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

November 13, 2013

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 NOS. 1 AND 2 – RELIEF REQUEST RR-ISI-04-08 REGARDING MITIGATION OF BURIED SALTWATER PIPING DEGRADATION (TAC NOS. MF0568 AND MF0569)

Dear Mr. Gellrich:

By letter dated January 17, 2013, as supplemented by letter dated May 17, 2013, Calvert Cliffs Nuclear Power Plant, LLC, the licensee, submitted a request for authorization of a proposed alternative to the requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, Subarticle IWA-4340 for Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (Calvert Cliffs) for the remainder of the Calvert Cliffs 10-year inservice inspection (ISI) interval.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii), the licensee requested to use metal reinforced polymeric patches to address inside diameter degradation of mortar lined ductile iron piping in the saltwater system 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 concluded that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the 30- and 36-inch ASME Class 3 buried saltwater system ductile cast iron piping, 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 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-04-08 for the remainder of the Calvert Cliffs fourth 10-year ISI interval, which ends on June 30, 2019.

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.

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

Sincerely,

Robert Beall, Acting Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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

RELIEF REQUEST RR-ISI-04-08

REGARDING MITIGATION OF BURIED SALTWATER PIPING DEGRADATION

CALVERT CLIFFS NUCLEAR POWER PLANT, LLC

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

DOCKET NOS. 50-317 AND 50-318

INTRODUCTION

By letter dated January 17, 2013 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML13022A048), as supplemented by letter dated May 17, 2013 (ADAMS Accession No. ML13141A270), Calvert Cliffs Nuclear Power Plant, LLC, the licensee, submitted a request for authorization of a proposed alternative to the requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, Subarticle IWA-4340 for Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (Calvert Cliffs) for the remainder of the Calvert Cliffs 10-year inservice inspection (ISI) interval.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii), the licensee requested to use metal reinforced polymeric patches to address inside diameter degradation of mortar lined ductile iron piping in the saltwater system 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.

2.0 REGULATORY EVALUATION

Adherence to article IWA-4000 of Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), which states, in part, that ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in Section XI of ASME Code.

Paragraph 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 Nuclear Regulatory Commission (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.

Enclosure

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-04-08

3.1.1 ASME Code Component Affected

The affected components are 30- and 36-inch ASME Class 3 buried saltwater system ductile cast iron piping for Calvert Cliffs. The pipe wall thickness is 0.550-inch and 0.630-inch for the 30-inch and 36-inch pipe, respectively. The inside surface of the buried saltwater pipe is coated with 0.25 inch thick of cement-mortar.

In Reference 2, the licensee clarified that the proposed repair alternative cannot be applied to any gray cast iron section of the saltwater system piping or the inside surfaces of elbows.

3.1.2 Applicable Code Edition and Addenda

The code of record for the fourth ten-year ISI interval is the ASME Code, Section XI, 2004 Edition, no Addenda.

The original Code of Construction of the affected components is United States of America Standards (USAS) B31.1, 1967 Edition as supplemented by the requirements of American National Standards Institute (ANSI) A21.1-1967/American Water Works Association (AWWA) C 101-67 and ANSI A21.50-1976 (AWWA C 150-1976).

3.1.3 Applicable Code Requirement

The ASME Code, Section XI, Subarticle IWA-4000 and IWA-4300 require degraded Class 3 piping to be either repaired or replaced.

3.1.4 Proposed Alternative and Basis for Use

In lieu of repairing or replacing the subject pipe in accordance with the ASME Code, Section XI, IWA-4000, the licensee proposed to install a sleeve assembly on the inside surface of the degraded saltwater system pipe. The sleeve assembly consists of a pressure retaining backing plate, a rubber gasket, a sleeve, and four retaining bands and epoxy filler/sealant.

The licensee provided the detailed sleeve installation procedures in Enclosure 1 of Reference 2. Before installing the sleeve, the licensee cleans the degraded area of the pipe, removes the cement liner in the degraded area, and backfills the cavity with an approved epoxy-type sealant.

After the cleaning and preparation, the licensee places a thin 1/16 - 1/8-inch thick rubber gasket over the degraded area to minimize potential galvanic corrosion between the stainless steel backing plate and the ductile cast iron pipe. The rubber gasket will wrap around the backing plate. Next, the licensee places the 14-inch (axial length) backing plate on top of the rubber gasket at the location of the degraded area. The backing plate is a single sheet of 16 gauge sheet metal made of AL6XN (UNS N08367). It is placed over the degraded area to restore the pressure boundary integrity. The circumferential length of the backing plate, rubber gasket, sleeve, and retaining bands is 360 degrees around the inside circumference of the pipe.

The licensee places the 20-inch long sleeve on top of and encloses the backing plate. The sleeve is made of Ethylene Propylene Diene Monomer (EPDM), which is factory vulcanized to form one continuous piece. The ends of the sleeve have grooved ribs. The sleeve is 0.3-inch thick. It is placed over the backing plate and extends beyond each end of the backing plate.

Two retaining bands are inserted into the pipe and placed on the EPMD sleeve, close to the backing plate so as to hold the backing plate in place. The retaining bands are also made of AL6XN, 2-inch wide and 0.-875 inch thick. The licensee inserts metal shims underneath the wedge area of the retaining bands to protect the EPMD sleeve from damages when the bands are expanded.

The licensee expands the retaining bands inside the pipe using a hydraulic expander. Each end of the retaining band has a welded push tab. The push tab is used to allow the expander to push the retaining band against the inside surface of the pipe. Once the expansion pressure has been achieved within the acceptable range, the licensee inserts a wedge, which is also made of AL6XN material, into the gap between the push tabs to lock the retaining band in place.

After the two middle retaining bands are installed, the licensee installs two remaining retaining bands at both ends of the EPMD sleeve to attach the sleeve on the inside pipe wall. The two end retaining bands compress the groove ends of the sleeve against the pipe inner circumference to provide a leak tight seal to prevent water intrusion past the sleeve. In addition, the licensee applies epoxy to the both ends of the EPMD sleeve to minimize water intrusion into the sleeve assembly.

The licensee performs a final examination of all gasket surfaces for any damage that could have potentially occurred during installation. The licensee will remove and replace the sleeve assembly, if damaged during installation.

The licensee stated that it designs the repair system consistent with the requirements of the original codes of construction (ANSI B31.1, 1967 Edition). The licensee qualifies the repair sleeve assembly based on stress analyses using the loads applied during installation and operation.

The licensee stated that it will disassemble the sleeve assembly and check for any deterioration of the retaining bands, signs of leakage past the gasket, or any other degradation after the sleeve is deployed for two operating cycles. The licensee will check the retaining bands and backing ring for corrosion, the liner under the sleeve for wetness, and any damage of the liner. The licensee will use the inspection results to determine if the inspection frequency needs to be changed. In case of multiple installations, the licensee will disassemble only one of the proposed repair systems while the rest will be visually inspected every other refueling outage during conduct of the current preventive maintenance task to inspect saltwater system piping.

The licensee noted that depending on the defect size, the pressure (backing) plate may be altered to provide adequate strength to account for degradation outside of the design basis calculation. The licensee will change the design calculation to reconcile any changes to the pressure plate dimensions. The licensee will characterize the defect and project its growth to ensure that the defect will be contained within the specified limits of the repair system. The licensee will determine subsequent inspection frequencies of the encapsulated degraded area and monitor the size of the degradation.

3.1.5 Duration of Proposed Alternative

In Reference 1, the licensee stated that the proposed alternative would be applicable to the repairs of future defects identified in buried portions of the saltwater system piping throughout the fourth ten-year ISI interval.

3.2 NRC Staff Evaluation

The NRC staff evaluated the design, examinations, analysis, pressure tests and hardship argument of the proposed alternative repair as follows.

3.2.1 Design

In its review of the design of the proposed alternatives, the NRC staff identified four issues: (a) operating conditions, (b) durability, (c) potential corrosion, and (d) structural sufficiency as issues critical to the design of the sleeve assembly.

Operating Conditions

The NRC staff questioned the operating temperature and pressure of the subject pipe. In Reference 2, the licensee clarified that the saltwater system operating temperature varies in accordance with Chesapeake Bay temperature throughout the year. The licensee stated that based on the past operating experience on rare occasions the temperature of the saltwater recorded a low of 30 degrees Fahrenheit (°F). The range for saltwater should be adjusted between 30 and 95 °F, versus the stated range in the relief request of 32 to 95 °F. The licensee stated that the temperature range of 30 to 95 °F and the design pressure of 50 pounds per square inch gauge (psig) bound the system's parameters during normal, emergency and faulted conditions.

Durability

The licensee stated that the EPDM rubber has a service life of 50 years in submerged conditions similar to those experienced at Calvert Cliffs. The licensee noted that the operating history of the rubber used in safety-related service water systems of other nuclear power plants has been excellent and no deterioration of the rubber has been identified. The EPDM rubber is designed to withstand a non-steam environment temperature of up to 300 °F . The general properties of the EPDM, based on testing in accordance with American Society for Testing and Materials (ASTM), are as follows:

Tensile Strength	1,450 psi	per ASTM D412
Durometer Shore A	65 (+/- 5)	per ASTM D2240
Elongation	350%	per ASTM D412

The EPDM rubber properties of the sleeve are examined and tested as part of the Commercial Grade Dedication process to ensure that the sleeve to be installed meets or exceeds these requirements. The licensee concluded that the EPDM sleeve is qualified for use under all bounding temperature and pressure conditions for the saltwater system.

The NRC staff determined that the EPDM rubber gasket has been qualified in accordance with ASTM and is qualified up to 300 °F . The NRC staff finds that the rubber gasket is qualified to be used in the temperature and pressure conditions of the saltwater system piping at Calvert Cliffs.

Potential Corrosion

Because the sleeve assembly is not welded or glued to the inside surface of the pipe, the NRC staff questioned whether saltwater may seep into the crevice between the backing plate and inside surface of the pipe, and therefore, would cause unintended corrosion. In Reference 2, the licensee explained that before installing the mechanical sleeve assembly, the cement liner of the piping is removed for the entire length of the mechanical sleeve assembly. The backing plate is placed directly over the degraded area on the inner diameter of the pipe to restore pressure boundary integrity. In addition, a thin (1/16 to 1/8-inch) rubber gasket is placed between the exposed metal ductile iron pipe and the backing plate to provide separation to negate the potential for galvanic coupling between the two dissimilar metals. The licensee stated that the EPDM sleeve is placed over the backing plate completely enclosing the entire backing plate and extends beyond each end of the backing plate. Two inner retaining bands hold the backing plate in position. A retaining band is placed directly over the ribs at each end of the rubber gasket. The high contact pressure exerted by the retaining bands deforms the ribs, provides a leak tight seal, and thus, prevents saltwater from seeping into the crevice under the sleeve. The retaining bands are only in contact with the EPDM sleeve and not the cement mortar or ductile iron piping. The licensee noted that operational history of similar components installed in service water systems at Seabrook Station, Unit No. 1, Indian Point Nuclear Generating, Unit No. 3, Salem Nuclear Generating Station, Unit Nos. 1 and 2, and Millstone Power Station, Unit Nos. 2 and 3 have not shown a propensity for crevice corrosion to occur since 1995. The NRC staff finds that the sleeve design will mitigate the potential leakage into the crevice between the sleeve and the pipe. Therefore, the crevice corrosion of the pipe resulting from the sleeve installation will be minimized.

By letter dated January 17, 2013, the licensee stated that::

> The repair sleeve assembly is capable of restoring pressure boundary of localized pipe wall thinning within a 3-inch diameter area.

The NRC staff noted that after the sleeve is installed, the degraded area (the flaw) may expand either laterally or through wall or in both directions as a result of corrosion growth. In Reference 2, the licensee explained that if a flaw is found on the piping inner diameter and the flaw is determined to be due to corrosion, the sleeve assembly can be installed, provided the flaw size does not exceed the allowable size of 3 inches in diameter. The NRC staff notes that the width (axial length) of the backing plate is 14 inches, which is 4.6 times longer than the allowed degraded area of 3 inch in diameter. The NRC staff finds that after the sleeve installation the corrosion growth should be reduced. In addition, the licensee will visually inspect the sleeve assembly every 4 years. Should the degraded area expand beyond the length of the backing plate, the licensee should be able to detect such degradation during the periodic inspection and correct the problem.

The licensee noted that the proposed alternative is limited to only cases where saltwater piping wall thickness has fallen below minimum design thickness values and is the result of corrosion initiated on the interior wall of the saltwater piping. As a result, in the case of a crack-like flaw, the licensee stated that it would submit a separate proposed alternative repair. The licensee noted that additional degradations that are outside the scope of this proposed alternative repair include through wall degradation and degradations caused by external corrosion. The NRC staff finds acceptable that the proposed alternative is not applicable to crack-like flaws, through wall degradation and degradation caused by external corrosion.

The NRC staff noted that degradation in the saltwater piping may be manifested in a cluster of wall thinning spots or pits that are scattered in a cluster pattern (e.g., a shotgun blast pattern). The NRC staff further noted that each of the spots or pits could be less than 3 inches in diameter. However, the total degraded area of the spots and pits may exceed 3 inches. The NRC staff asked whether the sleeve assembly is applicable in this scenario. In Reference 2, the licensee responded that the determination of the maximum diameter is based on the capacity of a 3-inch diameter span to provided pressure boundary retention in accordance with the original code of construction requirements. The licensee stated that shotgun pitting with small areas of degradation is in actuality a favorable condition as it relates to span stresses in the backing plate. The licensee stated that it is not practical to predict the configuration of degraded areas and typically these conditions are addressed on a case by case basis. The licensee stated that it intends to limit the total area of degradation under the backing plate that will be credited as a pressure retaining boundary for the projected service life, to the equivalent area of a 3-inch diameter circle. However, if the total sum of the areas are in excess of a 3-inch diameter circle, the licensee will submit a separate relief request to address this scenario. The NRC staff finds that the licensee has appropriately addressed the question regarding the application of the sleeve assembly for the degraded area that is greater than 3 inches in diameter.

Structural Sufficiency

Table 1 in Attachment 1 to Reference 1 shows that the required minimum wall thickness of the host pipe to support a sleeve assembly is 0.326-inch and 0.348-inch for the 30-inch and 36-inch diameter pipe, respectively. The NRC staff notes that the sleeve cannot be applied to a degraded area whose surrounding pipe area has less wall thickness than these values. In Reference 2, the licensee confirmed that the section of piping where the retaining bands are installed must maintain a minimum thickness of 0.326-inch and 0.348-inch for the 30-inch and 36-inch diameter pipe, respectively. The NRC staff finds it is acceptable that the retaining bands will be installed on the pipe wall with a minimum thickness of 0.326-inch and 0.348-inch. The NRC staff determines by independent calculations that these thickness values will provide sufficient strength to support the forces exerted by the retaining bands based on the design loading of the pipe and the pressure exerted by the retaining bands.

The NRC staff asked the licensee to discuss measures to prevent groundwater leaking from the outside surface into the pipe prior to installing the sleeve if a hole occurs on the subject pipe. In Reference 2, the licensee explained that the proposed alternative repair is limited to corrosion initiated on the interior of the saltwater piping. It will not be used in any case of corrosion that has resulted in a through wall condition. If a through wall condition was discovered, a separate alternate repair would have to be submitted. As a result, groundwater leakage is not a consideration for this proposed repair method. In addition, the licensee stated that a protective coating on the piping outer diameter provides a barrier from external corrosion. The external condition of the buried piping is passive and is only exposed to low chloride level groundwater. Therefore, the licensee stated that the potential for deterioration on the pipe outside diameter is considered to be negligible. The licensee stated that operating experience of this piping under similar conditions at older power stations has demonstrated good performance over many years.

The NRC staff finds that the licensee has clarified the limitation of the proposed alternative which cannot be applied to a hole in the subject pipe and to corrosion that initiates from the outside surface of the pipe.

In Reference 2, the licensee stated that the maximum cross sectional height will be 0.7826 inches and is located in the area of the push tabs. The licensee noted that the typical cross sectional height is 0.5473-inch around most of the circumference of the sleeve assembly. The licensee noted that the grout liner will be removed from the area of the sleeve installation; therefore the projection of the assembly into the flow will be approximately 0.5326-inch (max) and 0.2973-inch (typical) when accounting for the removal of the 0.25-inch concrete liner. The NRC staff finds that the cross sectional height of the sleeve assembly is relatively small when comparing to the 30- and 36-inch diameter pipe and will not be an obstruction to the flow inside the pipe. In addition, the NRC staff finds that the fluid dynamic force impacting on the cross section of the sleeve will not dislodge the sleeve from the inside wall when comparing to the pressure the retaining bands imposed on the inside surface of the pipe.

The NRC staff finds that the design aspect of the sleeve assembly is acceptable because: (1) the design uses the qualified and established components; (2) the sleeve assembly is attached to the inside surface of the pipe based on specified pressure of the retaining bands; and (3) the design can isolate the degraded area of the pipe from corrosion.

3.2.2 Examinations

Pre-Installation Examination

The licensee stated that it routinely monitors and inspects saltwater system components in accordance with the requirements of NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment." The licensee stated that it is currently increasing the level of inspections of buried portions of the system consistent with Nuclear

Energy Institute 09-14, "Guidelines for the Management of Underground Piping and Tanks". During the February 2013 refueling outage, the licensee inspected buried sections of Unit 2's 30 and 36 inch saltwater system piping to supplement visual inspections that routinely occur from the inner diameter (ID) of the piping. The licensee used the Broadband Electromagnetic examination to identify potential areas of deterioration that when found can be further identified by nondestructive examination methods to provide a more definitive characterization of the flaw.

Post-Installation and Inservice Examinations

In the relief request, the licensee stated that it will disassemble the first installed sleeve and inspect the degraded area after the sleeve assembly is deployed for two operating cycles. In case of multiple installations, the licensee will only disassemble one of the installed sleeves while the rest will be visually inspected every other refueling outage during conduct of current preventive maintenance task to inspect saltwater system piping. The licensee further stated that it will determine the subsequent inspections frequencies of the encapsulated degraded area and monitor the size of the degradation.

The NRC staff questioned the exact inspection frequency and method for the sleeve and degradation area beyond the first inservice inspection. In Reference 2, the licensee responded that all installed sleeve assemblies will be visually inspected (without disassembly) every four years (two refueling cycles) as part of Calvert Cliffs' ongoing visual inspections of saltwater piping. The visual inspection of the sleeve assembly will look for signs the assembly has become dislodged, tears or missing pieces of the rubber sleeve, misalignment or loosening of the retaining bands, and signs of corrosion on visible pieces.

The licensee stated that should significant signs of abnormal wear be observed, then the mechanical sleeve assembly would be disassembled to determine if any further growth of the area of degradation had occurred. The licensee would evaluate results from this disassembly to determine if a change to Calvert Cliffs' inspection intervals (including the possible requirement for periodic disassembly/replacement of the mechanical seal assembly) is necessary.

The licensee explained that the design of the sleeve assembly is to fully isolate the area of degradation from the source (saltwater) of the corrosion. The licensee stated that with the source of corrosion isolated, the area of degradation is not expected to increase over time and therefore, will not be inspected after the first inservice inspection.

The NRC staff questioned whether the retaining bands, gasket, wedge and backing plate will be replaced after disassembling the sleeve for inspection, what conditions that would cause the retaining band, gasket and back plate to be replaced, and whether the wedge and push tab will be examined during the inservice inspection. In Reference 2, the licensee explained that the retaining bands, wedges, backing plate, shims and EPDM sleeve are designed as a permanent installation capable of a 50 year operating life. The retaining band, wedges, and shims AL6XN materials were chosen for their corrosion resistance in saltwater applications. The AL6XN has an excellent operating history in US nuclear plants where it has been installed in safety-related saltwater cooling systems. The EPDM rubber has also been designed for a 50 year life. The licensee does not anticipate the disassembly and re-assembly to require the need for replacement parts due to degraded conditions of the components.

The licensee stated that the retaining bands, backing plate, and wedge materials were selected based on industry experience and the known properties of the AL6XN material not to degrade or corrode in service water (saltwater) submersion conditions. The licensee further stated that in addition the design and analysis of all structural components have ensured that adequate safety margins exist during all design basis loading conditions and therefore will not be subject to failure. There is a remote possibility that crevice corrosion could occur between the bottom to the retaining band and the wedge. The licensee noted that long term installation of similar type retaining bands using AL6XN materials installed at service water system piping at other nuclear plants have not shown a propensity for crevice corrosion to occur.

According to the licensee, the EPDM sleeve could become damaged from debris or sharp objects flowing over the exposed surface (pipe ID) and would be replaced if it were gouged or damaged in any way. The licensee noted that the EPDM sleeve is not considered likely to be damaged by the debris as the saltwater system is protected by traveling screens that limit the size of materials from entering the system to less than 0.375-inch in diameter. The licensee stated that there are no internal sources for sharp objects to be generated within the saltwater system. The licensee has spare parts available if replacement is required.

The licensee stated that it will inspect the push tab and wedge for any indication of degradation or corrosion.

The NRC staff finds that the licensee will inspect all the parts of the sleeve assembly. The NRC staff finds that the licensee's ISI regiment is acceptable because the licensee will visually inspecting the sleeve assembly every four years which is consistent with the inspection of the buried pipe. The flushing of the heat exchanger strainers is an automatic function and it flushes approximately every hour. These tests will confirm whether the sleeve assembly is dislodged from the pipe wall.

3.2.3 Analysis

The licensee's analysis of the sleeve assembly is documented in Enclosure 1 of the January 17, 2013 submittal. The licensee used the design criteria in USAS B31.1, *Power Piping,* 1967 and ANSI A21.50, *American National Standard for the Thickness Design of Ductile-Iron Pipe,* 1967 and 1976, which are the construction code of the subject pipe. The licensee calculated various forces and stresses to demonstrate that the retaining bands will hold the sleeve assembly in place and that the pipe is able to support the forces exerted by the retaining bands. The licensee also calculated contact forces between the retaining bands, gasket and pipe wall. The calculation considered applied loads including seismic loads, thermal loads and hydrodynamic loads. The NRC staff asked followup questions regarding the licensee's calculation.

The NRC staff asked the licensee to provide technical basis for Assumption number 10 of the licensee's analysis which stated that "...A maximum of long term stress relaxation of EPDM gasket is assumed to be 12%..." It seems to the NRC staff that the 12 percent stress relaxation can also be applied to the stress relaxation of the retaining bands. This implies that the compressive stresses of the retaining bands on the pipe wall may be relaxed and the gasket may reduce its contact on the pipe wall. The stress relaxation may cause salt water to seep into the crevice between the backing plate and pipe inside surface. In a worst case scenario, the retaining bands may dislodge from the pipe inside wall as a result of the stress relaxation. The NRC staff asked the licensee to address the potential of stress relaxation of the retaining bands.

In Reference 2, the licensee responded that the EPDM rubber is manufactured to have a maximum stress relaxation of 12 percent from a time of 30 minutes to 24 hours based on the British Standard Method of testing Vulcanized Rubber Part A42. This testing for EPDM rubber has been shown to be indicative of the long term creep properties of EPDM rubber. The licensee stated that in general cold flow or creep of the rubber under load is limited to this window under a given load. The licensee further stated that the effect of creep on other rubber gasket material used within the plant is similar. The licensee noted that initial installation procedures require re-expansion of the retaining bands after a period of time (greater than 30 minutes) to ensure creep considerations are addressed. Indication of creep or relaxation of the rubber would be exhibited by a drop in the expansion pressure below the desired range. If this were to occur a larger wedge would be re-inserted and required expansion pressure re-verified.

The licensee clarified that the 12 percent relaxation of the retaining bands is used in the calculation to ensure that the calculated loading on the EPDM sleeve is maintained if the maximum relaxation was to occur. This ensures that a leak tight seal is maintained and that there is no leakage of saltwater behind the seal. The NRC staff finds that the licensee has considered the impact of the stress relaxation in the design and calculations satisfactorily.

In Reference 2, the licensee explained that it will remove the cement mortar liner in the area where the mechanical sleeve assembly is to be installed. The licensee noted that the dimensions provided in the stress calculations are for the internal diameter of the piping without the cement mortar liner. The licensee stated that the cement mortar cannot be relied on as pressure boundary or adequate sealing surface as it is permeable and if there were a through wall hole, in the area adjacent to sealing point, water would migrate through the cement mortar liner and out the hole, thus negating the purpose of the pressure retaining sealing system. According to the licensee, under normal circumstances the cement mortar liner provides an excellent corrosion barrier and it performs as described below in an excerpt from the Ductile Iron Pipe Institute Manual dated 2000.

> The concrete material used for lining piping is a porous material. For this material to achieve its protective capabilities it must be submersed in the process fluid. When a cement-lined pipe is filled with water, water permeates the pores of the lining, thus freeing a considerable amount of calcium hydrate. The calcium carbonate tends to clog the pores of the mortar and prevent further passage of water. The first water in contact with iron through the lining dissolves some of the iron, but free lime tends to precipitate the iron as iron hydroxide, which also closes the pores of the cement. Sulfates are also precipitated as calcium sulfate. Through these reactions, the lining provides a physical as well as a chemical barrier to the corrosive water.

The licensee explained that this process works well as long as all the cement mortar liner in the pipe is exposed to the same pressure. Once a section is isolated such as with the proposed sleeve system with a potential opening to atmosphere the pressurized water will flow to atmosphere through the pores of the cement mortar liner. Positioning the sealing surfaces on the metal pipe ensures a bubble tight seal. The licensee noted that interface areas at the outermost boundaries of the sleeve system that are adjacent to the cement mortar liner not removed for the seal installation, will be coated with an epoxy or similar material under the seal and overlapped onto the cement mortar liner. The licensee explained that the intent is to mitigate any corrosion from occurring in any interstitial gap between the edge of the seal and the cement mortar liner. The NRC staff finds that the licensee will coat the interface between edge of the sleeve and the cement liner with epoxy to minimize potential corrosion. The NRC staff determines that the licensee has satisfactorily addressed the issue related to the cement liner.

The NRC staff noted that if the sleeve dislodged from the pipe wall, the loose sleeve components may clog the pipe and affect its intended function. The NRC staff questioned (1) how the sleeve loose parts in the saltwater system pipe can be detected, (2) what are the components and equipment downstream of the saltwater system piping that may be affected by the loose parts, (3) the worst case safety consequence caused by the loose parts, considering the entire sleeve is dislodged from the pipe wall, and (4) possible operator actions that could avert the serious damage to the downstream components, given a dislodged sleeve.

In Reference 2, the licensee responded that in the unlikely event that the rubber sleeve, retaining bands, or backing plate becomes loose parts in the saltwater piping, the service water heat exchangers, component cooling heat exchangers, and emergency core cooling system (ECCS) pump room air cooler may be affected.

The licensee stated that strainers are located upstream of each service water heat exchanger. There are two service water heat exchanger/strainer pairs per saltwater header. The majority of the flow in the saltwater pipes is directed through the service water heat exchanger and the strainer flushes once per hour. If the loose parts become lodged in the service water heat exchanger strainers and they restrict the operation of the strainer, a strainer trouble alarm in the control room will actuate and a local alarm would indicate that the proper strainer operation was stopped by miss-positioned valves. The licensee would remove the loose parts to return the strainer to service. The worst consequence is a reduction in flow to the service water heat exchanger. Because there are two saltwater headers per unit, and they are redundant, the safety consequence to the plant is bounded by loss of a saltwater header, which is the design basis.

The licensee stated that there is one component cooling heat exchanger per saltwater header. The maximum saltwater flow to the various branches of the saltwater system occurs during the weekly flow verification testing. If the loose parts are transported during flow verification testing, loose parts may end up at the component cooling heat exchanger where they would block the tube sheet and reduce flow. The component cooling heat exchanger has a flow indication in the control room. The low flow indication would be noted and acted upon as part of the test procedure. During the flow verification testing, the operator at the component cooling heat exchanger will record pressure drop and the high pressure drop. The licensee stated that component cooling heat exchanger would not experience serious damage from loose parts, as the sleeve would cover some of the tube sheet as long as there was relatively high flow. Once the flow is decreased, the sleeve would drop to the bottom of the channel. The licensee would remove the component cooling heat exchanger from service, open and retrieve the loose parts.

According to the licensee, there is one emergency core cooling system (ECCS) pump room air cooler per saltwater header. The licensee stated that it is not likely that any loose parts would end up in the ECCS pump room air cooler strainer as the supply lines leading to the cooler are 8 inches in diameter which is small for the sleeve components to pass through. There is also a strainer, located upstream of the ECCS pump room air cooler that has a high differential pressure alarm in the control room. Loose parts affecting strainer performance would trigger the high pressure drop alarm in the control room. The licensee would remove loose parts from the strainer.

The NRC staff notes that if dislodged from the sleeve, the epoxy that is applied to the edges of the sleeve will be caught by the strainers in the saltwater piping, the operator will be notified by the strainer alarm and take corrective actions. The NRC staff finds that dislodged epoxy should not significantly affect the operation of the downstream service water heat exchangers.

The NRC staff finds that the potential loose sleeve parts in the saltwater system piping will not likely to damage the service water heat exchangers, component cooling heat exchangers, and ECCS pump room air cooler because there are redundant detection alarms and/or strainers to protect these equipment. The NRC staff finds that the licensee has satisfactorily addressed the potential of loose parts affecting safety-related components.

The NRC staff finds that the licensee's calculation has demonstrated that the sleeve assembly will restore the structural integrity of a degraded pipe because the stresses are within the allowables.

3.2.4 Pressure Test

In Reference 2, the licensee reported that following installation of the sleeve, it will pressure test the buried saltwater system piping using the criteria of IWA-5244(b) of the ASME Code, Section XI, as a VT-2 visual examination cannot be performed in a buried pipe. The licensee stated that the required flow measurements of the weekly flow verification test ensure the saltwater system can perform its intended function and that flow during operation is not impaired. The NRC staff finds that the licensee satisfies the pressure test provisions of the ASME Code, Section XI, IWA-5000 because the licensee will perform the pressure test in accordance with IWA-5244(b), which provides provisions for pressure testing of buried piping. In addition, the licensee's weekly flow verification test will provide reasonable assurance of leak tightness of the subject piping.

3.2.5 Hardship Argument

The licensee stated that no welding technologies are available to repair degraded ductile cast iron piping that are allowed by the original codes of construction USAS B331.1-1967, ANSI A21.1-1967 (AWWA C010-67) and ANSI A21.50-1976 (AWWA C150-1976), or ASME Code Section XI repair rules. As such, the only alternatives to eliminate a pipe defect are via direct replacement of the affected component or a mechanical repair. The licensee considers that the direct replacement of the subject piping to correct relatively minor localized conditions is overly burdensome and does not result in a compensating increase in the system's overall level of quality and safety when compared to the proposed mechanical repair alternative.

The licensee noted that much of the buried saltwater system piping to be inspected runs under the 3 feet thick steel reinforced concrete base mat of the turbine building. The base mat supports numerous equipment and components that are located directly above the path of the buried piping. The licensee explained that the impact on outage duration and operational challenges to replace a portion of the buried saltwater system piping during an outage are substantial. The physical proximity of the saltwater system piping and the constraints encumbered by interferences located in the turbine building make replacement very challenging. According to the licensee, since the saltwater system is the ultimate heat sink, and replacement would affect both trains of that system it will likely require a full reactor core offload, aligning the unaffected unit to provide cooling to the spent fuel pool and establishing abnormal plant configurations for an extended period of time.

The NRC staff finds that the licensee provided sufficient argument to demonstrate that performing an ASME Code replacement of the subject pipe would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff has concluded that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the 30- and 36-inch ASME Class 3 buried saltwater system ductile cast iron piping, 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 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-04-08 for the remainder of the Calvert Cliffs fourth 10-year ISI interval, which ends on June 30, 2019.

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.

5.0 REFERENCES

1. Letter from J. J. Stanley to Document Control Desk, dated January 17, 2013, Proposed Alternative for Mitigation of Buried Saltwater Piping Degradation (RR-ISI-04-08).

2. Letter from J. J. Stanley to Document Control Desk, dated May 17, 2013, Response to Request for Additional Information, Re: Calvert Cliffs Relief Request RR-ISI-04-08 (TAC Nos. MF0568 and MF0569).

Principal Contributor: J. Tsao

Date: November 13, 2013

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

Sincerely,

/ra/

Robert Beall, Acting Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

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