



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

May 30, 2019

Mr. Bryan C. Hanson
Senior Vice President
Exelon Generation Company, LLC
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2 – ISSUANCE OF RELIEF REQUEST I5R-05 RE: RELIEF FROM THE REQUIREMENTS OF THE ASME CODE (EPID L-2018-LLR-0392)

Dear Mr. Hanson:

By letter dated December 19, 2018 (Agencywide Documents Access and Management System Accession No. ML18354A431), Exelon Generation Company, LLC (Exelon, the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives to certain American Society of Mechanical Engineers Boiler & Pressure Vessel Code (ASME Code), Section XI requirements at Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (Calvert Cliffs). The purpose of this letter is to provide the results of the NRC staff's review of the proposed alternative identified in Relief Request I5R-05, Revision 0. The NRC staff will provide separate correspondence regarding the other two requests (Relief Requests I5R-03 and I5R-04) in the licensee's letter dated December 19, 2018.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. In Relief Request I5R-05, Revision 0, the licensee proposed an alternative to the requirement of using volumetric examination technique with 100 percent of the reactor pressure vessel flange threaded stud holes examined every inservice inspection interval.

As set forth in the enclosed safety evaluation, the NRC staff has reviewed the subject request and determines that the proposed alternative provides an acceptable level of quality and safety. Exelon has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the proposed alternative for the fifth inservice inspection interval at Calvert Cliffs.

All other ASME Code requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

B. Hanson

- 2 -

If you have any questions, please contact the Calvert Cliffs Project Manager, Michael L. Marshall, Jr., at (301) 415-2871 or Michael.Marshall@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "James G. Danna". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

Enclosure:
Safety Evaluation

cc: Listserv



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO. I5R-05, REVISION 0

EXELON GENERATION COMPANY, LLC

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2

DOCKET NOS. 50-317 AND 50-318

1.0 INTRODUCTION

By letter dated December 19, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18354A431), Exelon Generation Company, LLC (Exelon, the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives to certain American Society of Mechanical Engineers Boiler & Pressure Vessel Code (ASME Code), Section XI requirements at Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (Calvert Cliffs).

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the proposed alternative in Relief Request I5R-05, Revision 0, on the basis that it provides an acceptable level of quality and safety. In Relief Request I5R-05, Revision 0, the licensee proposed an alternative to the requirement of using volumetric examination technique with 100 percent of the reactor pressure vessel (RPV) flange threaded stud holes examined every inservice inspection interval during the fifth inservice inspection interval (ISI) at Calvert Cliffs.

2.0 REGULATORY EVALUATION

The regulations in 10 CFR 50.55a(g)(4) state, in part, that ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in Section XI of the applicable editions and addenda of the ASME Code to the extent practical within the limitations of design, geometry, and materials of construction of the components. The threads in the RPV flange are categorized as ASME Code Class 1 components. Therefore, per 10 CFR 50.55a(g)(4), ISI of these threads must be performed in accordance with Section XI of the applicable edition and addenda of the ASME Code.

The regulations in 10 CFR 50.55a(z) state:

Alternatives to the requirements of paragraphs (b) through (h) of this section [50.55a] or portions thereof may be used when authorized by the Director, Office of Nuclear Reactor Regulation, or Director, Office of New Reactors, as

appropriate. A proposed alternative must be submitted and authorized prior to implementation. The applicant or licensee must demonstrate that:

- (1) *Acceptable level of quality and safety.* The proposed alternative would provide an acceptable level of quality and safety; or
- (2) *Hardship without a compensating increase in quality and safety.* Compliance with the specified requirements of this section [50.55a] would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that the licensee may propose an alternative to ASME Code, Section XI, and the NRC staff has the regulatory authority to authorize the licensee's proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Request for Alternative

3.1.1 ASME Code Components Affected

Proposed alternative I5R-05 applies to the RPV threads in flange Examination Category B-G-1, Item No. B6.40, in Section XI of the ASME Code.

Examination Category	Item No.	Examination Method	Description	Code Class
B-G-1	B6.40	Volumetric	RPV Threads in Flange	1

3.1.2 Applicable ASME Code Edition and Addenda

For the fifth 10-year ISI interval at Calvert Cliffs, the Code of Record for the inspection of ASME Code Class 1, 2, and 3 components is the 2013 Edition of the ASME Code, Section XI.

3.1.3 Applicable ASME Code Requirements and Proposed Alternative

The applicable inspection requirement for this component is contained in Examination Category B-G-1, Item No. B6.40, which is listed in Table IWB-2500-1, "Examination Categories," of the ASME Code, Section XI. This item requires volumetric examination every ISI interval of all the threads in RPV flange stud holes, as indicated in Figure IWB-2500-12, "Closure Stud and Threads in Flange Stud Hole," of the ASME Code, Section XI. The licensee proposes to eliminate the ASME Code requirement to volumetrically examine the threads in the RPV flange stud holes.

3.1.4 Licensee's Technical Basis for Proposed Alternative

The licensee stated that the technical basis for eliminating the RPV threads in flange volumetric examinations is provided in Electric Power Research Institute (EPRI) Report No. 3002007626, "Nondestructive Evaluation: Reactor Pressure Vessel Threads in Flange Examination

Requirements,” dated March 2016 (the “EPRI report”) (ADAMS Accession No. ML16221A068). The licensee discussed the potential degradation mechanisms, bounding stress analysis, flaw tolerance evaluation, and operating experience that were included in the EPRI report and concludes that these justify the elimination of volumetric examination of RPV threads. The licensee performed a stress analysis specific to Calvert Cliffs and compared the plant-specific preload stress to the bounding preload stress provided in the EPRI report. The licensee found that the preload stress for the Calvert Cliffs units (calculated as 30,747 pounds per square inch (psi)) was bounded by the preload stress in the EPRI report (calculated as 42,338 psi). The licensee noted that the conclusion from the EPRI evaluation states:

[...] the current requirements are not commensurate with the associated burden (worker exposure, personnel safety, radwaste, critical path time, and additional time at reduced water inventory) of the examination.

The licensee also stated that the requirements in Relief Request I5R-05 are based on ASME Code Case N-864, which has been approved by the ASME Board on Nuclear Codes and Standards. ASME Code Case N-864 states that the examination requirements of Examination Category B-G-1, Item Number B6.40, are not required. Additionally, the licensee stated that Calvert Cliffs uses detailed procedures for the care and visual inspection of the RPV threads in flange and studs every time the RPV head is removed.

The licensee provided a detailed description of the maintenance activities and inspections that will be performed on the RPV threads in flange and studs each time the RPV head is removed during the fifth ISI interval. The plant-specific procedures controlling these activities were identified. The licensee stated that these controlled maintenance activities provide assurance that any degradation would be detected and mitigated prior to returning the reactor to service.

3.1.5 Duration of Proposed Alternative

Proposed alternative I5R-05 is requested for the fifth ISI interval for Calvert Cliffs. The fifth ISI interval for Calvert Cliffs is scheduled to begin on July 1, 2019, and end on June 30, 2029.

3.2 NRC Staff Evaluation

The basis for proposed alternative I5R-05 is provided in the EPRI report. By letter dated January 26, 2017 (ADAMS Accession No. ML17006A109), the NRC staff authorized Southern Nuclear Operating Company, Inc. (Southern Nuclear) to use a similar alternative that was based on the generic stress analysis and flaw tolerance evaluation in the EPRI report. The NRC staff’s evaluation of the EPRI report is documented in Section 3.2.1, “The EPRI’s Generic Stress Analysis and Flaw Evaluation,” of the Southern Nuclear safety evaluation. The information in Section 3.2.1 of the Southern Nuclear safety evaluation concludes that the generic stress analysis and flaw tolerance evaluation in the EPRI report are acceptable, and the results can be used to support eliminating the RPV threads in flange examination. It should be noted that this conclusion was drawn in the context of authorizing the elimination of the volumetric inspection for a single 10-year ISI interval.

The NRC staff confirmed that the licensee performed the stress analysis consistent with the EPRI report. The NRC staff also verified the licensee calculation of preload stress at Calvert Cliffs (30,747 psi) and verified that it was bounded by the preload stress in the EPRI report (42,338 psi).

The NRC staff confirmed that the licensee performed a linear elastic fracture mechanics evaluation consistent with the ASME Code, Section XI, IWB-3600, and the EPRI report. The licensee used a maximum applied stress intensity factor (K) of 19.8 kilopounds per square inch square root inch (ksi√inch) for the combined pressure, preload, and thermal stress, consistent with the EPRI report. The allowable K based on the acceptance criteria in ASME Section XI, IWB-3610, for the RPV flange material is 69.6 ksi√inch. The NRC staff conclude that, since the allowable K is far greater than the applied K for all postulated crack depths, the threads in the RPV flange are reasonably flaw tolerant at operating temperatures.

The NRC staff reviewed the licensee's description of the maintenance activities and inspections that will be performed on the RPV threads in flange and studs each time the RPV head is removed during the fifth ISI interval. The licensee stated that the stud holes would be inspected as part of the stud cleaning and lubrication operation. The licensee also stated that if nonconforming conditions are identified, a corrective action report, consistent with 10 CFR Part 50, Appendix B, would be initiated to document the conditions. The NRC staff finds that the licensee's maintenance activities provide an opportunity, at frequent intervals, for the licensee to detect and mitigate degradation of the threads in flange during the fifth ISI interval. These maintenance activities, combined with the linear elastic fracture mechanics evaluation discussed in the prior paragraph, provide a defense in depth to the possibility of component failure resulting from undetected and unmitigated cracking.

The NRC staff notes that the basis for the acceptability of the proposal is Code Case N-864, which the licensee correctly identified as being approved by the ASME Code and supported by a generic fatigue crack growth analysis contained in the EPRI report. The NRC staff also notes that some measure of defense in depth must be provided in the event of an alternate mode of failure. Therefore, in its review, the NRC concentrated on:

- (1) the adequacy of the generic fatigue crack growth analysis,
- (2) the applicability of the generic analysis to the licensee, and
- (3) the adequacy of the defense-in-depth measures proposed by the licensee.

In summary, the NRC staff concludes that the stress analysis and flaw tolerance evaluation in the generic EPRI evaluation are bounding for Calvert Cliffs.

4.0 CONCLUSION

As set forth above, the NRC staff has reviewed the subject Relief Request I5R05, Revision 0, and determines that the proposed alternative provides an acceptable level of quality and safety. Exelon has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the proposed alternative for fifth ISI interval at Calvert Cliffs.

All other ASME Code requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Joel Jenkins

Date: May 30, 2019

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2 – ISSUANCE OF RELIEF REQUEST I5R-05 RE: RELIEF FROM THE REQUIREMENTS OF THE ASME CODE (EPID L-2018-LLR-0392) MAY 30, 2019

DISTRIBUTION:

- Public
- PM File Copy
- RidsNrrDorlLpl1 Resource
- RidsNrrPMCalvertCliffs Resource
- RidsNrrLALRonewicz Resource
- RidsACRS_MailCTR Resource
- RidsRgn1MailCenter Resource
- RidsNrrDmlrMvib Resource
- JJenkins, NRR
- JQuichocho, OEDO
- MMcCoppin, OEDO

ADAMS Accession No.: ML19134A373

*by e-mail

OFFICE	NRR/DORL/LPL1/PM	NRR/DORL/LPL1/LA	NRR/DMLR/MVIB/BC*
NAME	MMarshall	LRonewicz	DAlley
DATE	05/17/19	05/17/19	04/26/19
OFFICE	NRR/DORL/LPL1/BC	NRR/DORL/LPL1/PM	
NAME	JDanna	MMarshall	
DATE	05/24/19	05/30/19	

OFFICIAL RECORD COPY