect in the nozzle to safe end weld or weld HAZ. UT examination on the nozzle beyond the overlay will not provide any information regarding the defect that required the repair and consequently will not be useful. Alternatively, surface examination will assure that no defects have been created at the toe of the weld overlay. As noted in response to question 8, there are beneficial residual compressive stresses that result to the nozzle inside diameter (ID) that have been demonstrated by EPRI when an overlay is extended on the nozzle radius OD surfaces. Performing a surface exam on the OD surface assures that any flaws that could be generated by welding the overlay have been detected, and the resulting ID surface of the nozzle where no welding has occurred is preferentially placed into a compressive residual stress profile. Consequently the conduct of a full volume examination of the heat band area required by Code Case N-638 paragraph 4.0(b) is not warranted for this specific configuration. Code Case N-638 was not intended specifically for this application and the performance of an OD surface

examination in lieu of volumetric examination provides the needed assurance to detect welding defects that can credibly be generated by the overlay geometry due to welding.

NRC Question 12:

Describe how the contact pyrometer will be calibrated in the temperature range that it will be used. If it has already been calibrated and its accuracy demonstrated, describe the results.

PSEG Response to Question 12:

The AREVA calibration serial number for the pyrometer used for this repair is an Omega Digital Thermometer, VH-9103. This pyrometer was calibrated with an Omega Temperature Calibrator, VH-3911, which was calibrated by SIMCO electronics. The certificate from SIMCO shows National Institute of Standards & Technology (NIST) traceability.

NRC Question 13:

You requested the approval of the proposed alternative for the remainder of the plant life. The current staff position is that the staff will approve such alternative no longer than the remainder of the current ISI 10-year interval because the need for the proposed alternative may change with the improvement of the technology and the change of the regulation including ASME Code. Please provide a justification of why the requested duration is appropriate or revise the requested duration to the end of the next 10-year interval.

PSEG Response to Question 13:

The request for approval of the proposed alternative repair for the remainder of the plant life only applies to the weld overlay repair to nozzle to safe-end weld, RPV1-N2KSE. The structural weld overlay is intended to remain in-situ on the N2K nozzle for the remainder of plant life. Request for approval for use of a structural weld overlay for repair to any other component would be submitted to the NRC under a separate relief request.