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

August 5, 2014

Mr. William R. Gideon, Vice President
H. B. Robinson Steam Electric Plant, Unit 2
Carolina Power & Light Company
3581 West Entrance Road
Hartsville, SC 29550

SUBJECT: H.B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2, AGING MANAGEMENT PROGRAM EFFECTIVENESS AUDIT (TAC NO. ME6075)

Dear Mr. Gideon:

On April 19, 2004, the U.S. Nuclear Regulatory Commission (NRC) granted a renewed operating license for an additional twenty years of operation from July 31, 2010, to July 31, 2030, to the H. B. Robinson Steam Electric Plant, Unit 2 (HBRSEP). The NRC staff completed an aging management program (AMP) effectiveness audit at HBRSEP between January 8 and January 10, 2013. The NRC staff reviewed the implementation of HBRSEP AMPs for license renewal since HBRSEP entered the period of extended operation. This audit was supported by the Argonne National Laboratory. The information collected from this audit and from similar audits will be used by the NRC staff in reviewing the effectiveness of the AMPs in their license renewal guidance documents and in updating the AMPs for subsequent license renewal, (i.e., for licensing nuclear power plants to operate beyond their current 60-year operating license).

The summary of the audit is enclosed.

On behalf of the audit team, I appreciate your support for this voluntary audit. We are especially grateful to Richard Hightower, Al Maysam, and Tom Bardauskas for their time and effort in preparing for the audit and assisting us during and after the audit.

If you have any questions, please contact me at 301-415-2981 or via e-mail at bennett.brady@nrc.gov.

Sincerely,

/RA/
Bennett M. Brady, Senior Project Manager
Subsequent Renewal, Guidance,
and Operations Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-261

Enclosure:
As stated

cc w/encl: Listserv

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ADAMS Accession Number: ML14017A289

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OFFICE OF NUCLEAR REACTOR REGULATION

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2

SUMMARY OF AGING MANAGEMENT PROGRAM EFFECTIVENESS AUDIT

DOCKET NO. 50-261

I. BACKGROUND

The U.S. Nuclear Regulatory Commission (NRC) staff performed an audit of aging management programs (AMPs) at the H. B. Robinson Steam Electric Plant, Unit 2 (HBRSEP), in Hartsville, SC, between January 8 and January 10, 2013. The purpose of the audit was for the NRC staff to review the Carolina Power & Light Company (the licensee) implementation of the HBRSEP AMPs approved by the NRC staff during the review of the HBRSEP license renewal application. HBRSEP period of extended operation (PEO) began on July 31, 2010, and ends on July 31, 2030. The primary focus of the NRC staff's audit was to review the HBRSEP assessments and the implementation results of the AMPs.

The NRC is performing "AMP Effectiveness Audits" to provide an understanding of how AMPs have been implemented by nuclear power plants during the PEO from 40 to 60 years and any degradations identified by the AMPs. The results from these audits will provide key information to aid the NRC staff in identifying changes to existing AMPs and developing new AMPs that may be needed to provide assurance of safe plant operation during a subsequent license renewal operating period. The technical letter report "Summary of Aging Management Program Effectiveness Audits to Inform Subsequent License Renewal: R.E. Ginna Nuclear Power Plant and Nine Mile Point Nuclear Station, Unit 1," (ADAMS Accession No. ML13122A009) prepared by the U.S. NRC's Office of Nuclear Regulatory Research provides further discussion of the scope and implementation of these audits.

Prior to the AMPs audit, the licensee provided an internet portal to facilitate the NRC audit team access to relevant documents. The audit team reviewed the implementing procedure documents, inspection reports, and program basis documents associated with the HBRSEP AMPs. The portal also provided the licensee's self-assessment of AMPs such as the Program Health Reports. During the audit, the NRC staff team further reviewed additional documents, such as the action requests and work orders related to the implementation and corrective actions for each AMP. The audit team also interviewed the licensee personnel responsible for the implementation of AMPs.

During the three days of the audit, the licensee was responsive in answering the questions from the audit team and promptly provided additional documents on the portal as requested.

ENCLOSURE

II. GENERAL OBSERVATIONS

The NRC staff held a final briefing with the licensee on January 10, 2013, to discuss the preliminary findings of the audit. The audit team provided general observations regarding HBRSEP's implementation of the AMPs and the audit process:

- The licensee performed a gap analysis to identify the difference in the HBRSEP AMPs and the AMPs described in "Generic Aging Lessons Learned (GALL) Report (NUREG-1801)," Revision 2, for some of the AMPs.
- The NRC identified areas in some of their programs that were consistent with the GALL Report, Revision 2.
- The licensee indicated that (1) periodic assessments of license renewal commitments and AMPs will be performed at least every three years; and that (2) the license renewal manager periodically reviews completed preventive maintenance activities that are credited for license renewal to identify potential aging effects.
- The licensee changed one of the license renewal commitments in accordance with Section 50.59 of Title 10 of the Code of *Federal Regulations* (10 CFR) to eliminate inspections for specific components fabricated of corrosion-resistant materials.

The licensee provided the following support during the audit:

- The internet portal contained appropriate background material as requested by the NRC staff.
- The audit commitment binders included: (1) the program basis document; (2) the relevant section of the license renewal application; (3) the section of the NRC safety evaluation report; (4) the GALL Report Revision 2 AMP description; (5) the commitments associated with the AMP; (6) the License Renewal Inspection Procedure 71003 "Post-Approval Site Inspection Report," and implementing procedures; (7) Program Health Reports; (8) AMP self-assessments; and (9) GALL Report, Revision 2 gap analyses.
- During the audit, the licensee tracked the NRC staff questions and provided documents to the staff as requested.
- After the completion of the audit, the licensee continued to post the NRC staff requested documents on the internet portal.

III. AMP SPECIFIC OBSERVATIONS

Below are some of the observations from the inspections and monitoring of the AMPs at HBRSEP that were discussed with the licensee during the audit.

The names of the AMP below are those used in the latest revision of NRC's guidance document for license renewal, the GALL Report Revision 2, and are not necessarily the names of the programs at HBRSEP.

American Society of Mechanical Engineers (ASME) Section XI Inservice Inspection, Subsection IWB, IWC, and IWD

During the audit, the licensee stated that the HBRSEP AMP is consistent with GALL AMP XI.M01, with no deviation. HBRSEP entered the fifth 10-year Inservice Inspection (ISI) program interval on July 21, 2012. The ASME Section XI Code applicable to the fifth 10-year interval is the 2007 Edition through the 2008 Addenda. The licensee also noted that HBRSEP is evaluating a possible modification of the actual inspection sub-intervals during the PEO, within the ASME Code allowable timing, to better align with HBRSEP refueling outage schedule, including related considerations for the pressure tests.

The NRC staff asked the licensee if the HBRSEP ISI program implementation has included any risk-informed inspection basis, or has any plans to do so. The licensee stated that the HBRSEP ISI program has not used any risk-informed information and it has no currently planned action to do so.

The NRC staff also inquired about changes or updates to the HBRSEP ISI program related to its nickel-base components. The licensee indicated that HBRSEP replaced ultrasonic testing (UT) with the phased-array as the technique used for the reactor vessel loop pipe inspection. The licensee identified some weld indications during the inspection. However, the indications were all embedded (not inside diameter-connected or surface breaking) indications.

The NRC staff discussed with the licensee the inspections of socket welded locations, and whether any improvements or developments for use of UT in these cases were completed at HBRSEP. The licensee noted that while no UT related work on socket welds had been completed, HBRSEP will continue to follow the industry developments in related enhancements. The licensee also stated that its inspection program for socket welds is staggered with adequate coverage of these locations through the ISI program interval, but with essentially random selection. The NRC staff suggested that the ISI program would probably benefit if the sample selection included considerations of susceptibility and the significance of socket weld locations.

Water Chemistry

The licensee stated that the water chemistry monitoring program undergoes continuing revisions and has been revised numerous times since license renewal in 2004. The licensee reported during the audit that HBRSEP maintains a Chemistry Data Management System, which is an electronic database used for storing, limit checking, reporting, and trending chemistry analyses. The HBRSEP 2011 Secondary Chemistry Self-Assessment noted several deficiencies in the plant procedures where the procedure requirements were not in agreement with the water chemistry guidelines or where the water chemistry guidelines requirements were not fully implemented in the procedures. The licensee indicated that these concerns are being addressed.

Reactor Vessel Head Closure Stud Bolting

The NRC staff noted that the licensee's recent UT examination results for the reactor vessel head studs were satisfactory without a relevant condition identified. The NRC staff also noted that the HBRSEP ISI program summary report (ADAMS Accession No. ML12184A040) dated June 15, 2012, confirms that the licensee conducted visual and volumetric examinations of the reactor vessel head closure bolting components in accordance with the ASME Code Section XI, Table IWB-2500-1, Examination Category B-G-1 during refueling outage 27. The ISI summary report stated that no indication of aging was revealed by HBRSEP's visual and volumetric examinations. The licensee further clarified that the ISI did not reveal any leakage or stress corrosion cracking of the reactor vessel head stud assemblies.

Boric Acid Corrosion

The licensee documented in condition reports that the boric acid leaks identified after each refueling outage resulted in the removal of boron deposits. The licensee indicated that the majority of the leaks are related to maintenance practices, rather than aging effects. A trend analysis performed by the licensee in 2011 concluded that approximately 82 percent of the leaks in the operating cycle were related to packing glands, body to bonnet flange connections, mechanical seals, and fittings. The licensee also indicated that the increase in valve packing leaks could be related to the style of packing material used and design changes recently implemented at HBRSEP.

Thermal Aging Embrittlement of Cast Austenitic Stainless Steels (CASS)

The licensee performed flaw tolerance evaluations for the Class 1 CASS components to demonstrate flaw stability for the PEO as discussed in the HBRSEP license renewal application. These flaw tolerance evaluations remain valid for the PEO and provide the basis for the CASS program. The licensee also continues to perform ISI as described in the ASME Code Section XI, Subsection IWB, IWC, and IWD consistent with 10 CFR 50.55a. The licensee also stated that no indication was detected in the Class 1 CASS components included in the scope of the CASS program.

Pressurized Water Reactor (PWR) Vessel Internals

The Safety Evaluation Report (SER) related to the License Renewal of H.B. Robinson Steam Electric Plant, Unit 2 (NUREG-1785) (ADAMS Accession No. ML040200981) dated March 31, 2004, described a commitment made by the licensee to submit a Reactor Vessel Internals Inspection Plan to the NRC for review and approval at least 24 months prior to implementation. On September 24, 2009, the licensee submitted the inspection plan WCAP-17077-NP, Rev. 0: "PWR Vessel Internals Program Plan for Aging Management of Reactors Internals at Robinson Nuclear Plant" (ADAMS Accession Nos. ML092720461 and ML092750338). Subsequently, on June 22, 2011, the NRC issued its final SER on MRP-227 "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines" (ADAMS Accession No. ML111600498) as revised on December 16, 2011 (ADAMS Accession No. ML11308A770). The Electric Power Research Institute issued MRP-227-A in January 9, 2012 (ADAMS Accession No. ML12017A193).

On July 21, 2011, the NRC issued Regulatory Issue Summary 2011-07: "License Renewal Submittal Information for Pressurized Water Reactor Internals Aging Management," which stated that plants that have submitted their inspection plans could withdraw and submit updated plans, consistent with approved report MRP-227-A, no later than October 1, 2012. The licensee submitted its revised inspection plan WCAP-17077-NP, Rev. 1: "PWR Vessel Internals Program Plan for Aging Management of Reactors Internals at Robinson Nuclear Plant" (ADAMS Accession No. ML12278A399) on September 26, 2012.

The licensee completed inspections of several internals components during the HBRSEP spring 2012 refueling outage, including the control rod guide tube (CRGT) lower flange welds enhanced visual testing (EVT-1), the upper core barrel flange weld (EVT-1), the baffle-edge bolts visual testing (VT-3), the baffle-former assembly (VT-3) and the thermal shield flexures (VT-3), with additional inspections planned for the fall 2013 refueling outage. The licensee described accessibility issues with visual inspection of the CRGT lower flange welds. The licensee did not identify relevant indications in the areas inspected related to the CRGT lower flange welds, the upper core barrel flange weld, the baffle-edge bolts, the baffle-former assembly, and the thermal shield flexures. The licensee stated that they will replace their hold-down springs in an upcoming outage.

Flow Accelerated Corrosion

During the audit, the NRC staff determined that the HBRSEP recent (Third Quarter 2012) Program Health Report provided an adequate representation of the program's implementation and the status of current issues. The report noted that, based on UT results and trace chromium data collected in refueling outages 26 and 27, there is no wear taking place in the principal high energy systems. The licensee attributed the results to the extensive piping replacement with upgraded materials, major improvements in water chemistry since 1999, and the presence of trace chromium in plant piping.

Steam Generators

During the audit, the licensee indicated that the recent plugging of the steam generator tubes was due to wear that resulted from interaction with the pieces of spiral wound gaskets. Specifically, HBRSEP's System Health Report (December 3, 2012) indicates that a total of 18 tubes were plugged in refueling outages 24 and 26 and all tube damage was due to foreign material excursion (FME). The Program Health Report also indicates that the FME, which caused the tube wear, was determined to have originated from the degradation of the spiral wound gaskets on feedwater heaters 6A and 6B. The Program Health Report further indicated that the gaskets were replaced with a different style of gaskets to prevent release of gasket pieces into the secondary water system and a personnel performance issue is also being addressed with training. In addition, the Program Health Report stated that improvements will be assessed during the fall 2013 refueling outage 28.

Open Cycle Cooling Water System (The HBRSEP Cooling Water Reliability Program)

During the audit, the NRC staff noted that the original admiralty brass tubing in the component cooling water heat exchanger had previously been replaced with 90/10 copper nickel tubing in 1990. This tubing material was proactively replaced with AL-6XN during refueling outages 25 and 26, since the old tubing still had acceptable wall thickness. However, an evaluation of the ongoing erosion and corrosion concluded that the heat exchanger tubing would not be acceptable through the end of the PEO. The licensee had also included the inspections of these heat exchangers as part of its One-Time Inspection Program (discussed below). Also during the audit, the staff discussed with the licensee whether coatings were applied in service water components. The licensee stated that most of the service water carbon steel heat exchanger surfaces have been coated with a polymer ceramic coating to control corrosion, and that no issues regarding degradation of these coatings had been identified. All safety related service water heat exchangers are inspected for degradation per Generic Letter 89-13 and no issue with coated or uncoated surfaces have been identified.

Closed Treated Water System Program

The HBRSEP System Health Report for the component cooling water system included a discussion under “Other Concerns” about the degradation of rubber lined butterfly valves that caused a foreign material issue in the component cooling water “B” pump. The report indicated that the long-range asset management project to replace the two valves of concern was approved and budgeted for a near-term refueling outage. The NRC staff considered this issue to be similar to the wall thinning identified downstream of the spent fuel pool heat exchangers in that it was component-specific age-related degradation and would be appropriately managed through a comparable AMP such as the Preventive Maintenance Program in lieu of incorporating this aspect into the Closed Treated Water System Program.

Inspection of Overhead Heavy and Light Load (Related to Refueling) Handling Systems

The licensee’s Crane System Health Report for third quarter 2012 stated that the trend in system health is declining due to continuing corrosion problems with the spent fuel cask crane. The licensee indicated that there are engineering concerns regarding the spent fuel cask crane with regards to obsolescence, margin, and painting.

During the audit, the licensee explained that the spent fuel cask cranes are exposed to outdoor environment that causes continuing corrosion and that some parts of the crane are difficult to paint due to inaccessibility.

The majority of the equipment failures identified by the licensee are related to shear pins that experienced dezincification. The dezincification is due to the pins and similar mechanical parts being continuously submerged in borated water for an extended period in the spent fuel pool. These shear pins do not serve a license renewal function, and are not included in a license renewal-credited AMP. The licensee said that the majority of the equipment failures associated with cranes is of active and electronic components, also not subject to license renewal AMPs.

Fire Water System

The HBRSEP operating experience indicates failures of the fire pump casings due to wall thinning in the "splash zones." The licensee confirmed that wall thinning at the splash zones is due to general corrosion, not from erosion. The licensee indicated that this aging mechanism is managed by replacing the pump casings every 10 years by the HBRSEP Preventive Maintenance Program. The licensee also indicated that no pump casing failures have been documented since the implementation of the Preventive Maintenance Program.

The licensee implemented minor changes to the scope of the Preventive Maintenance Program. The licensee indicated that testing for bacteria has been completed since 2010 and that no degradation problems associated with chlorination have been identified. The licensee also indicated that there is no microbiological induced corrosion (MIC) or very minor MIC in the fire water piping which uses the lake water and that unintended consequences from excessive biocide treatment (e.g., chlorination) causing wall thinning are not an issue. During the PEO, the licensee will test representative samples of above ground fire water system using non-intrusive techniques (e.g., volumetric testing) or an internal inspection will be completed at a 10-year interval to identify evidence of loss of material due to corrosion. The NRC staff noted that some site-specific procedures have been implemented in the licensee's plant fleet, such as the model system walkdown commitment.

As a result of galvanic corrosion conditions noted in the HBRSEP Corrective Action Program, the licensee conducted an inspection of aluminum piping, 2-inch or smaller, for pipe unions. The licensee performed the inspection to avoid a recurrence of an event where joining of the pipe and bronze fittings, without a dielectric insulator between them, resulted in the corrosion of the aluminum through galvanic corrosion in the presence of an electrolyte. The licensee conducted this inspection in the auxiliary and fuel handling buildings, and observed two other potential precursors to galvanic corrosion which were documented in the HBRSEP corrective action program.

The HBRSEP Corrective Action Program also described an event in which the fire water line 2-FP-29 came apart due to a pressure surge caused by the starting of the fire pump. The licensee corrective actions included performing an extent condition walkdown of the fire water piping system in the power block. As a result, the licensee corrected areas of piping where other dissimilar metals were identified. The licensee also revised a plant procedure to add information that the fire water piping in the power block uses aluminum piping that is subject to galvanic corrosion if repairs are made with dissimilar metals without proper separation/insulation.

Aboveground Carbon Steel Tanks

Since implementation of this program, the licensee visual inspections identified minor expected surface corrosion and areas of missing paint which the licensee has repaired as needed. The NRC staff determined that the HBRSEP corrective actions associated with the Aboveground Carbon Steel Tanks program to date are adequate and involve cleaning degraded surfaces and touching up paint as necessary. Also, the NRC staff noted that the number of findings does not indicate a negative trend.

Fuel Oil Chemistry

The diesel fuel for the HBRSEP Unit 2 is delivered to HBRSEP Unit 1, an adjacent coal-fired generating plant. HBRSEP Unit 2 obtains its diesel fuel supply by pipeline from HBRSEP Unit 1. During the audit, the NRC staff noted that HBRSEP Unit 1 is shut down but not decommissioned, so the fuel oil control system through HBRSEP Unit 1 was still functional.

During the audit, the licensee stated that the fuel oil delivered to the HBRSEP Unit 1 is sampled before it is loaded into the tanker to ensure quality. The tanker is then sealed and no acceptance sampling of fuel oil is performed upon delivery. The audit team noted an incident in which fuel oil delivered to HBRSEP Unit 1 was found to be contaminated by impurities in the tanker. The licensee determined that there is no assurance that the contract carrier tankers were re-cleaned thoroughly prior to loading of the fuel oil. The audit team noted that the licensee procedure of sampling the fuel before it is loaded into the tanker and not at the off-load point would not prevent a recurrence of this incident. The licensee indicated that current procedures require monthly sampling of the fuel oil tanks for impurities except for bacteria, for which analyses are performed on a quarterly basis. The licensee also indicated that HBRSEP has no plans to add biocides to the fuel oil.

Reactor Vessel Surveillance

The licensee through the HBRSEP Reactor Vessel Surveillance program has completed testing of four surveillance capsules, with three surveillance capsules remaining in the reactor pressure vessel (RPV). The NRC approved the delay of the Capsule U testing until the capsule achieves 38 effective full power years (EFPY) of exposure. This allows the capsule to achieve a neutron fluence that approximates that for the RPV at 80 years. Capsules W and Y were relocated during refueling outage 27 to higher fluence locations. For Capsule Z, the licensee stated that it was withdrawn in 1977 and is in storage.

The NRC staff discussed with the licensee if there were any changes to plant operation since the HBRSEP license was renewed that could affect the vessel fluence or embrittlement. The licensee indicated there were no changes affecting these aspects of the program. The licensee also noted that the HBRSEP surveillance program is one of the few programs with availability of capsules suitable for long-term data collection covering the subsequent license renewal period.

One-time Inspection Program

The one-time inspection conducted as part of HBRSEP license renewal found indications of aging mechanisms.

During the audit, the NRC staff noted that the “B” component cooling water heat exchanger was re-tubed during refueling outage 25 in 2008. As a result of the inspection and based on the tube wall measurements, the licensee also re-tubed the “A” component cooling water heat exchanger during refueling outage 26 in 2010 because the predicted life of the tubing would not have been acceptable during the PEO. In addition, the licensee established preventive maintenance activities to perform eddy current testing for both heat exchangers on a 6-year (maximum) frequency.

The NRC staff also noted that the results of the licensee's inspection of the emergency diesel generator exhaust silencers determined them to be acceptable. However, due to the difficulty in performing periodic inspections and preventive maintenance, the licensee established a plan to periodically replace the silencers. The NRC staff further noted that, during the inspection of inaccessible areas of the containment liner behind insulation panels at the regenerative heat exchanger and refueling canal, the licensee identified degraded portions of the moisture barrier. Also, the licensee found no degradation of the containment liner, and removed and replaced the moisture barrier at each of the insulation panels.

Selective Leaching

During the one-time inspection for selective leaching (graphitization), the licensee identified degradation in four gray cast iron valve bodies in the service water system. The mechanical test used by the licensee to identify the graphitization was tapping and scraping of the surface. The licensee sand blasted two of the valve bodies and after all of the graphite was removed; the licensee determined that the leaching progressed to a depth of approximately 3/32 inch. Based on the estimated corrosion rate, the licensee determined that the valve bodies had adequate wall thickness for at least 20 years of additional service. The licensee did not perform destructive metallography or similar examinations in the service water system valves. Following this finding, the licensee sampled all susceptible valves in the service water system for selective leaching. The licensee stated that they plan to continue sampling and replacing more valves in future outages.

External Surfaces Monitoring of Mechanical Components (HBRSEP's Systems Monitoring Program)

The licensee indicated that the current HBRSEP Systems Monitoring Program is significantly improved from the program that HBRSEP had in place in the 1990's prior to license renewal. In particular, the program has improved in terms of program procedures, record-keeping, and data monitoring and trending. Also, the licensee maintains a comprehensive electronic database to track component conditions with time.

Flux Thimble Tube Inspection (HBRSEP's Flux Thimble Eddy Current Inspection**)**

During the AMP effectiveness audit interview, the licensee stated that there had been no changes made to the implementing procedures since the PEO. The licensee's letter dated April 13, 2009, related to the update on the NRC Bulletin 88-09: "Thimble Tube Thinning in Westinghouse Reactors" (ADAMS Accession No. ML091100397) stated that the frequency of eddy current inspection of the thimble tubes was being changed from every third fueling outage to every sixth refueling outage.

Lubricating Oil Analysis

The licensee implemented a Lube Oil Analysis Program, although this program is not identified in the HBRSEP license renewal SER. The Lube Oil Analysis Program monitors for moisture, corrosion particles, and contaminants in the lubricating oil, using a combination of acceptance limits from the lubricant manufacturer recommendations and the Electric Power Research

Institute documents. The licensee System Health Report completed on December 2010 concluded a green finding on each parameter.

Buried and Underground Piping and Tanks (HBRSEP Buried Piping and Tanks Inspection and Buried Piping and Tanks Surveillance)

The HBRSEP License Renewal Application included separate AMPs for Buried Piping and Tanks Surveillance (B3.8) and Buried Piping and Tanks Inspection (B3.12). Subsequent to license renewal, the licensee merged the two AMPs into a single program. The HBRSEP program described in the HBRSEP SER was based on opportunistic inspections of buried piping that has been uncovered; with no directed inspections of such piping. The NRC staff audited the combined program.

During the audit, the licensee stated that the inspections of the cathodic protection system are performed every three years, with plans to go to an annual inspection. The preventive maintenance has been changed to perform an annual inspection and to have a system assessment performed by annually. The licensee monitors rectifier output levels monthly, but there appears to be no systematic trending of these data. The licensee also stated that the cathodic protection system has been fully operational since October 2012, after the replacement of two anodes was completed. The licensee informed the NRC after the audit that anode 2-A20A was found out of service on November 15, 2012, and anode 2-A2 was found out of service on January 27, 2010. Both anodes were replaced and returned to service on September 10, 2013. Rectifier-2 was found out of service on August 1, 2013, and was repaired and returned to service on August 28, 2013.

The licensee performed soil survey testing to assess soil corrosion. The licensee took samples in the vicinity of buried and underground piping. At the time of the audit, the samples had not been analyzed. As part of an effort to bring the AMP into alignment with the GALL Report Revision 2, the licensee completed directed inspections of underground piping as well as opportunistic inspections. One of the directed inspections identified a leak in a potable water line under a roadway, possibly related to rocks in the backfill. The licensee performed a similar inspection on underground fire protection piping with similar backfill and no problems were identified.

The NRC staff reviewed a 2011 licensee self-assessment of the HBRSEP program which stated that the program was not meeting expectations. The licensee stated that the deficiencies cited in this self-assessment were addressed with new personnel and updated procedures, and the specific condition reports mentioned in this self-assessment are closed.

ASME Section XI, Subsection IWE

The HBRSEP containment liner is unique in that all vertical portions are covered by insulation. The licensee considers these portions of the liner to be inaccessible and has used the relief request process to keep from removing the insulation to inspect the liner during each period. The licensee is only required to perform an ASME Code Section XI, Subsection IWE inspection of the moisture barrier or the liner when a maintenance activity requires removal of insulation.

During the first ten-year ASME Code Section XI, Subsection IWE inspection interval, which ended in 2008, the licensee removed the entire bottom row of insulation and inspected the liner and the moisture barrier. Based on the results of the inspection, the licensee identified a worst case corrosion rate and location. They determined that at the current rates, the liner is acceptable until 2023. Since that time, the licensee has continued to remove the lower row of panels during each ASME Code Section XI, Subsection IWE inspection period and has replaced the moisture barrier completely during each inspection period. The licensee further informed the NRC staff that Robinson has committed to remove the entire bottom row of insulation again over the course of the second ten-year interval.

The licensee also implemented a separate liner restoration process which removes and replaces insulation panels with chloride free insulation during each refueling outage.

ASME Section XI, Subsection IWF

During the audit, the licensee stated that when a degraded support is identified, it is returned to an "as new" state regardless of whether or not the support was still acceptable per the ASME Section XI, Subsection IWF acceptance criteria. If the support does not fail the ASME acceptance criteria, none of the associated actions are taken (sample expansion, additional inspections) and the support remains in the original IWF sample. The NRC staff discussed with the licensee that this could lead to a situation where age-related degradation of a support within the IWF inspection sample is identified and repaired while supports outside the sample continue to degrade; eventually it may progress to a point where the IWF sample is not representative of the total support population. The licensee indicated that this was not an issue, because, if supports outside of the ASME IWF sample are degrading, they will be identified during system walk-downs and repaired as necessary.

ASME Section XI, Subsection IWL

During refueling outage 27 in 2012, the licensee performed the ASME Section XI, Subsection IWL inspection for containment concrete degradation. The licensee's visual surface examination reports demonstrated that there was no major structural degradation. During the inspection the licensee identified localized chemical leaching that resulted in staining of the concrete surface. The licensee also observed minimal concrete spalling on the exterior of the containment cylindrical wall between the 180 degrees and 270 degrees azimuths. The licensee determined that the concrete staining and spalling observed will not affect the structural integrity and safety functions of the containment building.

10 CFR Part 50, Appendix J: Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors

Since implementation of the 10 CFR Part 50, Appendix J Program, the licensee's pressure testing program has identified minor expected degradation such as individual penetrations exceeding the administrative leakage limits. The licensee indicated that these issues have been assessed and corrected as necessary (e.g., reworking the valves, re-lining the valves, etc.). The NRC staff determined that the corrective actions and the number of findings associated with the program to the date of the audit are appropriate and do not indicate a negative trend.

Structures Monitoring

The licensee identified indications of a small leak in the area above the fuel transfer canal in the spent fuel pool. The licensee attempts to locate and seal the leak that have been unsuccessful. The licensee also indicated that leakage in the reactor cavity seal has been observed for several refueling outages.

The licensee also indicated that the refueling canal leakage is due to the reactor cavity seal installed around the reactor during refueling outages and has been an issue for several years. The licensee stated that a permanent cavity seal is planned to be installed during the fall 2013 refueling outage. Following the audit, the licensee informed the NRC staff that the permanent cavity seal had been installed.

The HBRSEP roof design is a flat roof with a waterproofing membrane. The licensee identified persistent roof leakage in some structures. The NRC staff notes that the roof leaks could cause electric problems if water drips on energized equipment. The licensee stated that the leaks are continuously monitored, but repairs have been slow due to scheduled considerations. The licensee also informed us following the audit that the Auxiliary building roof was replaced in late 2012 to early 2013.

Regulatory Guide 1.127: "Inspection of Water-Control Structures Associated with Nuclear Power Plants" (HBRSEP's Dam Safety Inspection Program)

The Federal Energy Regulatory Commission and the U.S. Army Corp of Engineers program: "Recommended Guidelines for Safety Inspection of Dams," is credited by HBRSEP for the aging management of the Lake Robinson earthen dam and associated concrete structures. Lake Robinson reservoir provides plant cooling water and fire protection water.

The NRC staff reviewed the most recent Dam Safety Inspection Reports. The overall conclusion from the 2010 report was that "The H.B. Robinson Cooling Lake Dam is adequately designed and adequately constructed. It is in good condition with no visible dips, sags, slumps, sinks or other evidence of distress. The upstream rip rap is sound, and the downstream grass cover is well established. Maintenance of the dam by plant personnel is acceptable, and the dam is routinely inspected by plant personnel." The 2012 inspection report had similar conclusions.

Fatigue Monitoring (HBRSEP Metal Fatigue of Reactor Coolant Pressure Boundary)

As part of the fatigue cycle monitoring in this program, the licensee analyzed the cumulative usage factor (CUF) for the auxiliary feedwater pump discharge tie-ins to the main feedwater lines. The licensee indicated that the HBRSEP's fatigue cycle analysis estimated the CUF for these auxiliary feedwater connections is 0.98608 for 50 years of operation. In order to ensure that the CUF for these connections does not exceed the design limit, the licensee issued a work order to conduct replacement of these connections during the fall 2013 refueling outage 28. The licensee indicated that its Fatigue Monitoring Program would continue to monitor the transient cycles and CUF values for these components for adequate aging management.

Neutron Flux Instrumentation Circuits

The HBRSEP's refueling outage 25 test results indicated a decrease in the insulation resistance between the inner shield and the outer shield for the cable inside containment from the results taken at the beginning of refueling outage 24. The N-32 detector was replaced at the end of refueling outage 24. The licensee indicated that the lower insulation resistance values were likely the result of a very small amount of moisture from the containment atmosphere that became trapped in the connection between the detector and the field cable during the detector replacement. The refueling outage 26 test results demonstrated a return to normal insulation resistance values, confirming that the lower insulation resistance was due to moisture which has since dried out. Based on this information, the licensee concluded that the condition monitoring testing has not shown an adverse trend in insulation resistance that would be indicative of cable degradation.

Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualifications Requirements

Based on the licensee's analysis of the GALL Report, Revision 2, the licensee added (although not credited for license renewal) 480 volt safety related buried cable for the service water pumps, and the diesel generator fuel oil transfer pumps. The licensee performs service water cable tests on an 18-month frequency and the diesel generator fuel oil transfer pump motors are tested on a one-year frequency. Also, the licensee inspects the associated manholes on a 6-month frequency. The licensee stated that there are no gaps between HBRSEP's cable aging management program for inaccessible power cables and the GALL Report, Revision 2, XI.E3 AMP.

The licensee also stated in its industry operating experience evaluation that the underground medium voltage cables (circulating water pumps) are tested every 6 years and the replacement of these cables is scheduled. The licensee also indicated that the low voltage power cable for the service water pumps were replaced and installed in an above ground concrete cable tray. Also, the licensee stated that the diesel generator fuel oil transfer pump cables were replaced in 2003.

Metal Enclosed Bus

The licensee identified heat related degradation of tapped bolted connections broken and loose bolted connections on Bus Duct E2. The licensee indicated that no sign of damage or wear was found on the bus duct enclosure. Also, the licensee did not find any rust indications on the surface of interior of the Bus Duct E2. The licensee revised a work order to repair the broken lock washers.

Fuse Holders

The licensee used fuse clip thermography to confirm the absence of thermal fatigue in the form of high resistance caused by ohmic heating, thermal cycling or electrical transients, mechanical fatigue caused by frequent manipulation of the fuse or vibration, chemical contamination, corrosion and oxidation. Based on this survey, the licensee concluded that Shutdown Panel Diesel Generator Fuses are in good working order.

IV. CONCLUSION

The scope of NRC AMP Effectiveness Audit addressed:

- Understanding the licensee's implementation of the AMPs during the PEO (e.g., the types of component inspections that have been conducted and any impediments for the inspections)
- Reviewing the findings from the AMPs in terms of the types of degradation that have been identified
- Identifying how the AMPs have changed based on plant-specific and industry operating experience

The AMP Effectiveness Audit at HBRSEP provided the NRC staff an understanding of how the licensee AMPs has been implemented during the PEO and the degradations that have been identified by the AMPs.

The results from this audit and other audits will provide key information to aid the NRC in identifying needed changes to existing AMPs and potentially new AMPs that may be needed to provide assurance of safe plant operation during a subsequent license renewal (SLR) operating period.

The results from these audits will also be used to refine the approach for potential future AMP Effectiveness Audits, to widen the knowledge base; and enable broader conclusions to be drawn to support the development of guidance documents for SLR. Once sufficient information has been gathered from a sufficient number of sites to reach conclusions, the information will be evaluated to inform:

- Aging effects that need to be managed during a SLR operating period
- Changes to existing license renewal AMPs to improve the performance of the AMPs for management of aging effects during the SLR operating period
- New AMPs that need to be added for the SLR operating period

V. Major Documents Reviewed

a. License Renewal Program Basis Documents for all AMPs
b. Inspection Procedures for all AMPs
c. 10 CFR 50.59 evaluations
d. Selected Action Requests
e. Updated Final Safety Analysis Report
f. Technical Specifications

g. Aging Management Trend Reports

h. GALL Report Revision 2 gap analyses

i. Robinson Nuclear Plant License Renewal Application and the Safety Evaluation Report Related to the License Renewal of H.B. Robinson Steam Electric Plant, Unit 2 (NUREG-1785)

j. Summary of Aging Management Effectiveness Audits to Inform Subsequent License Renewal: R.E. Ginna Nuclear Power Plant and Nine Mile Point Nuclear Station, Unit 1, Technical Letter Report prepared by the Division of Engineering, Office of Nuclear Regulatory Research, USNRC

VI. Audit Team Members

The following NRC staff performed the AMP audit at the HBRSEP site:

Allen Hiser	NRR/DLR	Amy Hull	RES/DE
Bennett Brady	NRR/DLR	John Burke	RES/DE
Bryce Lehman	NRR/DLR		
Cliff Doutt	NRR/DLR		
Duc Nguyen	NRR/DLR		
Jim Gavula	NRR/DLR		
Seung Min	NRR/DLR		

VII. Licensee Personnel Contacted During The Audit

Balakhnin	Jackson	Pizzuti
T. Bardauskas	James	Snipes
Bennett	Ludwick	Spencer
Blew	Martrano	Starling
Crabtree	McCutcheon	Stuckey
Erno	McFadyn	Thompson
Flowers	Moore	Wallace
Hendrickson	Outlaw	