DUKE ENERGY®

Sharon W. Peavyhouse
H. B. Robinson Steam Electric Plant Unit 2
Dir – Nuc Org Effectiveness

Duke Energy Progress
3581 West Entrance Road
Hartsville, SC 29550

O: 843 857 1584
F: 843 857 1319

Serial: RNP-RA/14-0093

10 CFR 50.4

SEP 0 5 2014

Attn: Document Control Desk
United States Nuclear Regulatory Commission
Washington, DC 20555-0001

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/RENEWED LICENSE NO. DPR-23

DEVIATION FROM ELECTRIC POWER RESEARCH INSTITUTE (EPRI) MATERIALS RELIABILITY PROGRAM (MRP)-146 ULTRASONIC EXAMINATION SCHEDULE – NUCLEAR ENERGY INSTITUTE (NEI) 03-08, "NEEDED" WORK PRODUCT ELEMENT

Ladies and Gentlemen:

Nuclear Energy Institute (NEI) 03-08, Revision 2, "Guideline for the Management of Material Issues," allows licensees to deviate from the "Needed" work product elements with appropriate justification and documentation. Duke Energy Progress, Inc. has identified a deviation for the H. B. Robinson Steam Electric Plant, Unit No. 2, (HBRSEP2) from the NEI 03-08 "Needed" guidance within the Electric Power Research Institute (EPRI) Material Reliability Program (MRP)-146, Rev. 1, "Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines," dated 2011.

HBRSEP2 has four pipe lines affected by MRP-146, two of which have missed inspections suggested per the inspection frequency referenced in MRP-146 (3-RC-2501R-25 abbreviation: 3RC-25 [3-inch diameter Alternate charging line] and 2-RC-2501R-40 abbreviation: 2RC-40 [2-inch diameter Drain line]). An inspection was not performed on 3RC-25 in the HBRSEP2 winter outage (RFO-27 Feb 2012) nor in the HBRSEP2 fall outage (RFO-28 Sept 2013) as recommended by MRP-146. An inspection was not performed on 2RC-40 in the HBRSEP2 winter 2012 outage (RFO-27 Feb 2012) as recommended by MRP-146. Inspections will be performed on all four MRP-146 HBRSEP2 affected lines in the spring 2015 refueling outage (RFO-29). Since the MRP-146 frequency inspections are identified as an NEI 03-08 "Needed" element, misalignment with the recommended frequency of inspection is a "deviation" from the MRP-146, Rev. 1 guidance.

In accordance with NEI 03-08, Section 8.1.c, the enclosed is being submitted for information only and no NRC action is required. This document contains no regulatory commitments. Should you have any questions regarding this matter, please contact Mr. R. Hightower, Manager - Nuclear Regulatory Affairs at (843) 857-1329.

Sincerely,

Sharon W. Peavyhouse

Sharon W. Peavyhouse
Director – Nuc Org Effectiveness
H. B. Robinson Steam Electric Plant, Unit No. 2

A001
NRR

SWP/jmw

Enclosure: HBRSEP2 Deviation from NEI 03-08, "Needed" Recommendation Regarding MRP-146/MRP-146S, Inspections of Normally Stagnant Non-Isolable RCS Branch Lines

c: V. McCree, NRC, Region II
Ms. Martha C. Barillas, NRC Project Manager, NRR
NRC Resident Inspector, HBRSEP2
Division of Component Integrity, NRR

US NRC Document Control Desk
Enclosure to Serial: RNP-RA/14-0093
6 pages (including this cover page)

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DEVIATION FROM NEI 03-08, "NEEDED" RECOMMENDATION REGARDING MRP-146/MRP-146S, INSPECTIONS OF NORMALLY STAGNANT NON-ISOLABLE RCS BRANCH LINES

HBRSEP2 Deviation from NEI 03-08 "Needed" Recommendation Regarding MRP-146/MRP-146S Inspections of Normally Stagnant Non-Isolable RCS Branch Lines

Needed Requirement:

"Locations that do pass the screening criteria of Item # 1 shall receive augmented periodic re-inspection. The inspection frequency shall be determined per Section 2.1.5.5 (every other outage), Section 2.1.5.6 (Fatigue Analysis basis for reduced frequency) or Section 2.1.5.7 (ASME Section XI, Appendix L Flaw Tolerance Evaluation basis for reduced frequency)."

(Reference: Item #3 within Table 1-1B of MRP-146 Rev 1)

"In-leakage Determination: For UH/H branches, confirmation of whether in-leakage is present or absent is important in identifying if inspections every outage are necessary (see Figure 2-1)."

(Reference: Section 2.1 Assessment of Lines of MRP-146 Rev 1)

Deviation:

H. B. Robinson Steam Electric Plant, Unit No. 2 (HBRSEP2) has four lines affected by MRP-146, two of which have missed inspections suggested per the inspection frequency referenced in MRP-146 (3-RC-2501R-25 abbreviation: 3RC-25 [3-inch diameter Alternate charging line] and 2-RC-2501R-40 abbreviation: 2RC-40 [2-inch diameter Drain line]). An inspection was not performed on 3RC-25 in the HBRSEP2 winter outage (RFO-27 Feb 2012) nor in the HBRSEP2 fall outage (RFO-28 Sept 2013) as recommended by MRP-146. An inspection was not performed on 2RC-40 in the HBRSEP2 winter 2012 outage (RFO-27 Feb 2012) as recommended by MRP-146. Inspections will be performed on all four MRP-146 HBRSEP2 affected lines in the spring 2015 refueling outage (RFO-29). Since the MRP-146 frequency inspections are identified as an NEI 03-08 "Needed" element, misalignment with the recommended frequency of inspection is a "deviation" from the MRP-146 Rev 1 guidance.

Background:

In 1987 and 1988, thermal fatigue cracking and leakage in domestic PWR plants resulted in the issuance of the NRC Bulletin 88-08, "*Thermal Stresses in Piping Connected to Reactor Coolant Systems.*" The fatigue cracking was attributed to thermal cycling mechanisms not considered in initial plant design for the normally stagnant non-isolable lines attached to RCS piping (thermal fatigue stemming from in-leakage of cold water past a normally closed isolation valve toward the reactor coolant system which led to cyclic thermal stratification). The bulletin required plants to assess their susceptibility, perform inspections of suspect locations, and report back to NRC on plans to address the concerns. Based on the bulletin and the supplements, HBRSEP2 "completed an evaluation of the systems connected to the RCS at HBRSEP2 and determined that there were no unisolable piping systems that have the potential for inducing unacceptable thermal stresses as defined in NRC Bulletin 88-08". Also, no further actions were considered necessary to address the Supplement 3 to NRC Bulletin No. 88-08.

As result of continuing industry concerns with thermal stratification fatigue issues, in June 2005, the EPRI MRP issued MRP-146 providing additional industry guidance on the screening and evaluation of normally stagnant, non-isolable branch lines connected to RCS piping for thermal fatigue considerations. Based on MRP-146 guidance, all owners of PWR reactors needed to perform an initial MRP-146 assessment of their plants by June 2007. This initial assessment could lead to additional actions (e.g., thermal monitoring and/or inspection) to assure that thermal fatigue cracking would not occur within the screened-in lines. During this initial assessment, HBRSEP2 evaluated the 15 branch lines off the RCS, and 2 lines screened-in (i.e., did not meet the criteria), 3-RC-2501R-25 and 2-RC-2501R-40.

In November 2007, EPRI MRP issued letter MRP 2007-048, containing interim guidance for plants to perform "*initial*" inspections on screened-in lines, no later than the first refueling outage to occur after January 31, 2009. This interim guidance was issued under NEI 03-08 protocol as "Needed." In January 2009, EPRI replaced the interim guidance with issuance of letter MRP 2009-007 and technical report MRP-146S (supplement to MRP-146). Both MRP 2009-007 and MRP-146S also include the "Needed" guidance for plants to perform the "initial" inspections on screened-in lines no later than the first refueling outage to occur after January 31, 2009. The inspections are to be performed in accordance with the specific guidance contained within Section 2.4 of MRP-146. The MRP documents allow plants to take credit for any past inspections, conducted in accordance with the requirements of Section 2.4 of MRP-146, as satisfying the "Needed" requirement.

The two lines which screened in, 3-RC-2501R-25 and 2-RC-2501R-40 were scheduled and inspected (per NDEP-0425 modeled after the EPRI generic procedure, (Performance Demonstration Initiative – Ultrasonic Test (PDI-UT)-2) in accordance with MRP-146 guidance during RFO25 in the fall of 2008. Each line received 100% coverage and was judged "satisfactory" with no recordable indications.

An adverse condition investigation at the Harris Nuclear Plant, 341186-02, stated a corrective action enhancement to compile the initial MRP-146 evaluations into a calculation or an EC. During this work at HBRSEP2, in summer 2010, it was discovered that an additional two lines screened in and should also have been inspected. This condition was tracked through AR 418023. These two lines were inspected (per NDEP-0425 modeled after the EPRI generic procedure, PDI-UT-2) in RFO-27, winter 2012.

MRP-146 Rev. 1 was issued in 2011 and outlined a recommended frequency of inspection for all the screened-in normally stagnant non-isolable lines attached to RCS piping. Upon review of MRP-146 Rev. 1 for HBRSEP2 the frequency of inspection for the alternate charging line (3-RC-2501R-25) was determined to be at a frequency of every outage and the frequency of inspection for the drain lines off the RCS (2-RC-2501R-40, 2-RC-2501R-39 & 2-RC-2501R-38) was determined to be at a frequency of every other outage. This frequency of inspection was not communicated to the inservice inspection (ISI) program manager. Therefore, based on the NEI 03-08 "Needed" guidance within MRP-146 Rev. 1, HBRSEP2 should have performed additional volumetric (UT) inspections on the alternate charging line (3-RC-2501R-25) during winter 2012 (RFO-27) and fall 2013 (RFO-28) and additional volumetric (UT) inspections on the 'A' drain line (2-RC-2501R-40) during winter 2012 (RFO-27).

Technical Justification:

2RC-40 Drain Line Justification Statements

On the basis of the arguments below, it is reasonable to expect the initiation of a crack and development of a through wall leak will not occur in the 2RC-40 drain line during the period prior to the next scheduled MRP-146 inspection in Spring 2015:

1. Down-Horizontal (DH) Drain line 2RC-39 was inspected for MRP-146 in Spring 2012 with no recordable indications and is similar to the 2RC-40 DH drain line in question. In particular,
    a) The distance from the first elbow to the first vertical rigid support is approximately 13.5 feet for 2RC-40 as compared to approximately 10 feet 2RC-39; thus the 2RC-40 line is relatively more flexible. Thus for an assumed same stratification loading, the global bending stresses are smaller for the 2RC-40 line.
    b) The distance from the first elbow to the isolation valve is less than 2 feet from the elbow on line 2RC-40 and approximately 2.5 feet for 2RC-39; the geometries are comparable, thus the span over which the stratified temperatures are applied is comparable.

2. An estimate of alternating stress contribution from bending moment due to conservatively applied thermal stratification loads over distance Lh (see figure 1) was correlated to approximately the endurance limit of the material.

3. Based on a summary of relevant Operating Experience reported in MRP-2014-013 Assessment of thermal Fatigue OE to Identify MRP-146 Guidance Refinements", the time to grow through wall leaks on 1.5" - 2" drain lines whose failures were at least partially attributed to MRP-146, is on the order of 21 to 27 years. This well exceeds the 6.5 years between the last Robinson plant 2RC-40 MRP-146 inspection (Fall 2008) and the planned Spring 2015 MRP-146 inspection.

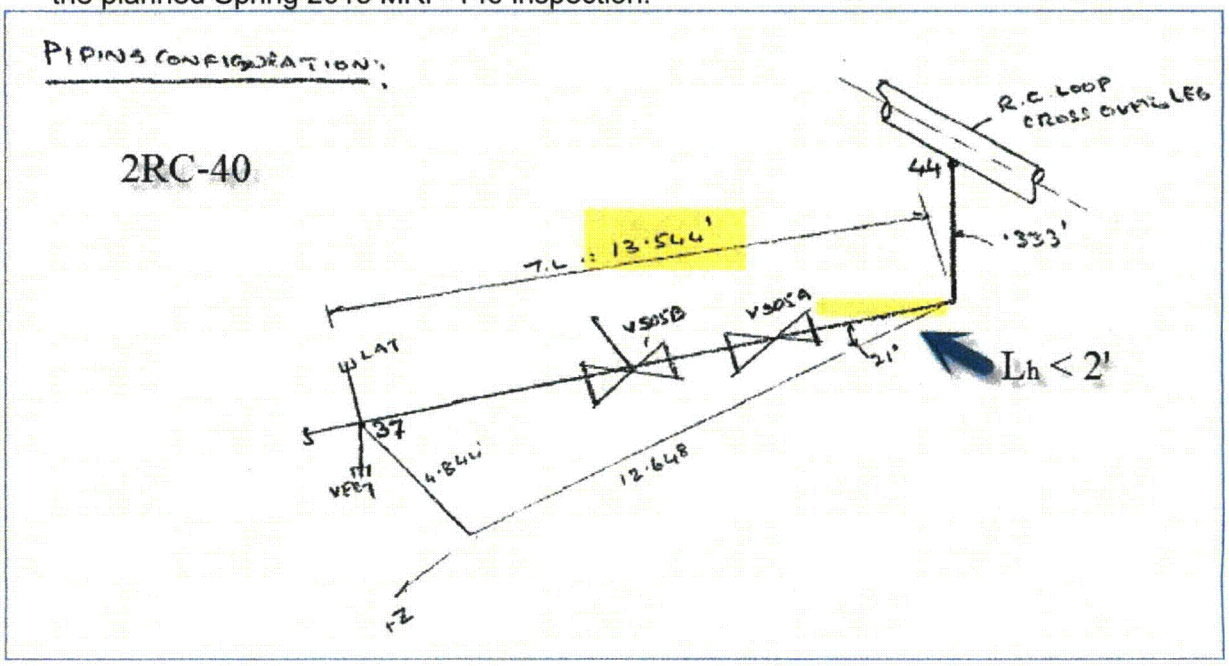

Figure 1 From Robinson pipe stress calculation

4. 2RC-40 Drain Line is insulated. Section 2.5.1.2 of MRP-146 mentions the use of insulation as a mitigation strategy for thermal stratification in DH configuration lines. The DH line, 2RC-40 at HBRSEP2 is insulated which "will result in a lower stratification temperature difference" to aid in mitigation or minimizing of fatigue effects of swirl penetration.

3RC-25 Alternate Charging Line Technical Justification

On the basis of the arguments below, it is reasonable to expect the initiation of a crack and development of a through wall leak will not occur in the 3RC-25 alternate charging line during the period prior to the next scheduled MRP-146 inspection in Spring 2015:

- The 3" Alternate Charging line screened in per the MRP-146 screening calculation; however, the alternate charging line has a "locked open" 3/4" bypass line around the normally isolated 3" isolation valve, thus there is low flow through the alternate charging line. Calculation documents show the estimated flow through the alternate charging line via the 3/4" bypass is approximately 2.66 gpm. Although this amount of flow is considered an estimate only, it is 1 to 2 orders of magnitude higher than the in-leakage flow predicted by MRP-170 model, for which cycling would occur for this line. Therefore, cycling is not expected to occur due to the MRP-146 phenomenon.
- Operational experience (OE) of thermal fatigue failures for Up-Horizontal (UH) lines has been predominantly the result of cold water in-leakage and all cracking was attributed to valve in-leakage where the fluid temperature was near ambient (i.e., in-leakage fluid was not pre-heated by a regenerative heat exchanger, such as is the case for the HBRSEP2 alternate charging line 3RC-25. Regenerative heat exchanger outlet temperature at HBRSEP2 is approximately 495°F.).

General Justification Statements

Postponement of re-inspection until the next refueling outage will not result in safety significant degradation. The results of a NRC sponsored study in 2000, NUREG/CR 6674 indicated that thermal fatigue does not have a significant contribution to core damage frequency and that utilities decision to address the potential effects in nonisolable lines should be a balanced decision based on both economic and plant safety considerations.

The limited thermal fatigue OE has also resulted in leakage that was easily detected by RCS leak rate or containment moisture or radiation monitoring so that safe shutdown was performed long before a safety significant situation occurred. Since the time of these leaks the industry has adopted the more stringent RCS leak rate monitoring action levels identified in WCAP-16465-NP and WCAP-16423-NP (implemented as documented in NCRs 237794, 237796, and 355604). In the unlikely event that leakage was to occur as a result of thermal fatigue at one of these locations, it would be detected by these enhanced leakage action levels long before a safety significant situation could occur.

There is a reasonable level of confidence that the risk of rupture of a 2-inch drain line or 3-inch alternate charging line is low. In addition, the HBRSEP2 Updated FSAR addresses current analyses for postulated rupture of piping inside containment. Section 15.6.2 includes 2-inch drain lines and the 3-inch alternate charging line and states: "The results of the Small Break LOCA analysis for the blowdown phase and the switchover phase, when analyzed at 102% of 2300 MWt, are well below acceptance criteria limits of 10 CFR 50.46 and demonstrate acceptability of operation with one high head safety injection (HHSI) pump."

Conclusion/Summary:

All of the HBRSEP2 four screened in normally stagnant non-isolable lines attached to the

RCS piping (3RC-25, 2RC-40, 2RC-38 and 2RC-39) have undergone initial inspection. Inspection of each line was satisfactory with no indications noted. No limitations were encountered on any of the examinations performed. All four examinations were performed by industry experienced PDI Level II personnel and NDE reports were reviewed by Ultrasonic Level III personnel.

The two lines with missed inspections (3RC-25 and 2RC-40) per the required inspection frequency of MRP-146 did receive initial inspections per the MRP-146 instructions.

The magnitude of in-leakage flow for which cycling can occur in the 3RC-25 alternate charging line is 1 to 2 orders of magnitude below the estimated normal operation flow through a 3/4" bypass line around the alternate charging isolation valve. The in-leakage fluid temperature in the 3RC-25 alternate charging line is pre-heated by the regenerative heat exchanger, whereas OE fatigue failures have predominately been the result of cold water in-leakage. Thus no thermal fatigue from the MRP-146 phenomenon would be expected.

Based on a review of the pipe stress calculation containing the 2RC-40 drain line geometry, it is considered to be more flexible than a comparable screened drain line 2RC-39 drain line, for which recent inspections have been performed.

Should the unanticipated event of a break in either of the screened in lines occur, the current small break LOCA analysis, described in the Updated FSAR 15.6.2, supports a 2" and 3" loss-of-coolant accident.

Thus, the missed MRP-146 inspections in RFO-27 (winter/spring 2012) and RFO-28 (fall 2013) does not compromise the two lines (3RC-25 and 2RC-40). All four screened in lines will again be inspected in RFO-29 (spring 2015). Postponement of the inspections is justified and poses negligible risk to the safe and reliable operation of the plant over the current operating cycle.

Inspection tasks for 3RC-25 and 2RC-40 have also been included on the forced Outage activity list, should a forced outage occur.

References

1. Materials Reliability Program: Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines (MRP-146, Revision 1). EPRI, Palo Alto, CA: 2011. 1022564.
2. MRP-2014-013 Assessment of thermal Fatigue OE to Identify MRP-146 Guidance Refinements"
3. HBRSEP2-M/MECH-1395 Rev. 001 DESIGN REVIEW FOR CVC - 312 A,B,C FOR HBRSEP2 CHECK VALVE DESIGN REVIEW PROJECT
4. HBRSEP2-M/STRS-1000 MRP-146, Rev. 0 " Screening of RCS Non-Isolable Stagnant Lines"
5. H.B. Robinson Nuclear Plant UFSAR Chapter 15.6.2 "Small Break Loss of Coolant Accidents"
6. Flow Diagram 5379-1971 Sh.1 of 2, Rev. 32 "Reactor Coolant System Flow Diagram"
7. Flow Diagram 5379-685, Rev. 57, "Chemical and Volume Control System Purification and Make-Up Flow Diagram"
8. RC-7-4701 Stress Calculation, Rev. 7 (2RC-40 Drain Line)
9. HBRSEP2-C/STRS-1064 Rev. 2 Stress Calculation (2RC-39 Drain Line)
10. HBRSEP2-M/MECH-1395, Rev. 1 "Design Review for CVC-312 A, B & C for HBRSEP2 Check Valve Design Review Project"