



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

February 21, 2023

Ms. Cheryl A. Gayheart
Regulatory Affairs Director
Southern Nuclear Operating Co., Inc.
3535 Colonnade Parkway
Birmingham, AL 35243

SUBJECT: EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2 - AUDIT SUMMARY FOR
LICENSE AMENDMENT REQUEST TO RELAX REQUIRED NUMBER OF
FULLY TENSIONED REACTOR PRESSURE VESSEL HEAD CLOSURE
BOLTS (EPID L-2022-LLA-0120)

Dear Ms. Gayheart:

By letter dated August 19, 2022, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22231B055), Southern Nuclear Operating Company (SNC, the licensee) submitted a license amendment request (LAR) for Edwin I. Hatch Nuclear Plant (Hatch), Units 1 and 2. The LAR proposes to relax the required number of fully tensioned reactor pressure vessel (RPV) head closure bolts in Technical Specification (TS) Table 1.1-1, "MODES" of Hatch, Units 1 and 2.

By letter dated November 17, 2022 (ML22320A072), the U.S. Nuclear Regulatory (NRC) staff issued an audit plan regarding the SNC's LAR as part of the NRC staff's review.

To support its review, the NRC staff conducted a regulatory audit from November 30, 2022, through January 31, 2023. The NRC staff reviewed documents and held discussions with members of SNC and its contractors. The regulatory audit summary is provided as an enclosure to this letter.

C. Gayheart

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If you have any questions, please contact me by telephone at (301) 415-5905 or by e-mail at Dawnmathews.Kalathiveettil@nrc.gov.

Sincerely,

/RA/

Dawnmathews Kalathiveettil, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-321 and 50-366

Enclosure:
Audit Summary

REGULATORY AUDIT SUMMARY
BY THE OFFICE OF NUCLEAR REACTOR REGULATION
FOR THE LICENSE AMENDMENT REQUEST
TO RELAX THE REQUIRED NUMBER OF FULLY TENSIONED
REACTOR VESSEL HEAD CLOSURE BOLTS IN
TECHNICAL SPECIFICATION TABLE 1.1-1, "MODES"
EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2
SOUTHERN NUCLEAR OPERATING COMPANY
DOCKET NOS.: 50-321 AND 50-366
EPID NO: L-2022-LLA-0120

1.0 BACKGROUND

By application dated August 19, 2022 (Agencywide Documents Access and Management System Accession No. ML22231B055), Southern Nuclear Operating Company (SNC, the licensee) submitted a license amendment request (LAR) to the United States Nuclear Regulatory Commission (NRC) to amend Renewed Operating License Nos. DPR-57 and NPF-5 for the Edwin I. Hatch Nuclear Plant (Hatch), Units 1 and 2, respectively. Specifically, the proposed LAR would relax the required number of fully tensioned reactor pressure vessel (RPV) head closure bolts in Technical Specification (TS) Table 1.1-1, "MODES" of the Hatch units.

The licensee included with the application calculations performed by Dominion Engineering, Inc. (DEI) that determined the impact of out-of-service bolts on RPV closure stresses, bolt stresses, closure flange separation, and fatigue usage. These DEI calculations are documented in C-037-2201-00-01, Revision 0, "Hatch Unit 1 Operation with One Stud Out of Service Evaluation" (Enclosure 2 to the application) and C-037-2201-00-02, Revision 0, "Hatch Unit 2 Operation with Two Studs Out of Service Evaluation" (Enclosure 3 to the application).

2.0 AUDIT SCOPE AND PURPOSE

By letter dated November 17, 2022 (ML22320A072), the NRC staff issued an audit plan regarding the licensee's LAR as part of the NRC staff's review. The audit plan includes a staff review of the structural evaluation provided in the above DEI calculations, with a focus on the finite element analyses documented in the calculations. Two specific objectives of the audit of the structural evaluation were to gain an understanding of the reason for the decrease in stress in the closure bolts going from the preload condition to the preload plus pressure condition, as well as to gain a better understanding of the hypothetical case of bolts failing in service described in the DEI calculations. These specific objectives are reflected in Part 1 of Section 3.0 of the audit plan, Items #1 through #6 listed in Attachment 1 of the audit plan, and Question 5 in Attachment 2 of the audit plan.

3.0 AUDIT LOGISTICS

On December 1, 2022, the NRC staff conducted its audit of the structural evaluation at the DEI office in Reston, Virginia. The audit was conducted by members of the Office of Nuclear Reactor Regulation (NRR) including Dawnmathews Kalathiveettil, Project Manager for Hatch Units 1 and 2 in the Division of Operating Reactor Licensing; Stewart Bailey, Branch Chief of the Mechanical Engineering & Inservice Testing Branch in the Division of Engineering and External Hazards; David Dijamco, Technical Reviewer in the Vessels and Internals Branch in the Division of New and Renewed Licenses; Kaihwa (Robert) Hsu, Senior Mechanical Engineer in the Mechanical Engineering & Inservice Testing Branch in the Division of Engineering and External Hazards; Michael Breach, Mechanical Engineer in the Mechanical Engineering & Inservice Testing Branch in the Division of Engineering and External Hazards; and Ravi Grover, Safety and Plant Systems Engineer in the Technical Specifications Branch in the Division of Safety Systems.

4.0 AUDIT REPORT – PART 1

During the audit on December 1, 2022, the licensee presented information on Part 1 of Section 3.0 of the audit plan, Items #1 through #6 listed in Attachment 1 of the audit plan, and Question 5 in Attachment 2 of the audit plan. The licensee also responded to Questions 1 through 4 in Attachment 2 of the plan. During the audit, the NRC staff discussed these items and questions with the licensee and made the following relevant observations.

Part 1, Items #1 through #6, and Question 5

- DEI presented displacement plots of a finite element model of one of the Hatch reactor vessel closure assemblies (which consists of the reactor closure head, reactor vessel shell, reactor vessel upper and lower flanges and the closure bolts) that was analyzed in one of the DEI calculations included with the LAR application. These displacement plots were for the preload and preload-plus-pressure cases. DEI showed that for the preload case, the reactor vessel upper and lower flange mating surfaces rotate; specifically, the flange mating surfaces move away from each other at the inner side and move toward each other (i.e., “pinch”) at the outer side. When pressure is added (i.e., the preload-plus-pressure load case), the flange mating surfaces rotate even more. DEI explained that this happens in boiling water reactors (BWR), such as the Hatch units, when the flanges are typically much stiffer than the shell portion of the reactor closure head and reactor vessel. Since the closure bolts are at a radial location where the flanges “pinch” when pressure is added, the initial stress (i.e., the preload) in the closure bolts decreases when pressure is added.
- For comparison, DEI presented similar displacement plots for a reactor vessel closure assembly of a pressurized water reactor (PWR). DEI explained that for a PWR vessel closure assembly, the stress in the closure bolts could increase in going from the preload case to the preload-plus-pressure case. DEI stated that this is because when pressure is added, the flange mating surfaces rotate as in BWRs, but there is less rotation in the upper flange, which leads to less pinching in the flanges compared to the preload only case. DEI explained that this occurs because the *difference* in stiffness between the flange and shell portions of a PWR vessel closure assembly is less than that of a BWR vessel closure assembly because the reactor closure head and reactor vessel shell of PWRs are thicker than those of BWRs.

- DEI explained the use of the three-dimensional spar elements to model the interface between the upper and lower flanges and nodal coupling to simulate full friction of the flange mating surfaces.
- DEI stated that the load cases analyzed with the finite element analyses in the DEI did not include thermal loads.
- DEI stated that the hypothetical case of closure bolts failing in service described in the DEI calculations was not a dynamic case. To illustrate this, DEI showed completed solutions in the finite element software, ANSYS, that was used in the DEI calculations included with LAR application: one for the case when closure bolts are preloaded and one for the case when a bolt fails in service.
- DEI clarified specific aspects of the finite element modeling techniques used in the DEI calculations, including aspects regarding use of latest elements, rotational constraints, setting of preload in the closure bolt elements, use of simulation files with pressure set a design pressure, command use to simulate untensioned/failed bolt, and use of macros.
- The NRC staff stated that a docketed response is not needed to address Question 5.

Questions 1 through 4

The NRC staff stated that docketed responses are not needed to address Questions 1 and 4. For Questions 2 and 3, the NRC staff stated that docketed responses would be needed, and therefore, will issue requests for additional information (RAIs).

5.0 AUDIT REPORT – PART 2

The NRC staff held a virtual audit meeting with SNC/DEI on December 14, 2022. The NRC discussed with SNC/DEI the information requested under Part 2 of the Audit Plan, Item Nos. 7 through 11 in “Audit Items List,” and audit questions 6 through 9.

6.0 CONCLUSION

As a result of the audit, the NRC staff gained a better understanding of the decrease in stress in the closure bolts going from the preload condition to the preload plus pressure condition and a better understanding of the FEA simulation of the case of closure bolts failing in-service. As a result of the audit, the NRC staff issued RAIs dated December 21, 2022 (ML22355A208). SNC responded to the RAI by letter dated January 20, 2023 (ML23020A902).

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OFFICE	NRR/DORL/LPL2-1/PM	NRR/DORL/LPL2-1/LA	NRR/DEX/EMIB/BC	NRR/DNRL/NVIB/BC
NAME	DKalathiveetil	KGoldstein	SBailey	DWidrevitz (A)
DATE	02/03/2023	02/06/2023	02/08/2023	02/07/2023
OFFICE	NRR/DSS/STSB/BC	NRR/DORL/LPL2-1/BC	NRR/DORL/LPL2-1/PM	
NAME	VCusumano	MMarkley	DKalathiveetil	
DATE	02/08/2023	02/08/2023	02/21/2023	

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