



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**  
REGION II  
245 PEACHTREE CENTER AVENUE NE, SUITE 1200  
ATLANTA, GEORGIA 30303-1257

July 10, 2013

Mr. Ernest J. Kapopoulos, Jr.  
Vice President  
Shearon Harris Nuclear Power Plant  
Carolina Power and Light Company  
P.O. Box 165, Mail Code: Zone 1  
New Hill, NC 27562-0165

**SUBJECT: SHEARON HARRIS NUCLEAR PLANT – NRC SPECIAL INSPECTION  
REPORT 05000400/2013010**

Dear Mr. Kapopoulos:

On June 11, 2013, the U. S. Nuclear Regulatory Commission (NRC) completed a Special Inspection pursuant to Inspection Procedure 93812, "Special Inspection," at your Shearon Harris Unit 1. The enclosed inspection report documents the inspection results, which were discussed on June 11, 2013, by teleconference with you and other members of your staff.

On May 13, 2013, during a secondary review of ultrasonic testing data of the reactor vessel head penetrations performed during the Shearon Harris Nuclear Plant spring 2012 refueling outage, it was determined that the results for one of the penetrations (Nozzle 49) appeared to not meet the applicable acceptance criteria. Further evaluation completed on May 15, 2013, characterized the indication as a 0.26 inch flaw on Nozzle 49 that overlapped the J-groove weld and exhibited characteristics of Primary Water Stress Corrosion Cracking (PWSCC). The review of the data indicated that the flaw was not through-wall. It was also determined that, based on inspections performed on the top of the reactor vessel head during the spring 2012 refueling outage, there was no evidence of leakage from the previous operating cycle. Based on the identification of flaw in Nozzle 49, the plant was shut down on May 15, 2013 to make the necessary repairs.

These events were evaluated by the NRC in accordance with Management Directive (MD) 8.3, "NRC Incident Investigation Program", and accordingly, the Special Inspection was initiated. The Special Inspection team was chartered to determine the facts surrounding the degraded condition of the Shearon Harris reactor vessel head, evaluate the licensee's response to this condition and to assess the licensee's corrective actions. The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspectors reviewed selected procedures and records, conducted field walkdowns, performed visual inspections, and interviewed personnel.

On the basis of the results of this inspection, the NRC has determined that one Severity Level IV violation of NRC requirements occurred. Because this issue was of very low safety significance, was not repetitive or willful, and because it was entered into your corrective action program, the NRC is treating this as a non-cited violation consistent with Section 2.3.2 of the NRC Enforcement Policy. If you wish to contest this non-cited violation, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN.: Document Control Desk, Washington DC 20555-001; with copies to the Regional Administrator Region II; the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Senior Resident Inspector at the Shearon Harris Nuclear Plant, Unit 1.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

*/RA/*

Terrence Reis, Director  
Division of Reactor Safety

Docket No: 50-400  
License No: NPF-63

Enclosure:  
Inspection Report 05000400/2013010  
w/Attachments: 1. Supplementary Information  
2. Event Timeline

cc: (See page 3)

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**(\*) – SEE PREVIOUS PAGE FOR CONCURRENCES**

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Letter to Ernest J. Kapopoulos, Jr. from Terrence Reis dated July 10, 2013.

SUBJECT: SHEARON HARRIS NUCLEAR PLANT – NRC SPECIAL INSPECTION  
REPORT 05000400/2013010

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**U.S. NUCLEAR REGULATORY COMMISSION**

**REGION II**

Docket No: 50-400

License No: NPF-63

Report No: 05000400/2013010

Licensee: Duke Energy

Facility: Shearon Harris Nuclear Plant, Unit 1

Location: 5421 Shearon Harris Road  
New Hill, NC 27562-9998

Dates: May 22 - June 11, 2013

Inspectors: R. Williams, Reactor Inspector  
B. Collins, Reactor Inspector

Approved by: Steven J. Vias, Branch Chief  
Engineering Branch 3  
Division of Reactor Safety

Enclosure

## SUMMARY

IR 05000400/2013010; 5/22/2013 – 6/11/2013; Shearon Harris Nuclear Power Plant, Unit 1; Special Inspection

This report covered a Special Inspection conducted by two Reactor Inspectors from the Region II office using Inspection Procedure 93812 "Special Inspection" to assess the circumstances surrounding the degraded condition of the Shearon Harris Unit 1 reactor pressure vessel head. One Severity Level IV non-cited violation (NCV) was identified. The significance of inspection findings is indicated by their color (Green, White, Yellow, or Red) using the NRC Inspection Manual Chapter (IMC) 0609, "Significance Determination Process," dated June 2, 2011. Cross-cutting aspects are determined using IMC 0310, "Components Within the Cross-Cutting Areas," dated October 28, 2011. All violations of NRC requirements are dispositioned in accordance with the NRC's Enforcement Policy, dated January 28, 2013. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," (ROP) Revision 4, dated December 2006.

### NRC-Identified & Self-Revealing Findings

Cornerstone: Barrier Integrity

- SL IV. The inspectors identified a non-cited violation of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.73(a)(2)(ii)(A) for the licensee's failure to submit a 60-day Licensee Event Report (LER) for a condition in which one of the plant's principal safety barriers was seriously degraded. The licensee generated Action Request 00606893 to document the failure to provide the required 60-day LER.

The inspectors determined that the failure to report a seriously degraded principal safety barrier as required by 10 CFR 50.73(a)(2)(ii)(A) was a performance deficiency. Using the guidance of Inspection Manual Chapter 0612, Appendix B, "Issue Screening," the team determined the performance deficiency involved a violation that could have impacted the regulatory process, therefore, it was dispositioned using the traditional enforcement process. In accordance with Section 6.9.d.9 of the NRC Enforcement Policy, a failure to make a report required by 10 CFR 50.73 is a Severity Level IV violation. Cross-cutting aspects are not assigned to traditional enforcement violations.

### Licensee-Identified Violations

Violations of very low safety or security significance or Severity Level IV that were identified by the licensee have been reviewed by the NRC. Corrective actions taken or planned by the licensee have been entered into the licensee's corrective action program. These violations and corrective action tracking numbers are listed in Section 4OA7 of this report.



## REPORT DETAILS

### 1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems and Barrier Integrity

#### 1.0 Special Inspection Scope

##### 1.1 Event Description:

On May 13, 2013, in preparation for the upcoming fall 2013 refueling outage, Shearon Harris Nuclear Plant commissioned the Electric Power Research Institute (EPRI) to perform a secondary review of ultrasonic testing (UT) data of the reactor pressure vessel head (RPVH) penetrations performed during their spring 2012 refueling outage. This review determined that the results for one of the penetrations (Nozzle 49) did not appear to meet the applicable acceptance criteria. Further evaluation completed on May 15, 2013, characterized the indication as a 0.26" flaw on Nozzle 49 that overlapped the J-groove weld and exhibited characteristics of Primary Water Stress Corrosion Cracking (PWSCC). The review of the data indicated that the flaw was not through-wall. It was also determined that, based on inspections performed on the top of the reactor vessel head during the spring 2012 refueling outage, there was no evidence of leakage from the previous operating cycle. Based on the identification of the flaw in Nozzle 49, the plant was shut down on May 15, 2013 to make the necessary repairs.

##### 1.2 Inspection Scope

A charter was issued to direct the scope of this special inspection. The inspectors reviewed calculations, design documents, licensing documents, work orders, modification packages, and corrective action documents as appropriate for each of the following charter items. The inspectors interviewed licensee personnel regarding the event. The inspector assessed the licensee's implementation of their corrective action program, design control process, and procedure implementation. The inspectors conducted these activities in accordance with NRC Inspection Procedure 93812, "Special Inspection." Documents reviewed are listed in Attachment 1 of this report.

#### 2.0 Charter Items

##### 2.1 Develop a timeline associated with the non-destructive examinations (NDE), subsequent review and evaluation of the data, and other licensee activities in response to the condition.

###### a. Discussion

The inspectors reviewed operating, maintenance and engineering logs, procedures and interviewed personnel to determine what actions the licensee took following the discovery of the missed indication in Nozzle 49 by EPRI, and to develop a timeline of events.

The inspectors observed various NDEs associated with characterizing the indication, the repair process itself and the post-repair NDEs.

The inspectors determined that the licensee responded in an effective manner in restoring the Reactor Pressure Vessel Head (RPVH) to an operable status. Once the missed indication on RPVH Nozzle 49 was identified, the licensee acted quickly and within their approved process. The licensee worked with vendors and the NRC to adequately understand the extent of the indication. Once this was understood, the licensee took appropriate actions to safely shut down the plant and begin the repair process. The licensee utilized the proper procedures, drawings, and examinations in characterizing the flaw and performing the repair.

The inspectors did not identify any emergency action levels that should have been declared, and determined that that licensee properly reported the missed indication in accordance with 10 CFR 50.72. An event timeline is included in Attachment 2.

b. Findings

Introduction: The inspectors identified a non-cited violation of 10 CFR 50.73(a)(2)(ii)(A) for the licensee's failure to submit a 60-day Licensee Event Report (LER) for a condition in which one of the plant's principal safety barriers was seriously degraded.

Description: On April 27, 2012 the licensee identified axially-oriented flaws in four reactor vessel head penetration nozzles that exhibited characteristics of PWSCC. The flaws were described as outside diameter surface connected and located either near the toe of the J-groove weld or extending upward past the toe of the weld. The licensee's initial reportability evaluation concluded that the event was not reportable because the flaws did not exceed the 75% through-wall acceptance criterion of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section XI, Table IWB-3663-1. The licensee subsequently made a voluntary notification in accordance with 10 CFR 50.72 to the NRC. The inspectors determined that the licensee failed to recognize that they had exceeded a separate acceptance criterion of ASME Section XI, Table IWB-3663-1 which states that "linear surface flaws of any size in the partial penetration nozzle to vessel (J-groove) welds are not acceptable." Exceeding this acceptance criterion placed the above nozzles in a degraded condition.

The inspectors reviewed the event reporting guidelines contained in NUREG-1022, "Event Reporting Guidelines 10 CFR 50.72 and 50.73," Revision 2. Section 3.2.4 stated, in part, that an LER is required for a seriously degraded principal safety barrier. Section 3.2.4(A)(2) of the NUREG also provided an example of a reportable event or condition as welding or material defects in the primary coolant system that cannot be found acceptable under ASME Section XI, IWB-3600, "Analytical Evaluation of Flaws," which mirrored this event. Consequently, the inspectors determined that while the licensee did submit a notification to the NRC in accordance with 10 CFR 50.72, they failed to submit an LER within 60 days as required by 10 CFR 50.73. The licensee entered this issue into their corrective action program as Action Request 00606893.

Analysis: The inspectors determined that the failure to submit a 60-day LER for a seriously degraded principal safety barrier as required by 10 CFR 50.73(a)(2)(ii)(A) was a performance deficiency. Using the guidance of IMC 0612, Appendix B, "Issue Screening," the performance deficiency involved a violation that could have impacted the

regulatory process, therefore, it was dispositioned using the traditional enforcement process. In accordance with Section 6.9.d.9 of the NRC Enforcement Policy, a failure to make a report required by 10 CFR 50.73 is a Severity Level IV violation. Cross-cutting aspects are not assigned to traditional enforcement violations.

Enforcement: Title 10 of the *Code of Federal Regulations* Part 50.73(a)(1) states, in part, that licensees shall submit a Licensee Event Report (LER) for any event of the type described in this paragraph within 60 days after the discovery of the event. Title 10 of the *Code of Federal Regulations* Part 50.73(a)(2)(ii)(A) requires, in part, that licensees report to the NRC via an LER the condition of the nuclear power plant, including its principal safety barriers, being seriously degraded. Contrary to the above, the licensee failed to submit an LER within 60 days of discovering the four degraded nozzles of the RPVH on April 27, 2012. The violation is being treated as an NCV, consistent with Section 2.3.2 of the Enforcement Policy because it was Severity Level IV and was entered into the licensee's corrective action program as AR 00606893 to address recurrence. (NCV 05000400/2013010-01, Failure to Report a Degraded Primary Safety Barrier per 10 CFR 50.73(a)(2)(ii)(A)).

- 2.2 Assess the ability of the reactor pressure vessel to meet its design basis functions in the as-found condition and the licensee's compliance with regulatory requirements following identification of the flaw.

a. Discussion

The inspectors evaluated the technical adequacy of the licensee's bases for the RPVH operability. The inspectors reviewed the Updated Final Safety Analysis Report, design bases documents, and consulted with regional and headquarters staff to identify the design and licensing bases requirements of the RPVH. The inspectors performed a detailed review of NDEs performed on all RPVH nozzles, including Nozzle 49, to verify the adequacy of the licensee's operability determination. The inspectors reviewed operator logs, the RPVH's prompt operability determination, and interviewed NDE personnel that analyzed the examination data to assess the licensee's compliance with regulatory requirements. The inspectors also observed a bare metal visual examination of RPVH Nozzle 49 to assess the visible material condition of nozzle and its surrounding area.

The inspectors determined that the licensee adequately assessed the RPVH's capability to perform its design basis functions. The licensee performed an as-found UT on RPVH Nozzle 49, conducted by AREVA NDE personnel, on 05/23/13 using a time-of-flight detection ultrasonic procedure that was qualified via the EPRI Performance Demonstration Initiative. The missed indication was detected and confirmed to be in the same position as reported in the previous EPRI review of the 2012 data and exhibited nearly identical echo-dynamic responses when compared to the 2012 data. The as-found indication was sized to be 0.314" in length and through-wall to a depth of 0.154" or 24.6% through-wall. A comparison of the 2012 and 2013 data showed that the as-found indication's through-wall depth was measured to within 5% of the data from 2012. Additionally, the as-found indication was found to be approximately 33% longer than that from the 2012 data. The licensee attributed the changes in flaw size to more detailed techniques used during the 2013 examination including multiple scans at enhanced acquisition speeds and indexing intervals that exceeded the procedure qualification requirements. The licensee also determined that the results of the as-found data were

in-line with the projected growth estimates for the approximate 12 months of operation that the missed indication laid undiscovered.

The licensee also performed a leak path assessment and bare metal visual examination of the as-found condition prior to performing any repairs on Nozzle 49. The leak path assessment was found to be comparable to the 2012 refueling outage data, with no reported leak path signature in either the interference fit region adjacent to the as-found indication or in any other location surrounding RPVH Nozzle 49. The bare metal visual examination was performed on the penetration tube, interference fit annulus between the penetration tube and vessel head and the adjacent RPVH material. The examination showed no evidence of active or inactive primary coolant leakage from the penetration annulus or adjacent RPVH surfaces.

The NDEs performed on the as-found condition of the RPVH provided reasonable assurance that sufficient margin existed in the reactor vessel design such that the RPVH would have continued to meet its design basis requirements. Additionally, from reviewing operations logs, operability determinations and operator interviews, the inspectors determined the licensee made an adequate and timely entry of the appropriate Technical Specification Action Statement.

b. Findings

No findings were identified.

2.3 For previous non-destructive examinations of the upper head penetration nozzles, assess the examination technique(s), data evaluation methods, examination results, the training provided to NDE personnel, and quality control measures associated with these activities.

a. Discussion

The inspectors reviewed the examination procedures used during the 2012 RPVH examination, the qualification records of those procedures and the examination results from the 2012 RPVH examination. The inspectors interviewed NDE personnel to assess the adequacy of the examination practices and the required knowledge level of examiners. Additionally, the inspectors reviewed the examiner qualification process, the qualification records of the examiners that performed the 2012 RPVH examinations, operating experience, generic communications, and ASME inservice inspection requirements to determine whether the examiners were adequately qualified to implement the exams performed in 2012. The inspectors also reviewed transcripts of interviews with the 2012 RPVH examiners and the site procedures for vendor oversight to determine whether an adequate level of quality control was provided for these activities.

The RPVH nozzles were examined in 2012 using a contact time-of-flight-diffraction technique that used a dual blade probe on the penetrations' inside diameter surfaces. Each probe carried two sets of time-of-flight-diffraction probes with one set oriented axially and one set oriented circumferentially. The inspectors determined that the examination techniques used during the 2012 RPVH exams were adequate to meet the requirements of 10 CFR 50.55a and ASME Code Case N-729-1. The inspectors reviewed the samples of the 2012 examination data and determined that the data quality

met the procedural requirements for essential variables, examination sensitivity and data density. Additionally, the inspectors interviewed several qualified Level III examiners (including four examiners from the vendor, two from the licensee and one from EPRI) who all confirmed that the missed indication was visible within the 2012 examination data and that the expectation would be that an examiner qualified to this procedure would have identified this indication.

The inspectors reviewed the level of oversight of the examination data present during 2012 exams and found that 100% of the inspection data was reviewed by at least two examiners specifically qualified to the procedure used. While this requirement was not directly implemented or delineated via a procedure or contract, it was the standard business practice that the vendor employed. Additionally, it was noted that the licensee performed a 100% data review on the datasheets for completeness and accuracy. The licensee also reviewed the electronic examination data for coverage completeness without accepting or rejecting signal characteristics.

The inspectors reviewed the qualification process for qualifying examiners and found that it met the regulatory and ASME Code requirements. Additionally, the inspectors found that the two examiners who performed the 2012 examinations were both fully qualified at the time of the 2012 examinations. The inspectors reviewed the results of the licensee's root cause investigation and noted that it found that either time pressure or inadequate licensee oversight were the likely causes as to why this indication was missed during the 2012 examinations.

The inspectors noted that while the licensee's root cause analysis report identified several corrective actions to address this event, they were all limited in scope to only address actions that were within the capabilities of the licensee to implement. The details of the licensee's corrective actions taken are listed in Section 2.5 of this report. The regulatory aspects associated with this missed indication are dispositioned in Section 4OA7 of this report.

b. Findings

No findings were identified.

2.4 Assess licensee actions to confirm that the indication did not extend through-wall, including actions to confirm that no operational reactor coolant system leakage occurred in the last operating cycle.

a. Discussion

The inspectors interviewed personnel and reviewed the licensee's analysis of the ultrasonic and liquid penetrant exams performed during this current shutdown to determine whether the indication extended through-wall and whether a leak path existed through RPVH Nozzle 49. Additionally, the inspectors observed the bare metal visual examination performed during this shutdown and compared the results to the prior bare metal visual examination performed to determine whether any leakage occurred during the previous operating cycle. The inspectors also reviewed action requests from the licensee's corrective action program and other plant leakage monitoring systems to independently assess the licensee's conclusions that no operational leakage occurred during the previous operating cycle.

The inspectors reviewed the results of the UT performed during this shutdown and noted that the as-found indication was sized to be 0.314" in length and through-wall to a depth of 0.154". RPVH Nozzle 49 had a nominal thickness of 0.626" which placed the indication at approximately 24.6% through-wall. A comparison of the 2012 and 2013 data showed that the as-found indication's through-wall depth was measured to within 5% of that from the 2012 data and, as mentioned previously, was also in-line with the projected growth estimates for the approximate 12 months of operation that the missed indication laid undiscovered.

The inspectors interviewed licensee staff and vendor personnel and noted that the results of the UT leak path assessment showed no indications of any active leak paths for RPVH Nozzle 49. The leak path assessment was performed in addition to the bare metal visual examination to provide defense-in-depth for detecting nozzle penetration leakage. The inspectors also noted that the bare metal visual examination encompassed the penetration tube, adjacent RPVH material and the interference fit annulus between the penetration tube and the vessel head. The results of the bare metal visual examination showed no evidence of active or inactive primary coolant leakage from the penetration annulus or adjacent RPVH surfaces. The inspectors did note that there was staining around the nozzle area; however, the staining was verified to have originated from above the RPVH surface during a previous refueling outage resulting from maintenance activities on in-core instrumentation components. Additionally, the staining pattern showed no change from images recorded during the 2012 bare metal visual examination.

The inspectors reviewed the indications from plant leakage monitoring systems including the containment sump in-leakage monitors, the containment radiation particulate and gaseous monitors and the surveillance leak rate calculations and found that none of these leakage measurement indicators displayed any evidence of operational leakage from RPVH Nozzle 49. The results from all of the aforementioned indications including the flaw sizing, leak path assessment, NDEs performed and plant leakage monitoring systems led the inspectors to conclude that the licensee adequately confirmed that the indication did not extend through-wall and that no operational leakage occurred during the previous operating cycle.

b. Findings

No findings were identified.

2.5 Review licensee's activities related to the problem investigation performed to date (e.g., root cause analysis, extent of condition, etc.) to assess the probable cause(s) of the issue.

a. Discussion

The inspectors interviewed personnel and reviewed available station documents related to the licensee's efforts to identify potential causes for the event. The inspectors also reviewed action requests and work orders to independently assess the conclusions from the licensee's preliminary investigation.

The inspectors noted that the investigation was focused on the processes and procedures associated with the assessment of the data from the UT exams of the RPVH

nozzles. The licensee's investigation did not address the technical aspects of why the indication formed, as primary water stress corrosion cracking has been a widely studied phenomenon in the nuclear industry. Preliminary reviews of the event pointed to a breakdown in the process following the data acquisition. To this end, the licensee's investigation focused on four areas: (1) the vendor review and validation process of inspection data, (2) independent Level III examiner reviews by both Duke and the vendor, (3) human and environmental factors that could have contributed to the missed indication and (4) industry best practices for data validation and verification.

The inspectors noted that the licensee implemented several immediate and interim corrective actions in response to the missed indication. Immediately following the plant shutdown, the licensee performed a containment walkdown during Mode 3 and found no signs of boric acid buildup in the area surrounding RPVH Nozzle 49. In addition to the licensee's staff confirming that no further indications were missed from the 2012 examination, the licensee commissioned a 100% review of the 2012 UT data by the original vendor AREVA and by EPRI staff. All entities concluded that no additional indications existed which were not properly analyzed during the 2012 examination.

For the interim examinations, the inspectors noted that the licensee implemented a more stringent oversight plan for the analysis of the 2013 UT data than used during the 2012 examinations. This new plan emphasized greater redundancy and independent data analysis followed by comparison and discussion of the separate teams' analysis results. To accomplish this, the licensee implemented four independent teams to review the data. One vendor team working to their own procedures analyzed the data in a manner similar to the process used during the 2012 examinations. One vendor team composed of Level III personnel working with the vendor's procedures performed a 100% analysis of the inspection data. One team of EPRI staff, using their own procedures, performed a 100% analysis of the inspection data. Finally, one team of licensee Level III personnel performed their own independent review of the inspection data. Each team analyzed the data independently and sequestered apart from the other teams. The inspectors noted that this new analysis methodology addressed potential concerns with both personnel and the analysis process. The potential personnel concerns were addressed by having four groups of independent analysts review the data, while the potential process concerns were addressed by using multiple separate processes/procedures (vendor, EPRI and licensee) to analyze the data.

The licensee's root cause analysis report concluded that there was little that the licensee could have directly done to cause the analysts to identify the missed flaw; however, there were changes that could have been made to the contract and working conditions that would have increased the likelihood of the flaw being properly identified. The inspectors noted that the licensee's contract with the vendor did not specify that a minimum of two analysts would perform independent analysis of the UT data prior to collaboration. The minimum ASME Code requirement did not include this requirement either; however, the licensee stated that it would have significantly reduced the possibility of missed flaw identifications. The inspectors noted that while the root cause analysis report found no hard evidence of non-independent analyses being performed, it did find that the analysts were working in close proximity to each other and other inconsistencies in the vendor analysts' interview responses with respect to whether data analysis reviews were being performed in parallel or independently.

The licensee's root cause analysis report stated that the analysts' working conditions could also have been a contributing factor in causing the event. It noted that the work environment included tight quarters, noise and other distractions. Additionally, of the two analysts who missed identifying this indication, one analyst had worked 24 days without a day off while the other had worked 17 days without a day off. The inspectors noted that the vendor analysts did not express concern with this type of working environment and responded that it was typical of working conditions during other outages at other nuclear facilities.

The major corrective actions identified in the licensee's root cause analysis report included:

- Creating mitigating program governance for providing oversight for complex automated NDE inspections through the generation of new procedures
- Contractually requiring vendor analysts to perform independent analysis of the UT inspection data
- Implementing work-hour restrictions for vendor analysts
- Incorporating requirements for more conducive vendor work environments
- Incorporating requirements for the inclusion of licensee personnel in the vendor briefs for data analysis activities

b. Findings

No findings were identified.

2.6 Assess the licensee's actions for site specific and industry operating experience to determine if lessons learned could have prevented the issue.

a. Discussion

The inspectors interviewed personnel and reviewed the documents that the licensee considered as operating experience prior the spring 2012 refueling outage to determine whether this event could have been prevented by lessons learned. The inspectors also reviewed site procedures and instructions to assess whether the licensee adequately translated the industry operating experience into actionable items.

The licensee's operating experience review prior to the spring 2012 refueling outage focused on potential repair scenarios, shortcomings from prior similar inspections performed in the industry and potential missteps common in these types of inspections. The inspectors noted that the licensee's operating experience review was thorough and resulted in several technical lessons learned that the licensee enacted prior the spring 2012 refueling outage including: ensuring that resources were available onsite during the examinations to analyze historical NDE data of the RPVH, ensuring that NDE examiners and equipment were staged onsite to perform additional examinations and repairs if necessary and prioritizing each RPVH penetration nozzle in terms of its susceptibility based upon previous examination data.

The licensee's operating experience review also included process level lessons learned for performing UT on the RPVH including: an extensive procedural qualification and adequacy review, the need for extensive pre-job briefs, adequate oversight of the vendor performing the examinations and the prompt review and disposition of examination



results. The inspectors noted that under this last area of prompt review and disposition of examination results, the licensee specifically called out the need for data analysis to be performed by at least two qualified individuals prior to acceptance with additional reviews and analysis to be performed on a random sampling basis by the licensee's oversight personnel. The inspectors concluded that the licensee performed an adequate operating experience review.

b. Findings

No findings were identified.

2.7 Assess whether the issue involves generic safety concerns with the qualification process for both the NDE technique and NDE personnel.

a. Discussion

The inspectors reviewed the regulatory and ASME Code requirements for the qualification of both the examiners and the NDE technique to determine whether a generic safety concern existed. Specifically, the inspectors focused on whether the minimum procedural and examiner qualifications were sufficient to give reasonable assurance that unacceptable indications would be identified during the examination.

The inspectors noted that the licensee's root cause analysis report identified that no requirement or regulation existed for an independent review of UT data, but that such an independent review would be an enhancement which would reduce the possibility of missed indications; however, the inspectors determined that this was not a generic safety concern, as the vast majority of indications have been identified utilizing existing requirements and regulations. Additionally, the same statement would be true for the qualification process for NDE personnel. The inspectors determined that the qualification process for NDE personnel was sufficiently rigorous enough such that a fully-qualified examiner would be expected to identify indications similar to the one missed during this event. Thus, the inspectors determined that no generic safety concern existed for the NDE personnel qualification process.

b. Findings

No findings were identified.

4OA6 Exit Meeting

The inspectors presented the inspection results via teleconference to Mr. Kapopoulos and other members of the licensee's staff on June 11, 2013. The inspectors informed the licensee that no proprietary information would be retained by the inspectors or documented in this report.

4OA7 Licensee-Identified Violations

The following violation of very low safety significance (Green) was identified by the licensee and was a violation of NRC requirements which met the criteria of Section VI of the NRC Enforcement Policy, NUREG-1600, for being dispositioned as an NCV.

- The licensee identified a violation of 10 CFR 50 Appendix B, Criterion XVI, Corrective Action, which requires, in part, that measures shall be established to assure that conditions adverse to quality, such as deficiencies, defective material and equipment, and non-conformances are promptly identified and corrected. Contrary to this requirement, while performing ultrasonic examinations on the reactor pressure vessel head during the spring 2012 refueling outage as required by 10 CFR 50.55a(g)(6)(ii)(D), the licensee failed to identify an unacceptable indication in Nozzle 49 that overlapped the J-groove weld and exhibited characteristics of primary water stress corrosion cracking. This finding was determined to be of very low safety significance because subsequent visual and volumetric examinations performed did not detect any leakage and sizing of the indication determined that structural integrity of the vessel head was not compromised. Additionally, the licensee reanalyzed 100% of the spring 2012 inspection data and did not discover any further missed indications. The licensee entered this condition in their corrective action program as Action Request 00606317.

ATTACHMENTS:

1. SUPPLEMENTARY INFORMATION
2. EVENT TIMELINE

## SUPPLEMENTARY INFORMATION

### KEY POINTS OF CONTACT

#### Licensee personnel:

S. Allen, Licensing Engineer  
J. Caves, Licensing Engineer  
D. Corlett, Licensing Manager  
M. Denny, Engineering Manager  
K. Miller, Engineering Supervisor  
S. Volk, Quality Control Supervisor  
S. Williams, Engineering Programs  
G. Wilson, Licensing Engineer

#### NRC personnel:

J. Austin, Senior Resident Inspector  
P. Lessard, Resident Inspector  
S. Vias, Branch Chief

### LIST OF ITEMS OPENED, CLOSED, DISCUSSED AND UPDATED

#### Opened and Closed

05000400/201310-01	NCV	Failure to Report a Degraded Primary Safety Barrier per 10 CFR 50.73(a)(2)(ii)(A) [Section 40A3.1]
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### LIST OF DOCUMENTS REVIEWED

#### Procedures

51-9182556-000, Progress Energy Shearon Harris RPVH Penetration Examination Report RF17  
54-ISI-30-016, Written Practice for the Qualification and Certification of NDE Personnel, Rev. 16  
54-ISI-30-017, Written Practice for the Qualification and Certification of NDE Personnel, Rev. 17  
54-ISI-603-006, Automated Ultrasonic Examination of PRV Closure Head Penetrations Containing Thermal Sleeves, Rev. 6  
54-ISI-604-011, Automated Ultrasonic Examination of Open Tube RPV Closure Head Penetrations, Rev. 11  
54-PT-200-015, Color Contrast Solvent Removable Liquid Penetrant Examination of Components, Rev. 15  
CAP-NGGC-0200, Condition Identification and Screening Process, Rev. 36  
CAP-NGGC-0205, Condition Evaluation and Corrective Action Process, Rev. 17

#### ARs Reviewed

00606317, EPRI Data Review of R17 PRV Head Penetration UT  
00606893, Previous NRC report missed criterion  
00608329, RPV Closure Head IDTB Repair

#### Drawings

1364-898339 S01, Core Exit Thermocouple Nozzle Assemblies Westinghouse Version 3" Cetna Interface References, Rev. 1

Work Orders

2199346-12, Work Order: Reactor Vessel Heal Inspections

2242618-05, Work Order: Reactor Vessel Head Nozzle #49 Repair

Design Change Documents

EC 84144, IDTB weld repair at RVCH nozzle #49

EC 91990, Reactor Vessel Head CRDM Nozzle #49 Grinding Repair

Other

50-9176411-003, Shearon Harris CRDB Nozzle 49 IDTB Weld Repair Traveler

AREVA Certificate of Personnel Qualification for examiners: Getz, D. Yetter, Langenfeld, N.

Bauman, M. Hacker, M. Key, R. Rose, P. Anderson, H. Bezljaj

AREVA Certificate of Vision Examination for examiners: Getz, D. Yetter, Langenfeld, N.

Bauman, M. Hacker, M. Key, R. Rose, P. Anderson, H. Bezljaj

Control Room Log Entries for 5/11 through 5/31

EPRI TR 1019132, Nondestructive Evaluation: Good Practices to Optimize Human Performance During In-Service Inspection

Event Notification 49038, Technical Specification Required Shutdown Due to Discovery of an Unacceptable Flaw During Data Review, May 15, 2013

HNP RFO-17 Operating Experience Review Package

H-OM-FR-12-01, 2012 Outage Focused Review

Letter from C. Latiolais to A. Tucker of Progress Energy Carolinas, Inc, Subject: Harris RPV Head Penetration 38

Letter from J. Caves to NRC, Subject: Relief Request I3R-11 Reactor Vessel Closure Head Nozzles Inservice Inspection Program – Third Interval, May 22, 2013

RCE 606317, Technical Specification Required S/D of HNP Due to Flaw in the RVCH Penetration Nozzle

UT Data Package – Penetration No. 49

Welding Procedure Qualification Record: PQ7296-000

Welding Procedure Specification: WP3/43/F43TBSC3-001

## EVENT TIMELINE

<u>Time</u>	<u>Event</u>
4/2006	During Refueling Outage 13, all reactor pressure vessel head (RPVH) nozzles were examined in accordance with NRC order EA-03-009.
4/27/2012	During Refueling Outage 17, while examining all RPVH nozzles were in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME) Code Case N-729-1 and 10CFR50.55a, the licensee identified four RPVH nozzles (RPVH nozzles 5, 17, 38 and 63) that contained indications and submitted a voluntary 8-hour notification to the NRC.
5/2012	The licensee filed a relief request with the NRC in accordance with 10 CFR 50.55a(a)(3)(i) to repair the four nozzles identified as containing indications. The repairs were performed using the Inside Diameter Temper Bead weld method, an NRC-approved repair method.
9/5/2012	The licensee filed a 90-Day Inservice Inspection Summary Report with the NRC in accordance ASME Code Case N-532-4, identifying the repairs made on the four nozzles that were found to contain indications during the spring 2012 refueling outage.
5/2013	In preparation for the upcoming fall 2013 refueling outage and to better manage their resources, the licensee had commissioned the Electric Power Research Institute (EPRI) to review to the ultrasonic testing (UT) data from their spring 2012 refueling outage.
5/13/2013	Unit 1 was operating at 100% power.
1100	A representative from EPRI notified Shearon Harris Nuclear Plant of a potential indication in RPVH Nozzle 49 that appeared to exceed the recordability threshold, but was neither recorded nor analyzed during the 2012 refueling outage. The licensee notified the vendor, AREVA, and requested validation of the information that EPRI provided.
1400	AREVA concurred that the information from EPRI appeared to be accurate and that further evaluation and characterization was required.
1509	AREVA staff informed the licensee that the indication was evaluated to be 0.26" long, 26% through-wall and exhibited characteristics of primary water stress corrosion cracking. The condition was entered into the licensee's corrective action program as CR 606317. The licensee performed an immediate

operability evaluation and declared the reactor vessel head operable on the basis of no reactor coolant system pressure boundary leakage being detected from the nozzle, the containment sump in-leakage was normal, radiation monitors were reading normal and the preliminary dimensioning of the indication appeared to provide margin to the acceptance criteria in ASME Code Case N-729-1.

- 5/14/2013 1100 Results of a refined characterization by the vendor were incorporated into the preliminary calculations to predict flaw growth and project that against the acceptance criteria in the ASME Code. The location of the indication was reported as “straddling the weld” at and outboard of the J-groove weld.
- 5/15/2013 0900 The licensee held a teleconference with AREVA staff to discuss the ongoing flaw growth analysis to support continued operation until the fall refueling outage. The call resulted in the determination that if the flaw was postulated to be in the weld material, acceptance of the flaw would require an NRC-approved relief request.
- 1230 NRC Region II and NRR staff held a teleconference with the licensee challenging the licensee’s basis for their immediate operability determination due to the possibility that the indication could have penetrated the adjoining J-groove weld.
- 1700 AREVA staff reported to the licensee that the non-destructive examination (NDE) technique used during the 2012 examinations was only qualified to detect indications in the exam volume specified in Figure 2 of ASME Code Case N-729-1 and was not qualified to detect flaws in the weld material. Further discussions with the vendor’s materials group indicated that based on their knowledge and experience, there was a greater than 50% probability that the flaw also penetrated the adjoining J-groove weld material.
- 1730 The licensee’s engineering staff reviewed the vendor expert’s opinion and concluded that there was no longer a reasonable expectation of operability for the RPVH.
- 1800 The licensee conducted a management brief with the Shearon Harris Nuclear Plant leadership team and supported the conclusions held by the vendor and the licensee’s engineering staff.
- 1830 The shift manager was informed that there was no longer confidence that RPVH Nozzle 49 could be determined to be in compliance with the ASME Code and the recommendation to declare the RPVH inoperable and to enter the appropriate Technical Specification Action Statement.

	1849	The shift manager declared the RPVH inoperable and entered the Action Statement of Technical Specification 3.4.6.2 and commenced plant shutdown.
	1955	The licensee submitted a 50.72 Report (Event Notice 49038) notifying the NRC of the condition in accordance with 10 CFR 50.72(b)(2)(i), 50.72(b)(3)(ii)(A) and 50.72(b)(3)(v)(C).
	2345	Shearon Harris Nuclear Plant entered Mode 3 and the licensee performed a walkdown of the RPVH.
5/17/13	0033	Shearon Harris Nuclear Plant entered Mode 5.
5/23/13	1700	The licensee completed a UT scan of Nozzle 49 and began analysis of the data by two separate and independent teams from AREVA, one team from EPRI and one team from Duke Energy.
	1900	The licensee convened the four groups of Level III examiners that independently reviewed the UT data and each separately confirmed an indication near the one seen in the 2012 UT data. The indication was sized at 0.314" in length and through-wall to a depth of 0.154" (or ~24.6% through-wall).
5/24/13	0500	The licensee performed a liquid penetrant examination (PT) to determine if the indication seen in the UT data (Indication #1) was in the weld material. The liquid penetrant examination results confirmed that Indication #1 was in the weld material and revealed a second rounded indication (Indication #2) 1/16" in diameter with a separation of approximately 0.625" between the two indications. The licensee attributed Indication #2 to either prior surface grinding of the weld or an attempt to remove or reduce a fabrication indication following the final PT test during fabrication. The licensee scheduled a grinding process to remove both indications.
	1917	The licensee completed the initial grinding activity and immediately moved on to a post-grinding PT to confirm that the two indications were removed. The PT results confirmed the removal of the Indication #2, but not Indication #1. Additionally, the PT results also revealed a new 0.3" diameter rounded indication (Indication #3) at a position 0.1" from the nozzle's outside surface. Indication #3 was found to lie outside of the area bounded by the grinding modification package.
5/25/13	0100	The licensee determined that the initial grinding evolution did not reach to the maximum depth as stipulated in the grinding modification package. The licensee moved forward with a second grinding evolution to the maximum depth allowed by the grinding modification package for only Indication #1 as Indication #3 was not within the bounds of the modification package.

	0237	The licensee completed the grinding of Indication #1 and performed another PT. The PT results showed that the second grinding activity also failed to remove Indication #1. The licensee began mobilizing personnel and equipment to perform the Inner Diameter Temper Bead repair for Nozzle 49, as detailed in their previously-submitted relief request.
5/26/13	1500	The licensee began removal of the existing Nozzle 49 weld.
	2200	The licensee began post-machining NDEs.
5/28/13	0800	The licensee began the Inner Diameter Temper Bead welding repair process.
	1237	The licensee completed layer #3 of the welding process which began the 48-hour holding period before the final NDEs could commence.
5/30/13	1238	The licensee began the required post-repair UT.
	1800	The licensee began the required post-repair PT.
5/31/13		Following successful results from the post-repair NDEs, the licensee began the post-repair remediation through the process of abrasive water jet machining on the portion of the remaining nozzle most susceptible to primary water stress corrosion cracking. This process removed a small amount of material thickness while imposing a compressive residual stress on the nozzle surface. The final post-remediation NDEs were successfully performed and the RPVH was returned to service.