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

November 6, 2014

Mr. George H. Gellrich, Vice President
Calvert Cliffs Nuclear Power Plant, LLC
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657-4702

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 2 – RELIEF REQUEST RR-ISI-04-09 REGARDING SALTWATER SYSTEM PIPING REPAIR (TAC NO. MF3074)

Dear Mr. Gellrich:

By letter dated November 14, 2013, as supplemented by letter dated December 6, 2013, Calvert Cliffs Nuclear Power Plant, LLC, the licensee, submitted Relief Request RR-ISI-04-09 for authorization of a proposed alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Sub paragraph IX-1000(c)(4) for Calvert Cliffs Nuclear Power Plant, Unit No. 2 (Calvert Cliffs).

Specifically, the licensee proposed to install a mechanical clamping device on a leak discovered on a 12-inch, Code Class 3, saltwater (SW) system pipe until the next refueling outage, scheduled for February 2015, or until Calvert Cliffs enters a shutdown of sufficient duration prior to the refueling outage. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(ii), the licensee requested to use the proposed alternative on the basis that complying with the specified ASME Code would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The Nuclear Regulatory Commission (NRC) staff has determined that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the 12-inch SW system pipe, and that complying with the specified ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff has concluded that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii). Therefore, the NRC staff authorizes the use of the licensee's proposed alternative in RR-ISI-04-09 for Calvert Cliffs until the next refueling outage, scheduled for February 2015, or until Calvert Cliffs enters a shutdown of sufficient duration prior to the refueling outage.

All other ASME Code, Section XI requirements for which relief was not specifically requested and authorized in the subject proposed alternative remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

On December 12, 2013, the NRC staff granted verbal authorization of the licensee's proposed alternative in Relief Request RR-ISI-04-09. The enclosed safety evaluation documents the NRC staff's review and technical basis for this authorization.

If you have any questions, please contact the Calvert Cliffs Project Manager, Nadiyah Morgan, at (301) 415-1016.

Sincerely,

Benjamin Beasley

Benjamin Beasley, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-318

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST RR-ISI-04-09

REGARDING SALTWATER SYSTEM PIPING REPAIR

EXELON GENERATION COMPANY, LLC

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 2

DOCKET NO. 50-318

INTRODUCTION

By letter dated November 14, 2013 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML13319B080), as supplemented by letter dated December 6, 2013 (ADAMS Accession No. ML13346A629), Calvert Cliffs Nuclear Power Plant, LLC, the licensee, submitted Relief Request RR-ISI-04-09 for authorization of a proposed alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Sub paragraph IX-1000(c)(4) for Calvert Cliffs Nuclear Power Plant, Unit No. 2.

Specifically, the licensee proposed to install a mechanical clamping device on a leak discovered on a 12-inch, Code Class 3, saltwater (SW) system pipe until the next refueling outage, scheduled for February 2015, or until Calvert Cliffs enters a shutdown of sufficient duration prior to the refueling outage. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(ii), the licensee requested to use the proposed alternative on the basis that complying with the specified ASME Code would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

On December 12, 2013, the Nuclear Regulatory Commission (NRC) staff granted verbal authorization of the licensee's proposed alternative in Relief Request RR-ISI-04-09. This safety evaluation documents the NRC staff's review and technical basis for this authorization.

2.0 REGULATORY EVALUATION

The regulations at 10 CFR 50.55a(g)(4), Inservice Inspection Requirements, state that ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 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 inspection interval and subsequent 10-year inspection 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(b) 12 months prior to the start of the 120-month inspection interval, subject to the conditions listed therein.

The regulations at 10 CFR 50.55a(a)(3) states, in part, that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternative provides an acceptable level of quality and safety, or (ii) compliance with the specified requirements 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 regulatory authority exists for the licensee to request the use of an alternative and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Relief Request RR-ISI-04-09

The affected component is the SW system pipe line 12"-LJI-2011. The licensee stated that, "this is a 12-inch schedule "Standard" (12-75 inch outside diameter and 0.375-inch nominal wall) American Society for Testing and Materials A-53 Grade B carbon steel pipe that is rubber-lined to prevent interaction of the carbon steel with brackish Chesapeake Bay water. This 12-inch line ties into the 24-inch SW discharge header via a reducing tee. The 24-inch header routes the heat exchanger discharge from both trains of SW to a 30-inch underground pipe and then discharges" to the Chesapeake Bay via the circulating water discharge conduit.

The design pressure is 50 pounds per square inch gauge (psig) and the design temperature is 95 degrees Fahrenheit (°F). The operating pressure is 35 psig and the operating temperature is 95 °F.

Calvert Cliffs is currently in its fourth 10-year inservice inspection (ISI) interval. The Code of Record for this ISI interval is the ASME Code, Section XI, 2004 Edition with no Addenda. The subject piping is the ASME Code Class 3. The piping construction code is the American National Standards Institute B31.1, 1967 Edition.

The licensee requested relief from the ASME Code Section XI, 2004 Edition, with no Addenda, Appendix IX, Subparagraph IX-1000(c)(4), which restricts mechanical clamping devices (clamp) to nominal pipe size (NPS) 6 when the nominal operating temperature or pressure does not exceed 200 °F or 275 psig. Authorization of the licensee's proposed alternative would allow an ASME Section XI, Appendix IX clamp to be installed on the subject NPS 12 pipe while all other applicable requirements of Appendix IX will be met.

The licensee identified a pin-hole leak on line 12"-LJI-2011 in September 2013. The licensee stated that, "the leak is located approximately five inches downstream of the flange connecting the subject pipe section to control valve 2-CV-5206. The valve is located in the SW discharge

of Component Cooling Water Heat Exchanger Number 21 and controls the flow through this heat exchanger." The licensee addressed the degraded condition using ASME Code Case N-513-3.

In its November 14, 2013, letter, the licensee stated that,

> This flaw is in a section of SW piping that cannot be isolated during operation and requires special conditions to be isolated when the unit is offline. As it is impractical to complete a repair or replacement to the SW leak without an extended outage, [the licensee] proposes to use an ASME Section XI, IWA-4130 Alternative Requirement, a mechanical clamping device described in ASME Section XI, Appendix IX, until the next refueling outage, scheduled for February, 2015.
>
> The flaw is located in a section of the piping that is directly connected to the common system discharge and cannot be removed from service to gain safe access to the inside for detailed inspection, so the the root cause cannot be definitively ascertained. Based on ultrasonic testing inspection of the [defect] area and the fact that this is an isolated incident; there are two possible root causes for the localized corrosion that resulted in the through-wall leak.
>
> - A manufacturing defect has resulted in a local failure of the rubber lining, such as a seam split, that has allowed SW to come in contact with the carbon steel.
>
> - A flow disturbance from the throttle valve has resulted in localized damage of the rubber liner allowing SW to come in contact with the carbon steel. This cause may also be accelerating the localized corrosion by eroding the passive corrosion layer.
>
> Either of these mechanisms would likely result in the type of failure indicated by the inspections, which appears to be pitting corrosion, a localized form of corrosion where cavities or "holes" are produced in the material.

The licensee concluded that the pitting corrosion is the result of a local flow disturbance, most likely caused by the upstream flow throttling valve, eroding a local region of the rubber liner, exposing the carbon steel pipe to the corrosive brackish water environment. This corrosive site then led to a through wall condition by continuing corrosion coupled with destruction of the passive layer by the eroding flow disturbance.

The licensee proposed to install a clamp on the defect area of the subject pipe until a permanent repair/replacement can be performed. Upon approval of Relief Request RR-ISI-04-09, Calvert Cliffs will shift from application of Code Case N-513-3 to the IWA-4133 requirement. The licensee stated that the clamp will meet all applicable requirements of the ASME Code, Section IX, Appendix IX other than the restriction to NPS 6, including the following:

- All seal clamp components are made from austenitic stainless steel which is acceptable for service from a corrosion standpoint in SW service without any coating and is compatible with the system fluid. External areas of piping that will be in contact with brackish water after installation of the clamp are coated to prevent corrosion.

- The clamp design will encompass the projected growth of the flaw as described herein, with additional margin.

- No additional supports are required for the mechanical clamping device.

- Analysis has shown that the piping is capable of remaining intact with the projected growth of the defect. Additional analysis shows that even in the extremely unlikely event that the defect would grow through wall around the circumference, the existing piping and supports will remain intact and the pipeline ends will move approximately 0.125 inch and will remain within the encapsulation provided by the mechanical clamping device.

    - The mechanical clamping device has been evaluated for all postulated loads, including seismic Operating Basis Earthquake and Design Basis Earthquake levels, and the stresses remain well below those found in ASME Section XI, Appendix IX, Table IX-3200-1.

    - Provisions have been made in the mechanical clamping device design and location to ensure that both edges of the mechanical clamping device are accessible for ultrasonic testing wall thickness measurement at least every ninety days. Provisions are in place in the event that the defect monitoring reveals that the defect has grown outside of the mechanical clamping device dimensions.

    - A leakage monitoring task has been added to facilitate weekly leakage monitoring at the boundary of the mechanical clamping device.

In its December 6, 2013, letter, in response to request for additional information (RAI) Item 15, the licensee stated that it will visually inspect the clamp for leakage daily. The daily monitoring is an enhancement from the weekly monitoring, as stated in the licensee's November 14, 2013, letter.

The licensee requested that the clamp remain in place until the next refueling outage scheduled for February 2015 or until Calvert Cliffs enters a shutdown of sufficient duration prior to the refueling outage. At that time, the licensee will replace the mechanical clamping device with a permanent code repair or replacement.

3.2 NRC Staff Evaluation

The NRC staff evaluated the design, defect characterization, installation, examination, and testing of the proposed clamp in accordance with the requirements of the ASME Code, Section XI, Appendix IX. Pursuant to 10 CFR 50.55a(a)(3)(ii), the NRC staff reviewed the hardship justification for RR-ISI-04-09.

Article IX-1000(a) of the ASME Code, Section XI, Appendix IX limits the use of mechanical clamping devices to the next refueling outage. The licensee stated that it will remove the clamp during the next refueling outage; therefore, the NRC staff finds that the licensee has satisfied Article IX-1000(a).

Article IX-2000 of the ASME Code, Section XI, Appendix IX requires the characterization of the size, location, and apparent cause of the defect be identified. The licensee identified that the degradation mechanism is most likely pitting corrosion. The NRC staff finds that based on industry operating experience, pitting corrosion or microbiological-induced corrosion would be the most likely degradation mechanism for the subject piping carrying brackish water. The licensee reported that the last two ultrasonic examinations dated October 31 and November 14, 2013 showed that hole "A" has remained approximately constant at 1.10 inches in size; hole "B" has increased in size from 0.06 inches to 0.09 inches; and hole "C" has increased in size from 0.38 inches to 0.75 inches. The NRC staff finds that the licensee has appropriately characterized the defects and has satisfied the requirements of Article IX-2000.

Article IX-3000 of the ASME Code, Section XI, Appendix IX provides design requirements. The subject piping is safety-related, and is located on the discharge of the Component Cooling Heat Exchangers to the Chesapeake Bay. The leak has a potential impact on flooding limitation. The clamp is designed to stop the leak and is credited to maintain system pressure boundary.

The acceptance criterion for the clamp is that no leakage is present after the installation is complete. The licensee noted that minor visual leakage may occur and is an indication of the clamp surface not meeting with the pipe. The licensee will evaluate more than minor leakage and will schedule the permanent repairs as appropriate.

In its December 6, 2013, letter, the licensee stated that with a full circumferential break, the pipe would:

> ...exert minimal load on the mechanical clamp and the mechanical clamp would remain intact on the pipe.

Additionally, the licensee stated that:

> The piping in the area around the break would restrain the piping movement to a small value (approximately 1/8-inch with no structural credit taken for the mechanical clamp) so that the leakage would be contained inside the clamp. The licensee noted that "because the system pressure and pipe loads are small, a rupture or catastrophic failure of the mechanical clamp resulting in significant discharge of SW is not considered a credible event. It is possible for the mechanical clamp to have some minor leakage into the room.

The licensee also stated that:

> the piping area that will be encased by the clamp will be coated with an epoxy material. A rubber gasket material will be placed over the through wall holes and applied [coal tar] coatings. This will aid against future corrosion attack on the

> external portion of the piping if bay water should leak past the rubber gasket material into the clamp annulus area.
>
> The internal surface of the clamp will also be coated with an epoxy material in addition to the piping. This will protect against galvanic corrosion if bay water should leak into the sealing area between the piping and the mechanical clamp.

The licensee will inject the sealant into the perimeter seal area during installation of the clamp. The sealant will remain in a pliable state and will not completely harden as designed for this application. The sealant is safety-related with a limited shelf life. The perimeter seal is designed to seal leakage. The sealant will be contained within the perimeter seal and will not be exposed to the system fluid.

Article IX-3300 of the ASME Code, Section XI, Appendix IX requires projection of wall thickness to the time of clamp removal and consideration of the stiffness and weight of the clamp. The licensee projected that the total size of the defect at the end of the current fuel cycle will be 10.3 inches axially and 11.0 inches circumferentially, which can be enclosed by the 14-inch width of the clamp. The NRC staff finds that the licensee's projection is acceptable, based on the corrosion rate for the environment and operating experience. The licensee's analysis showed that there is sufficient remaining pipe wall for a postulated 11-inch diameter hole (the worst case scenario) to occur in the pipe without the addition of the clamp.

The licensee revised the existing pipe stress calculation to include the impact of the clamp. Additionally, the licensee performed calculations to determine the extent of pipe separation in the event of a circumferential break. The licensee's pipe stress calculations showed that the axial pipe separation is well within the total mechanical clamp length of 14 inches between the pipe seals. The NRC staff finds that the proposed clamp satisfies Article IX-3300, based on the design, installation, and pipe stress calculations.

The licensee stated that it will perform an ASME Code, Section XI, VT-2 examination at normal operating pressure and temperature upon installation of the clamp. The NRC staff finds that the licensee has satisfied the pressure testing requirements of the ASME Code, Section XI, Appendix IX, Article IX-5000.

Article IX-6000 of the ASME Code, Section XI, Appendix IX provides monitoring requirements. The licensee stated that the defect areas of the pipe are accessible for inspection and that they are "located above ground, and are not insulated externally." The upstream inspection area is approximately 3/4-inch wide and the area downstream of the clamp is approximately 2 inches wide. The licensee will ultrasonically inspect the upstream and downstream areas of 360 degrees pipe circumference around the clamp at a frequency that does not exceed 90 days. The licensee also stated that,

> ...the zero degree transducer used for the ultrasonic inspection is 1/4-inch in diameter, which will ensure that adequate contact is maintained based on the inspection area dimensions described above.

In its December 6, 2013, letter, in response to RAI Item 15, the licensee stated that it will also visually inspect the clamp for leakage daily.

The licensee stated that if the nondestructive examination shows wall thinning along either edge of the clamp, it will initiate corrective actions. The licensee further stated that, if the wall thinning is determined to be due to bay water corrosion, it would indicate that the flaw has extended beyond the mechanical clamp and an immediate repair/replacement of this pipe segment would be initiated.

If there is no wall thinning due to bay water corrosion, and there is leakage, the leakage would be acceptable, provided it does not challenge the flooding limit for the room. Any leakage would be evaluated and the perimeter seal would be re-injected to stop any leakage. The maximum limit leakage amount would be the leakage amount that exceeds the flooding calculation for the building. Any leakage that is more than minimal will be entered into the corrective action process to evaluate when permanent repairs need to be made. The NRC staff finds that with the daily visual inspection and 90-day ultrasonic inspection of the clamp, the licensee has satisfied the monitoring requirements of Article IX-6000 of the ASME Code, Section XI.

The licensee performed extent of condition ultrasonic inspections at identical locations on three different SW trains in both units. The licensee stated that:

> The examinations were performed on the upstream and downstream piping sections that are identical in layout and flow conditions as the subject [degraded piping] for RR-ISI-04-09. The ultrasonic examination area was 2 inches wide and 360 degrees around the pipe; the area was scanned 100 percent for wall thinning with a zero degree transducer. All ultrasonic readings were consistent with nominal pipe thickness ranges of 0.38 - 0.40 inches at the four locations.

The NRC staff finds it acceptable that the licensee has evaluated the extent of the condition with favorable inspection results.

With regards to the hardship justification, the licensee noted that the inside surface of the SW piping has a rubber liner to protect it from SW corrosion. Any permanent repair such as repair by welding cannot be done on-line because the heat from welding can damage the liner and cause more corrosion. The licensee stated that to perform a permanent repair, Unit 2 would need to be shutdown. The number 21 SW header would then be removed from service to accommodate the one remaining SW header (SW header 22) on the emergency overboard configuration. "This configuration limits the plant's heat removal capability to one SW header with its discharge routed to the [Chesapeake] Bay via the 21 circulating water canal (normal intake canal) versus the discharge canal."

This would affect plant operation. The NRC staff finds that performing the ASME Code repair of the degraded pipe would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

In summary, the NRC staff has determined that the proposed mechanical clamp will provide reasonable assurance of the structural integrity and leak tightness of the degraded SW system pipe because the licensee has demonstrated that it has satisfied the provisions of the ASME Code, Section XI, Appendix IX, with the exception of the pipe size. The NRC staff finds that the pipe size exception is acceptable because the low energy operating conditions of the SW

system will not significantly affect the structural integrity of the subject piping and the proposed daily visual inspection provides sufficient monitoring of leak tightness of the subject piping.

4.0 CONCLUSION

As set forth above, the NRC staff has determined that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the subject 12-inch SW system piping and complying with the specified ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff has concluded that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii). Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the NRC staff authorizes the licensee's proposed alternative in RR-ISI-04-09 until the next refueling outage scheduled for February 2015 or until Unit 2 enters a shutdown of sufficient duration prior to the refueling outage.

All other ASME Code, Section XI requirements for which relief has not been specifically requested and approved in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: J. Tsao

Date: November 6, 2014

On December 12, 2013, the NRC staff granted verbal authorization of the licensee's proposed alternative in Relief Request RR-ISI-04-09. The enclosed safety evaluation documents the NRC staff's review and technical basis for this authorization.

If you have any questions, please contact the Calvert Cliffs Project Manager, Nadiyah Morgan, at (301) 415-1016.

Sincerely,

/RA/

Benjamin Beasley, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-318

Enclosure:
Safety Evaluation

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