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

March 10, 2016

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

SUBJECT: CLINTON POWER STATION, UNIT 1 – USE OF BWRVIP GUIDELINES IN LIEU OF SPECIFIC ASME CODE REQUIREMENTS (CAC NO. MF6115)

Dear Mr. Hanson:

By letter dated April 10, 2015, as supplemented by letters dated September 29 and November 24, 2015 (Agencywide Documents Access and Management System (ADAMS) Nos. ML15100A228, ML15272A029, and ML15328A514, respectively), Exelon Generation Company, LLC (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) concerning the use of the Boiling Water Reactor Vessel and Internals Project (BWRVIP) guidelines as an alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) requirements at Clinton Power Station, Unit 1 (CPS), and Nine Mile Point Nuclear Station, Units 1 and 2 (NMPNS). This letter applies to CPS only. The request related to NMPNS is still under review at the NRC.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee requested to use the proposed alternative on the basis that it provides an acceptable level of quality and safety.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the alternative proposed by the licensee will ensure that the integrity of the reactor pressure vessel interior surfaces, attachments, and core support structures, is maintained with an acceptable level of quality and safety and has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). The licensee clarified that any revised version of a BWRVIP report used to satisfy the alternatives will meet or exceed the BWRVIP inspection and evaluation (I&E) guidelines of its original version, and if it does not meet this criteria, NRC staff approval is mandatory prior to its implementation.

All other requirements of ASME Code, Section XI, for which the alternative has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear In-service Inspector. Any ASME Code, Section XI, reactor vessel internals (RVI) components that are not included in Section 3.1.1 of this safety evaluation will continue to be inspected in accordance with the ASME Code, Section XI, requirements. The inspection and evaluation guidelines addressed in the relevant BWRVIP reports should be implemented for the non-ASME Code, Section XI, RVI components at CPS.

The NRC staff acknowledges that the BWRVIP Executive Committee periodically revises the BWRVIP guidelines to include enhancements in inspection techniques and flaw evaluation methodologies. While the licensee may choose to implement enhancements described in a revised version of the referenced BWRVIP inspection guideline, the licensee is expected to continue to meet the requirements of the version of the BWRVIP inspection guidelines that forms the safety basis for the NRC staff authorized proposed alternative to the requirements of 10 CFR 50.55a.

If you have any questions, please contact Ms. Eva A. Brown at 301-415-2315 or via e-mail at Eva.Brown@nrc.gov.

Sincerely,

Justin C. Poole, Acting Branch Chief
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-461

Enclosure:
Safety Evaluation

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO. I3R-10 FOR THE THIRD 10 YEAR INTERVAL

INSERVICE INSPECTION FOR

EXELON GENERATION COMPANY, LLC

CLINTON POWER STATION, UNIT 1

DOCKET NO. 50-461

1.0 INTRODUCTION

By letter dated April 10, 2015, as supplemented by letters dated September 29 and November 24, 2015 (Agencywide Documents Access and Management System (ADAMS) Nos. ML15100A228, ML15272A029, and ML15328A514, respectively), Exelon Generation Company, LLC (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC or Commission) concerning the use of the Boiling Water Reactor Vessel and Internals Project (BWRVIP) guidelines as an alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) requirements at Clinton Power Station, Unit 1 (CPS), and Nine Mile Point Nuclear Station, Units 1 and 2 (NMPNS). The NRC's review of the NMPNS submittal will be issued under separate cover.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee requested to use the proposed alternative on the basis that it provides an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

The inservice inspection (ISI) of ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by 10 CFR 50.55a(g), except where specific relief has been granted by the NRC pursuant to 10 CFR 50.55a(g)(6)(i). Pursuant to 10 CFR 50.55a(z), alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC if the proposed alternatives would provide an acceptable level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system

pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(a)(1)(ii), 12 months prior to the start of the 120-month interval, subject to the conditions listed in 10 CFR 50.55a(b)(2).

The regulations in 10 CFR 50.55a(g)(4)(iv) state that the inservice examination of components and system pressure tests may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in paragraph 10 CFR 50.55a(a), subject to the limitations and modifications listed in 10 CFR 50.55a(b), and subject to Commission approval. Portions of editions or addenda may be used provided that all related requirements of the respective editions or addenda are met. The applicable ASME Code of Record for the third 10-year ISI interval for CPS is the ASME Code, Section XI, 2004 Edition.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Request for Alternative

3.1.1 Components for Which an Alternative is Requested

Section XI, ASME Code Class 1, Examination Categories B-N-1 and B-N-2, Code Item Nos. B13.10, Vessel Interior, B13.20, Interior Attachments within Beltline Region, B13.30, Interior Attachments Beyond Beltline Region, and B13.40, Core Support Structure.

3.1.2 Examination Requirements from Which an Alternative is Requested

Section XI, ASME Code, requires the visual examination (VT) of certain reactor vessel internals (RVI) components. These examinations are included in Table IWB-2500-1, Categories B-N-1 and B-N-2, and are identified with the following item numbers:

> B13.10 - Examine accessible areas of the reactor pressure vessel interior surfaces each period using a technique which meets the requirements for a VT-3 examination, as defined in paragraph IWA-2213 of the ASME Code, Section XI (B-N-1).
>
> B13.20 - Examine interior attachment welds within the beltline region each interval using a technique which meets the requirements for a VT-1 examination as defined in paragraph IWA-2211 of the ASME Code, Section XI (B-N-2).
>
> B13.30 - Examine interior attachment welds beyond the beltline region each interval using a technique which meets the requirements for a VT-3 examination, as defined in paragraph IWA-2213 of the ASME Code, Section XI (B-N-2).
>
> B13.40 - Examine surfaces of the core support structure each interval using a technique which meets the requirements for a VT-3 examination, as defined in paragraph IWA-2213 of the ASME Code, Section XI (B-N-2).

These examinations are performed to assess the structural integrity of the reactor pressure vessel interior surfaces, attachments, and core support structures.

3.1.3 Licensee's Basis for Requesting an Alternative and Justification for Granting Relief

In the April 10, 2015 submittal, the licensee, in lieu of ASME Code, Section XI, requirements, submitted an alternative inspection program per the BWRVIP guidelines for Categories B-N-1 and B-N-2 reactor pressure vessel interior surfaces, attachments, and core support structures at CPS. The licensee stated that implementation of the alternative inspection program will maintain an adequate level of quality and safety of the affected welds and components and will not adversely impact the health and safety of the public. As part of its justification for the relief, the licensee stated that boiling-water reactors (BWRs) now examine the reactor pressure vessel interior surfaces, attachments, and core support structures in accordance with BWRVIP guidelines. The proposed alternative covers examination methods, examination volume, frequency, training, successive and additional examinations, flaw evaluations, and reporting. The BWRVIP guidelines have been written to address the examination of safety significant RVI components using appropriate methods and re-inspections at conservative intervals. In contrast, the code re-inspection intervals are less conservative than the intervals stipulated in the BWRVIP inspection and evaluation (I&E) guidelines.

3.1.4 Alternative Examination

In lieu of the requirements of the applicable Edition and Addenda of Section XI of the ASME Code, the licensee proposed to examine the CPS RVI components in accordance with BWRVIP guideline requirements. In their request, the licensee included only the RVI components that come under the jurisdiction of Section XI of the ASME Code. The following reports include the relevant BWRVIP I&E guidelines for the reactor pressure vessel interior surfaces, attachments, and core support structures. Furthermore, the licensee clarified that not all RVI components listed in the following BWRVIP reports are ASME Code, Section XI, components:

- BWRVIP-03, "BWRVIP Reactor Pressure Vessel and Internals Examination Guidelines"
- BWRVIP-18, Revision 1-A, "BWRVIP Core Spray Internals Inspection and Flaw Evaluation Guidelines"
- BWRVIP-25, "BWRVIP Core Plate Inspection and Flaw Evaluation Guidelines"
- BWRVIP-26-A, "BWRVIP Top Guide Inspection and Flaw Evaluation Guidelines"
- BWRVIP-27-A, "BWRVIP BWR Standby Liquid Control System/Core Plate Delta P Inspection and Flaw Evaluation Guidelines"
- BWRVIP-38, "BWR Shroud Support Inspection and Flaw Evaluation Guidelines"
- BWRVIP-41, Revision 3, "BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines"
- BWRVIP-42, Revision 1, "Low Pressure Coolant Injection System (LPCI) Coupling Inspection and Flaw Evaluation Guidelines"
- BWRVIP-47-A, "BWR Lower Plenum Inspection and Flaw Evaluation Guidelines"
- BWRVIP-48-A, "Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines"
- BWRVIP-76, Revision 1, "BWR Core Shroud Inspection and Flaw Evaluation Guidelines"
- BWRVIP-94, Revision 2, "BWRVIP Program Implementation Guide"
- BWRVIP-138, Revision 1-A, "BWRVIP Updated Jet Pump Beam Inspection and Flaw Evaluation Guidelines"
- BWRVIP-180, "Access Hole Cover Inspection and Flaw Evaluation Guidelines"
- BWRVIP-183, "BWRVIP, Top Guide Grid Beam Inspection and Flaw Evaluation"

The licensee stated that inspection services by an authorized inspection agency will be applied to the proposed alternative. The licensee further indicated that the BWRVIP has established reporting protocol for examination results and deviations that are consistent with the requirements of BWRVIP-94. The licensee clarified that any revised version of a BWRVIP report used to satisfy the alternatives will meet or exceed the I&E guidelines of its original version, and if it does not meet this criteria, NRC staff approval is mandatory prior to its implementation.

In Table 1 of Attachment 1 of the April 10, 2015 submittal, the licensee provided a comparison of the ASME Code, Section XI, examination requirements for Categories B-N-1 and B-N-2 for the reactor pressure vessel interior surfaces, attachments, and core support structures to the BWRVIP I&E Guidelines examination requirements. In Attachment 2 of the April 10, 2015, submittal, the licensee provided additional information regarding the BWRVIP inspection requirements for the following welds (shown as examples) of the reactor pressure vessel interior surfaces, attachments, and core support structures and their subcomponents representing each of the ASME Code, Section XI, Item Nos. B13.10, B13.20, B13.30, and B13.40:

- Core Spray Piping (B13.10)
- Jet Pump (B13.20)
- Core Shroud (B13.30)
- Core Shroud Support and Core Support Structure (B13.40)

The licensee claimed that these examples demonstrated that the inspection techniques that are recommended by the BWRVIP inspection guidelines are superior to the inspection techniques mandated by the ASME Code, Section XI, ISI program. Additionally, these examples demonstrated that the BWRVIP inspection guidelines require more frequent inspections of some RVI components compared to the corresponding ASME Code, Section XI, ISI program. The licensee stated that by implementing the BWRVIP inspection guidelines, the aging degradation of the reactor pressure vessel interior surfaces, attachments, and core support structures can be identified in a timely manner so that proper corrective action can be taken to restore the integrity of the applicable component. Therefore, the licensee concluded that implementation of the BWRVIP inspection guidelines for the CPS reactor pressure vessel interior surfaces, attachments, and core support structures would provide an acceptable level of quality and safety. Furthermore, the licensee referenced an April 7, 2014 EPRI (Electric Power Research Institute) inspection summary (ADAMS Accession No. ML14241A014), which included inspection methods used on the RVI components, inspection dates, the results of the inspection and corrective actions related to the findings of the inspections at CPS for the fall 2013 refueling outage.

3.2 NRC Staff Evaluation

The NRC staff found the referenced BWRVIP reports (other than BWRVIP-180 and BWRVIP-183) to be acceptable for use because I&E guidelines addressed in these reports are consistent with ASME Code, Section XI ISI criteria. In addition, for CPS compliance with inspection criteria included in the reports would provide reasonable assurance that the Aging Management Program is effective in identifying the aging degradation in the RVI components in a timely manner.

The NRC staff noted that the licensee must perform a plant-specific leakage assessment in core spray, jet pump and low-pressure coolant injection (LPCI) coupling systems. This requirement was established to ensure that the ability to cool the core is maintained during postulated loss-of-coolant accident (LOCA) conditions. Maintaining core cooling capability is dependent upon the leakage assessment of the aforementioned RVI components considering any cracks that are present in the components that might lead to leakage outside of the core. Therefore, the NRC staff questioned whether a plant-specific leakage assessment was performed, as indicated by BWRVIP-18 (core spray), BWRVIP-41 (jet pump assembly), BWRVIP-42 (low pressure coolant injection system), and BWRVIP-76 (core shroud), for the internals at CPS, which accounts for the leakage from all internals that impact the ability to cool the core and maintain peak clad temperature within allowed limits during postulated loss of coolant accidents.

Additionally, the NRC staff questioned whether a plant-specific integrated leakage assessment was performed at CPS for the RVI components associated with the BWRVIP documents listed above. In a response dated September 29, 2015, the licensee stated that a plant-specific leakage assessment was performed for core spray piping because cracks were identified in the core spray piping at CPS. The licensee also indicated that the calculated leakage from the identified cracking in the high and low pressure core spray piping is below the allowed leakage for the core spray system. The licensee further stated that the calculated leakage from the detected cracks is below the leakage assumed in the CPS LOCA analysis.

In a response dated September 29, 2015, the licensee also stated that it did not perform a leakage assessment for the cracking found in the core shroud vertical weld because no through-wall cracking was identified. For the cracking detected in the core shroud horizontal weld, the licensee stated that the current plant-specific LOCA analysis considers leakage from core shroud circumferential welds, including consideration of the core shroud tie rod repair.

Finally, the licensee stated that no plant-specific leakage assessment was performed for the LPCI coupling and jet pumps because no cracking has been detected to-date in these components.

The NRC staff was concerned that the issues related to potential nonconservatisms loading conditions on RVI components raised in several of the General Electric-Hitachi safety communications (SCs), may lead to increased loads on the RVI components, which could potentially change the inspection and evaluation criteria of some of the BWRVIP guidelines. The NRC staff requested that the licensee identify whether the loads on the RVI components have been revised for CPS, based on those SCs. In a response dated November 24, 2015, the licensee indicated that SC 09-01 related to annulus pressurized loads did not apply to CPS, and repairs were implemented to the shroud tie rod for SC 09-03. Therefore, the NRC staff found that the license had sufficiently addressed the concerns identified in these SCs. However, regarding the response to SC 11-07, SC 12-20, Revision 1, SC 13-08, and SC-14-03, the NRC staff is currently pursuing resolution of these issues with the BWROG and the BWRVIP.

In summary, the BWRVIP I&E guidelines require more frequent inspections than ASME Code, Section XI, criteria for the RVI components that are susceptible to aging degradation mechanisms. Therefore, subsequent inspections of the RVI components per the relevant BWRVIP I&E guidelines will provide adequate assurance that any emerging aging effects will be identified in a timely manner. In addition, frequent inspections per these guidelines will

enable the licensee to effectively monitor the existing aging degradation in reactor pressure vessel interior surfaces, attachments, and core support structures.

The NRC staff finds that the licensee properly addressed all the applicable BWRVIP I&E guidelines listed in Section 3.1.4 of this SE. Therefore, the NRC staff further finds that the licensee's proposed alternative will identify aging degradation of the RVI components in a timely manner. Therefore, the NRC staff concludes that the implementation of the inspection requirements specified in the licensee's proposed alternative will ensure that the integrity of the RVI components will be maintained with an acceptable level of quality and safety.

The NRC staff authorizes only the BWRVIP inspection guidelines proposed as an alternative. In the event the licensee wishes to take exceptions to, or deviations from the authorized alternative, the licensee must revise and resubmit its request for authorization to use the proposed alternative under 10 CFR 50.55a.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the alternative proposed by the licensee will ensure that the integrity of the reactor pressure vessel interior surfaces, attachments, and core support structures is maintained with an acceptable level of quality and safety.

Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1), and is in compliance with the ASME Code's requirements. Therefore, the NRC staff authorizes the licensee's proposed alternative at CPS until June 30, 2020, with the condition that in the event the licensee wishes to take exceptions to, or deviations from, the NRC staff-approved BWRVIP inspection guidelines authorized as a proposed alternative, the licensee must revise and resubmit its request for authorization to use the proposed alternative under 10 CFR 50.55a.

All other requirements of ASME Code, Section XI, for which the alternative has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear In-service Inspector. Any ASME Code, Section XI, RVI components that are not included in this request for alternative will continue to be inspected in accordance with the ASME Code, Section XI, requirements. The I&E guidelines addressed in the relevant BWRVIP reports should be implemented for the non-ASME Code, Section XI, RVI components at CPS.

Principal Contributors: Christopher Sydnor, NRR
Ganesh Cheruvenki, NRR

Date of issuance: March 10, 2016

The NRC staff acknowledges that the BWRVIP Executive Committee periodically revises the BWRVIP guidelines to include enhancements in inspection techniques and flaw evaluation methodologies. While the licensee may choose to implement enhancements described in a revised version of the referenced BWRVIP inspection guideline, the licensee is expected to continue to meet the requirements of the version of the BWRVIP inspection guidelines that forms the safety basis for the NRC staff authorized proposed alternative to the requirements of 10 CFR 50.55a.

If you have any questions, please contact Ms. Eva A. Brown at 301-415-2315 or via e-mail at Eva.Brown@nrc.gov.

Sincerely,

/RA/

Justin C. Poole, Acting Branch Chief
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-461

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Safety Evaluation

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