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

August 10, 2017

Mr. James J. Hutto
Regulatory Affairs Director
Southern Nuclear Operating Company, Inc.
P.O. Box 1295 / Bin - 038
Birmingham, AL 35201-1295

SUBJECT: EDWIN I. HATCH NUCLEAR PLANT, UNIT 2 – RELIEF REQUEST HNP-ISI-RR-05-01 REGARDING REACTOR PRESSURE VESSEL HEAD STUD INSERVICE INSPECTION REQUIREMENTS (CAC NO. MF9271)

Dear Mr. Hutto:

By letter dated February 17, 2017, Southern Nuclear Operating Company (SNC, the licensee) submitted relief request HNP-ISI-RR-05-01 requesting relief certain inservice inspection (ISI) requirements of Section IX of the 2001 Edition through the 2003 Addenda of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code for the Edwin I. Hatch Nuclear Plant (HNP), Unit 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.55a(g)(5)(iii), the licensee requested relief from the required surface examination of ASME BPV Code IWB-3515.2(c) that specifies surface examination requirements for the reactor pressure vessel studs. The licensee asserts that compliance with the specified ASME BPV Code requirement is impractical.

On February 17, 2017, the U.S. Nuclear Regulatory Commission (NRC) granted temporary verbal authorization for relief requested by HNP-ISI-RR-05-01 until the beginning of the next HNP, Unit 2, refueling outage (2R25). The NRC review concluded that SNC had adequately addressed all of the regulatory requirements and that the ASME BPV Code requirements were impractical. The enclosed safety evaluation provides the final regulatory and technical evaluation that authorizes HNP-ISI-RR-05-01 in accordance with 10 CFR 50.55a(g)(6)(i).

All other ASME BPV Code requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable.

If you have any questions, please contact the Project Manager, Randy Hall, at 301-415-4032 or by e-mail at Randy.Hall@nrc.gov.

Sincerely,

Michael T. Markley

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-366

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST HNP-ISI-RR-05-01

REGARDING INSERVICE INSPECTION OF REACTOR PRESSURE VESSEL HEAD STUD

EDWIN I. HATCH NUCLEAR PLANT, UNIT 2

SOUTHERN NUCLEAR OPERATING COMPANY

DOCKET NO. 50-366

1.0 INTRODUCTION

By letter dated February 17, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17048A090), Southern Nuclear Operating Company (SNC, the licensee) submitted relief request HNP-ISI-RR-05-01 requesting relief from certain inservice inspection (ISI) requirements of Section IX of the 2001 Edition through the 2003 Addenda of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPV Code) for the Edwin I. Hatch Nuclear Plant (HNP), Unit 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.55a(g)(5)(iii), the licensee requested relief from the required surface examination of IWB-3515.2(c) that specifies surface examination requirements for the reactor pressure vessel studs. The licensee asserts that compliance with the specified ASME BPV Code requirement is impractical.

On February 17, 2017, the U.S. Nuclear Regulatory Commission (NRC) granted temporary verbal authorization for relief requested by HNP-ISI-RR-05-01 until the beginning of the next HNP, Unit 2, refueling outage (2R25) (ADAMS Accession No. ML17052A035). The NRC staff review concluded that SNC had adequately addressed all of the regulatory requirements and that the ASME BPV Code requirements were impractical. This safety evaluation (SE) provides the final regulatory and technical evaluation that authorizes HNP-ISI-RR-05-01 in accordance with 10 CFR 50.55a(g)(6)(i).

2.0 REGULATORY EVALUATION

The licensee requested relief from the ASME BPV Code, Section XI, in accordance with 10 CFR 50.55a(g)(5)(iii). ASME BPV Code Class 1, 2, and 3 components must meet the requirements of Section XI of the ASME BPV Code as required by 10 CFR 50.55a(g)(4), which states, in part, that:

> Throughout the service life of a boiling or pressurized water-cooled nuclear power facility, components, (including supports) that are classified as ASME Code Class 1, Class 2, and Class 3 must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI of editions and addenda of the ASME BPV Code...

The licensee may request relief from portions of the ASME BPV Code as provided in 10 CFR 50.55a(g)(5)(iii), which states, in part, that:

> If the licensee has determined that conformance with a Code requirement is impractical for its facility the licensee must notify the NRC and submit, as specified in §50.4, information to support the determinations. Determinations of impracticality in accordance with this section must be based on the demonstrated limitations experienced when attempting to comply with the Code requirements during the inservice inspection interval for which the request is being submitted.

And, the NRC staff may grant relief from ASME BPV Code requirements as provided in 10 CFR 50.55a(g)(6)(i), which states that:

> The Commission will evaluate determinations under paragraph (g)(5) of this section that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

Given that 10 CFR 50.55a(g)(4) requires the use of the ASME BPV Code, Section XI, that 10 CFR 50.55a(g)(5)(iii) permits the licensee to request relief, and that 10 CFR 50.55a(g)(6)(i) permits the NRC staff to grant relief for requests submitted under 10 CFR 50.55a(g)(5), the NRC staff finds that, subject to the following technical evaluation, the licensee may request relief from the ASME BPV Code, Section XI, and the NRC staff has the regulatory authority to grant the requested relief.

3.0 <u>TECHNICAL EVALUATION</u>

3.1 Requested Relief

3.1.1 Component for Which Relief Is Requested

Relief request HNP-ISI-RR-05-01 applies to the HNP, Unit 2, Reactor Pressure Vessel (RPV) stud at location number 33. This stud is an ASME BPV Code, Section XI, Examination Category B-G-1, Item No. B6.20 component.

3.1.2 Code Edition and Addenda of Record

The applicable code of record is the 2001 Edition through the 2003 Addenda of the ASME BPV Code, Section XI.

3.1.3 Applicable ASME Code Requirements

The required examination for the RPV studs is a volumetric examination of 100 percent of the volume defined in Figure IWB-2500-12, "Closure Stud and Threads in Flange Stud Hole" of Section XI of the ASME BPV Code, as specified in Table IWB-2500-1, "Examination Categories" for Examination Category B-G-1, Item No. B6.20, "Pressure Retaining Bolting Greater Than 2 in. (50.8 mm) in Diameter." In addition, IWB-3515.2(c) of Section XI of the ASME BPV Code states that a flaw detected by volumetric examination in the stud shall be investigated by a surface examination.

3.1.4 Requested Relief

The licensee stated that during a volumetric examination of the 56 RPV studs of the HNP, Unit 2, RPV closure flange on February 7, 2017, it detected an indication in stud location number 33. Section IWB-3515.2(c) of Section XI of the ASME BPV Code requires surface examination of the stud if an indication is detected by volumetric examination, which necessitates removal of the stud. The licensee attempted to remove the stud prior to flooding the reactor cavity for fuel movement using on-site equipment, but was unsuccessful. The licensee planned two additional attempts to remove the stud, first with a "Basic Removal" technique, then with an "Advanced Removal" technique. The licensee stated that these two removal techniques have been successful at other utilities. However, in the event the stud cannot be removed using these techniques during refueling outage 2R24, the licensee stated that it would not be able to create a detailed plan and mobilize or design special equipment to successfully remove the stud without significantly extending the refueling outage. Accordingly, the licensee requested relief from the surface examination requirements of stud location number 33 on the basis of impracticality. The relief is requested until Mode 5 is achieved for refueling outage 2R25 at HNP, Unit 2.

The licensee's evaluations address the structural integrity of the 55 remaining RPV studs and RPV closure flange and leak integrity of the RPV flange interface if one stud is not in tension (i.e., no preload in the stud) or one stud fails during service. The structural evaluation consisted of two parts: (1) a calculation to show that the primary membrane stresses on the remaining studs remain below the design stress allowable value for the stud material, and (2) a finite element analysis to demonstrate that leaving one stud untensioned or one stud failing in service does not cause exceedance of the ASME BPV Code stress and fatigue limits in the remaining studs and RPV closure flange. In the leak integrity evaluation, the licensee determined the increase in RPV flange interface separation and compared that increase with the allowable flange separation.

3.2 NRC Staff Evaluation

3.2.1 Evaluation of Impracticality

The licensee requested relief from the surface examination requirements of IWB-3515.2(c), stating that it is impractical to meet the requirements because significant additional time would be needed to plan another removal technique if the two planned removal techniques are unsuccessful during refueling outage 2R24.

The NRC staff finds that the licensee's claim of impracticality of meeting the surface examination requirements of IWB-3515.2(c) is acceptable because the contingency stud removal technique would take significant additional outage time and resources to implement if the two planned stud removal techniques are not successful.

3.2.2 Primary Membrane Stress in Studs with One Untensioned Stud

The licensee calculated the primary membrane stress in each of the remaining studs considering the redistribution of forces and moments caused by one untensioned stud. The licensee reported a maximum primary membrane stress of 32.8 thousand pounds per square inch (ksi), which is below the allowable value of 36.3 ksi for the RPV stud material.

The NRC staff reviewed the calculation of primary stress with one untensioned stud. The NRC staff finds that the licensee's approach in determining the primary membrane stresses is acceptable, for the following reasons: (1) the calculation considered the change in restraint conditions due to one untensioned stud in the equilibrium equations to solve for the primary membrane stresses; (2) the distribution of the primary membrane stress shows that the studs immediately adjacent to the untensioned stud have the highest stress; and (3) the primary membrane stresses attenuate, as expected, for studs further away from the untensioned stud.

3.2.3 Finite Element Analysis, Stress Results, and Fatigue Usage

3.2.3.1 Finite Element Model and Analyses

The licensee used the finite element method (FEM) model developed for the HNP, Unit 2, RPV stud tensioning evaluation report (Reference 1 of Enclosure 2 of the submittal) to perform FEM analyses of the RPV closure flange with one untensioned stud or one stud that fails during service.

The NRC staff reviewed the FEM model information provided by the licensee. The FEM model is a three-dimensional, half-symmetry model of the RPV closure flange, which includes the RPV head, the RPV upper and lower flanges, vessel shell, and RPV studs. The licensee used appropriate elements to model these components (for example, solid elements for the RPV head, upper and lower flanges, and vessel shell and beam elements for the RPV studs). The licensee also used the appropriate elements to model the flange interface to determine the maximum separation of the mating surfaces of the upper and lower flanges (see Section 3.2.4 of this SE). The licensee applied the appropriate boundary conditions to the surfaces and nodes of the FEM model to ensure the proper structural behavior of the model. Examples of these boundary conditions are: (1) symmetry boundary conditions on the symmetry surfaces and (2) nodal coupling between the nodes of the top of the upper flange and top end of the studs. The NRC staff finds that these modeling techniques are consistent with standard industry practice. Therefore, the NRC staff concludes that the FEM model of the HNP, Unit 2, RPV closure flange is acceptable for use in the analyses.

The licensee evaluated the following six cases for the Hatch, Unit 2 RPV closure flange:

- Case A1 - all studs intact at preload condition
- Case A2 - preload condition with all studs intact at RPV design pressure
- Case B1 - one stud untensioned, other studs tensioned at preload condition

- Case B2 - one stud untensioned, other studs tensioned at RPV design pressure
- Case C1 - one stud fails, other studs tensioned at preload condition
- Case C2 - one stud fails during service, other studs tensioned at RPV design pressure

The NRC staff reviewed the six cases and finds they are sufficient to evaluate the impact of one untensioned stud or one stud that fails during service to the structural integrity of the 55 remaining RPV studs and RPV closure flange and to the RPV flange interface separation. Therefore, the NRC staff concludes that the use of the six cases is acceptable.

3.2.3.2 Stresses in the Studs and RPV Closure Flange Compared with ASME BPV Code Stress Limits

The licensee determined the increase in stress when the RPV is at design pressure (Cases B2 and C2 relative to Case A2). The licensee also showed the increase in stress for the preload condition (Cases B1 and C1 relative to A1) for comparison. The licensee added the increase in stress when the RPV is at design pressure to the limiting stresses in the original HNP, Unit 2, design basis stress report and compared the resulting stresses to the ASME BPV Code allowable stress limits. The NRC staff reviewed this approach and finds that adding the stress increase to the design basis stress conservatively estimates the maximum stresses in the studs and RPV closure flange. Therefore, the NRC staff finds the approach to be acceptable.

The NRC staff reviewed the resulting stresses from the above approach that were provided in Table 3, "Stress Increase Due to Stud Out of Service" of Enclosure 2 of the submittal. When the RPV is pressurized, having one untensioned stud or one stud that fails during service would lead to the remaining studs taking a slightly higher load, especially the studs closest to the untensioned or failed stud, and consequently, higher stresses in the remaining studs and RPV closure flange. The licensee presented values of the increased stresses in the remaining RPV studs and in the RPV closure flange and showed they are all below the ASME BPV Code stresses limits for normal and upset conditions. The licensee stated that meeting the ASME BPV Code requirements for normal and upset conditions bounds the requirements for emergency and faulted conditions. To demonstrate this, the licensee considered the internal pressure in the RPV during emergency and faulted conditions and the corresponding allowable stress for these conditions relative to normal conditions. Referring to the original design basis report, for the emergency condition, the licensee stated that the internal pressure is 1.08 times the normal condition pressure and the corresponding allowable stress is 1.2 times the normal condition allowable stress. For the faulted condition, the licensee stated that the internal pressure is lower than the normal condition pressure, and is therefore acceptable. The NRC staff reviewed the licensee's evaluation for emergency and faulted conditions and finds that it considered the internal pressure load and allowable stress from the original RPV design basis report. Therefore, the NRC staff finds this acceptable for demonstrating how these conditions are bounded by the normal and upset conditions

Based on the above, the NRC staff concludes that the licensee's evaluation of the stresses in the RPV closure flange and RPV studs is acceptable. Additionally, the NRC concludes that the higher stresses resulting from one untensioned stud or one stud that fails during service will not exceed the ASME BPV Code stress limits for all service conditions.

3.2.3.3 Fatigue Usage

The licensee considered the impact on fatigue usage of one untensioned stud or one stud that fails during service by: (1) comparing the increase in stress in the RPV studs and RPV closure flange discussed in Section 3.2.3.2 of this SE, (2) relating the increase back to the alternating stress using the design basis fatigue curves, and (3) estimating the decrease in allowable number of cycles. The licensee then related the lower allowable number of cycles to the increase in fatigue usage from the design basis fatigue usage values.

The licensee demonstrated using the simplified approach summarized above that with the approximately 1 percent increase in stresses in the stud and RPV closure flange, the fatigue usages would be below the ASME BPV Code allowable of 1.0.

The NRC staff reviewed the licensee's simplified approach of evaluating the increase in fatigue usage and finds that: (1) it considered the correct stress (stress intensity in the RPV closure flange and membrane-plus-bending stress in the stud) for estimating the increase in alternating stress and the corresponding decrease in allowable number of cycles; (2) the licensee related the increase in fatigue usage to the original design basis fatigue usage values; and (3) the decrease in allowable number of cycles was determined for the full service life of HNP, Unit 2, whereas the relief request is only for one cycle of operation. The increase in fatigue usage would thus be lower than the increase in fatigue usage estimated by the licensee. Based on the above, the NRC staff concludes that the higher stresses resulting from one untensioned stud or one stud that fails during service will not exceed the ASME BPV Code allowable fatigue usage value of 1.0 before the next refueling outage and that structural integrity of the tensioned studs and RPV closure flange will be maintained.

3.2.4 RPV Flange Interface Separation

The licensee compared the calculated increase in maximum separation of the RPV flanges for the case when all studs are intact with the cases when one stud is untensioned or one stud fails in service (Case A2 relative to Case B2 or Case C2) and determined the maximum difference between the cases. This calculation is based on the FEM analysis (discussed in Section 3.2.3.1 of this SE) that shows that the maximum separation is less than the allowable separation specified in the RPV tensioning report. The NRC staff finds that the licensee modeled the RPV flange interface and analyzed the appropriate cases properly.

The licensee stated that a Class 1 system leakage test will be performed before start-up to verify the integrity of the RPV head joint. The licensee stated that the system leakage test pressure shall correspond to a rated RPV pressure (at least 1,045 psig) and be attained at a rate in accordance with the NRC-approved Pressure/Temperature limit curves and procedures. After the test conditions are attained, the licensee will perform visual examination for leakage (VT-2). In addition, during plant operation, the licensee will monitor the bleed off line between the double o-ring seal by a pressure switch with an annunciator in the control room to ensure that the leak integrity of the RPV closure flange interface is maintained. The NRC staff reviewed the information regarding the leakage test and concludes that performing the ASME BPV Code-required system leakage test before start-up from refueling outage 2R24 supports verifying the leak integrity of the RPV closure flange interface.

Based on the above, the NRC staff concludes that having one untensioned stud or one stud that fails during service will not cause the separation of the RPV flange interface to exceed the allowable separation and that the licensee has adequately demonstrated leak integrity of the RPV flange interface. Additionally, the NRC staff finds that the VT-2 examination and the monitoring of the bleed off line provides reasonable assurance of leak detection through the RPV closure flange interface should a leak occur.

4.0 CONCLUSION

As set forth above, the NRC staff concludes that the ASME BPV Code, Section XI, required surface examination of IWB-3515.2(c) is impractical for the HNP, Unit 2, RPV head stud number 33 as described in relief request HNP-ISI-RR-05-01. Furthermore, the NRC staff concludes that the licensee has provided reasonable assurance of structural integrity of the remaining studs and RPV closure flange, and leak integrity and detection of the RPV closure flange, at HNP, Unit 2, if the stud at location number 33 is left untensioned or fails in service. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(5)(iii) and granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law, will not endanger life or property, or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Therefore, in accordance with 10 CFR 50.55a(g)(6)(i), the NRC staff grants relief request HNP-ISI-RR-05-01 from refueling outage 2R24 to the beginning of refueling outage 2R25 at HNP, Unit 2.

Principle Contributor: D. Dijamco

Date: August 10, 2017

SUBJECT: EDWIN I. HATCH NUCLEAR PLANT, UNIT 2 – RELIEF REQUEST HNP-ISI-RR-05-01 REGARDING REACTOR PRESSURE VESSEL HEAD STUD INSERVICE INSPECTION REQUIREMENTS (CAC NO. MF9271)
DATED: AUGUST 10, 2017

cc w/encl: Distribution via Listserv

DISTRIBUTION:
PUBLIC
LPL2-1 R/F
RidsNrrLAKGoldstein Resource
RidsACRS_MailCTR Resource
RidsRgn2MailCenter Resource
RidsNrrDorlLpl2-1 Resource
RidsNrrDeEvib Resource
DDijamco, NRR
RidsNrrPMHatch Resource

ADAMS Accession No.: ML17205A345 *by e-mail

OFFICE	NRR/DORL/LPL2-1/PM	NRR/DORL/LPL2-1/PM	NRR/DORL/LPL2-1/LA	NRR/DE/EVIB/BC*
NAME	MOrenak	RHall	KGoldstein	DRudland
DATE	08/03/17	08/04/17	08/02/17	07/09/17
OFFICE	NRR/DORL/LPL2-1/BC			
NAME	MMarkley			
DATE	08/10/17			

OFFICIAL RECORD COPY