Calvert Cliffs Nuclear Power Plant

1650 Calvert Cliffs Parkway
Lusby, Maryland 20657

CENG
a joint venture of
Constellation Energy
EDF

CALVERT CLIFFS
NUCLEAR POWER PLANT

January 29, 2014

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Revised Proposed Alternative for Mitigation of Buried Saltwater Piping Degradation (RR-ISI-04-08, Revision 1)

REFERENCES:

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

(b) Letter from N. S. Morgan (NRC) to G. H. Gellrich (CCNPP), dated November 13, 2013, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 & 2 – Relief Request RR-ISI-04-08 Regarding Mitigation of Buried Saltwater Piping Degradation (TAC Nos. MF0568 and MF0569)

In Reference (a), Calvert Cliffs Nuclear Power Plant, LLC, (Calvert Cliffs) requested the Nuclear Regulatory Commission's approval of a proposed alternative (RR-ISI-04-08) for mitigation of buried Saltwater System piping degradation. The Nuclear Regulatory Commission approved the proposed alternative in Reference (b).

Following submittal of the proposed alternative Calvert Cliffs determined the design temperature cited in the original proposed alternative for the buried Saltwater System piping was incorrect. Attachment (1) contains the revised proposed alternative (RR-ISI-04-08, Revision 1) encompassing the higher design temperature for the buried Saltwater System piping. The associated calculation (Enclosure 1) is also revised and it demonstrates the mechanical sleeve assembly's ability to function at the higher temperature.

The revised alternative also adds a specific statement that mentions the installation of the mechanical sleeve assembly is applicable to joints within the buried Saltwater System piping. While the joints were considered part of the buried Saltwater System piping covered in the original proposed alternative, the

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original proposed alternative did not specifically mention them. This revision makes it clear that the joints are included in this proposed alternative.

Consistent with the original proposed alternative, this revised proposed alternative is submitted pursuant to 10 CFR 50.55a(a)(3)(ii) as replacement of the buried Saltwater System piping would be a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Further, as per the original proposed alternative, this revised proposed alternative would be applicable to the repairs of future defects identified in buried portions of our Saltwater System piping throughout the Fourth Ten Year Inservice Inspection Interval.

Calvert Cliffs will conduct inspection of Unit 1 Saltwater System buried piping during its upcoming refueling outage that starts in February 2014. Calvert Cliffs requests review and approval by February 20, 2014. To aid in the review, the portions of the revised proposed alternative that are different from the original proposed alternative (Reference a) are marked with a vertical line on the right hand side of the page.

This letter contains regulatory commitments as listed in Attachment (2).

Should you have questions regarding this matter please contact Mr. Douglas E. Lauver at (410) 495-5219.

Very truly yours,

Kenneth F. Robinson
Manager – Engineering Services

KFR/KLG/bjd

Attachments: (1) Proposed Alternative for Mitigation of Buried Saltwater Piping Degradation (RR-ISI-04-08, Revision 1)
Enclosure: 1 Evaluation of Repair Sleeve Assemblies, Calculation 11-2357-C-003
(2) Regulatory Commitments

cc: N. S. Morgan
W. M. Dean, NRC
Resident Inspector, NRC
S. Gray, DNR

ATTACHMENT (1)

PROPOSED ALTERNATIVE FOR MITIGATION OF BURIED SALTWATER PIPING DEGRADATION (RR-ISI-04-08, REVISION 1)

Calvert Cliffs Nuclear Power Plant, LLC
January 29, 2014

10 CFR 50.55a Request ISI-04-08, Proposed Alternative In Accordance with 10 CFR 50.55a(a)(3)(ii)

1. ASME Code Component(s) Affected

30 and 36 inch Inservice Inspection (ISI) Class 3 Buried Saltwater System ductile cast iron piping for Calvert Cliffs Units 1 and 2.

2. Applicable Code Edition and Addenda

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel 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) C101-67 and ANSI A21.50-1976 (AWWA C150-1976).

3. Applicable Code Requirement

American Society of Mechanical Engineers Code, Section XI, Subarticle IWA-4300. Allowable activities under IWA-4000 for Class 3 piping involve either weld repairs or replacement. Weld repair is not possible because this buried Saltwater System piping is ductile cast iron piping. Replacement of the buried piping is a hardship that poses unusual difficulty without a compensating increase in quality and safety over the proposed alternative repair. It is recognized that the proposed alternative repair would fall under the provisions of IWA-4340, whose use is prohibited by 10 CFR 50.55a(b)(2)(xxv). However, the proposed alternative repair is significantly more comprehensive than the provisions provided by IWA-4340.

4. Reason for Request

Calvert Cliffs routinely monitors and inspects Saltwater System components in accordance with the requirements of Generic Letter (GL) 89-13, Service Water Problems Affecting Safety Related Equipment. Calvert Cliffs is currently increasing the level of inspections of buried portions of the system consistent with Nuclear Energy Institute (NEI)-09-14, Guidelines for the Management of Underground Piping and Tanks.

At this time Calvert Cliffs has no reason to suspect that any conditions exist that do not meet the minimum wall thickness as defined in the design basis calculations of record for the 30 and 36 inch buried Saltwater System piping. However, it is prudent that a method to repair defects in the piping be identified in advance of any inspections, in the event deteriorated conditions are identified.

It should be 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. In addition there are no welded type repair technologies that can be applied to ductile cast iron piping that are allowed by the original codes of construction USAS B31.1, 1967 Edition, ANSI A21.1-1967 (AWWA C101-67) and ANSI A21.50-1976 (AWWA C150-1976), or ASME Code Section XI repair rules. As such the only alternatives to eliminate a defect are via direct replacement of the affected component or a mechanical repair.

The reason for this proposed alternative repair is to allow the use of a mechanical repair system to restore pressure boundary integrity for degraded conditions found during inspections. The specific limitations of the repair systems will be governed by conditions identified and those limitations discussed in Section 7.0 below. In general the proposed mechanical repair system will be utilized only for localized degradation in the piping. The direct replacement of this piping to correct relatively minor localized conditions is considered overly burdensome and costly 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.

5. Component Scope

The scope of the repair alternative is limited to the buried sections of the 30 and 36 inch Saltwater System ductile cast iron piping. As such, this proposed repair alternative is not applicable for use on any gray cast iron section of the Saltwater System piping.

The supporting calculation (Enclosure 1) states any repairs are made in straight lengths of pipe. This includes the bell and spigot joints that are part of straight lengths of pipe within the Saltwater System. The proposed repair alternative is not designed to be used in pipe elbows or across mitered joints.

The buried saltwater piping has a design pressure of 50 psig. The Saltwater System temperature varies in accordance with Chesapeake Bay temperature throughout the year and load demands on the system. The Saltwater System is exposed to temperatures from 30°F up to it's design temperature of 200°F.

6. Burden Caused by Compliance

There are no approved methods or new technologies that provide an adequate method to weld ductile cast iron piping without adversely affecting the integrity of the base metal. The ductile cast iron Saltwater System is a bell and spigot pipe with fittings that connect to compress the joint gasket. This consists of a loose flange or gland that is slid over the spigot section of the pipe prior to insertion into the bell. Once inserted into the joint, bolting is installed between the gland and the integrally cast flange on the bell section of piping. The bolting is then tightened to seat the "V" wedge type gasket and thus provide a leak tight joint. Figure 1 below provides the general configuration of an ANSI/AWWA A21.10/C110 style joint.

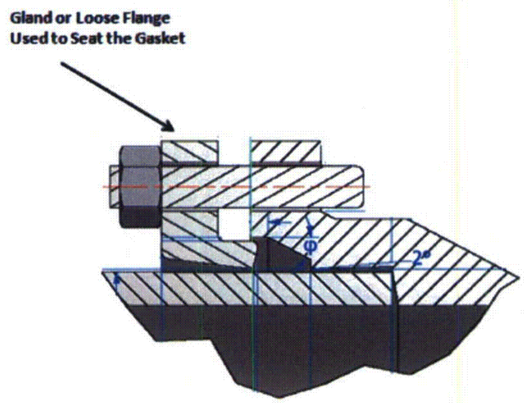

Figure 1

Repairs and modifications to ductile cast iron pipe must use similar methods of mechanical compression for connectivity. In some cases threaded joints may also be utilized.

The planned comprehensive inspection of the buried Saltwater System piping is being performed by Calvert Cliffs to assess and ensure the long-term integrity of the pipe. During previous internal inspections of the piping, areas of missing or deteriorated cement mortar liner have been identified and the mortar lining repaired. Areas where base metal deterioration has been noted have been minor and have not fallen below minimum wall thickness criteria. At this time Calvert Cliffs has no reason to believe that the integrity or reliability of the buried piping has been compromised. Nor are we aware of any specific areas that may be subject to accelerated degradation due to saltwater corrosion or areas of high stress concentration that could be prone to cracking or fracture. Regarding external corrosion of the pipe there is a protective coating on the piping outer diameter (OD) and this generally 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 potential for deterioration on the pipe OD is considered to be negligible. Operating experience of this piping under similar conditions at older power stations has demonstrated good performance over many years.

The examinations to be performed utilizing BEM technology will provide a qualitative assessment of the cross-sectional pipe wall. This exam will identify potential areas of degradation that when found can be further characterized by localized NDE methods. This intensity of examinations to be performed on the pipe is greater than that required during the original construction. There are no baseline comparisons available and original manufacturing defects may be identified that are inherent and acceptable to this type of piping material.

The construction cost, 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. Furthermore, 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. Industry experience has shown that the type of degradation usually found in saltwater piping (external or internal) is localized pitting.

Considering the hardship and unusual considerations of a replacement, the proposed repair alternative described and as limited by the constraints below will preserve the structural integrity of the buried Saltwater System piping to an acceptable level of quality and safety.

7. Proposed Alternative and Basis for Use

Description of Repair/Replacement

The repair/replacement alternative (Figure 2) is a sleeve assembly primarily consisting of a pressure retaining backing plate, an internal rubber gasket and four retaining bands.

The backing plate is made of AL6XN (UNS N08367), a single sheet of 16 gauge sheet metal 14" wide and designed to enclose the entire inside circumference of the 30" and 36" size pipe. It is placed directly over the degraded area on the inner diameter of the pipe to restore pressure boundary integrity.

The rubber gasket is made of Ethylene Propylene Diene Monomer (EPDM). It is factory vulcanized to form one continuous piece and designed to fit the piping inner surface. The gasket is 0.3" thick and about 20" long. The ends of the gasket have grooved ribs. It is placed over the backing plate completely enclosing the entire backing plate and extends beyond each end of the backing plate.

The retaining bands are also made of AL6XN (UNS N08367), 2" wide and 0.1875" thick and ring shaped. Two retaining bands are placed on each end of the gasket and two near the middle where the backing plate is located. To keep the backing plate and the gasket in place and held tightly against the pipe, the retaining bands are radially expanded by a hydraulic expander. The retaining bands are locked in place by wedges also made of AL6XN material. The two end retaining bands compress the groove ends of the gasket against the pipe inner circumference and provide a leak tight seal to prevent water intrusion past the gasket. The two middle retaining bands secure the backing plate in place.

The Saltwater System underground piping has 1/4" cement coating on the inside surface. Prior to installation of the sleeve, the cement lining for the entire length of the sleeve assembly will be removed and repaired with an approved sealant. To prevent galvanic corrosion, the outer surface of the backing plate will be wrapped with a 1/8" thick rubber gasket so that the stainless steel backing plate does not come in direct contact with ductile cast iron piping. Should water leak under the outer stainless steel retaining bands, it is possible, although unlikely, to have crevice corrosion. Therefore, periodic inspections will be performed by disassembling the sleeve assembly and checking for any deterioration of the retaining bands, signs of leakage past the gasket, or any other degradation.

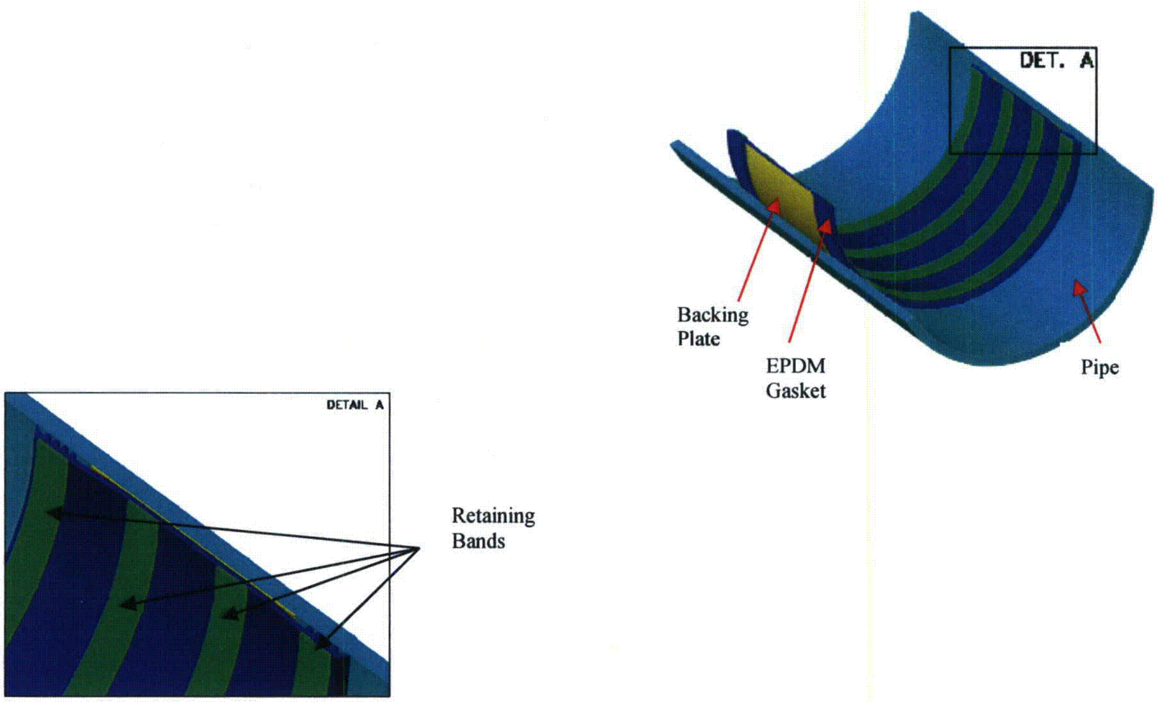

Figure 2

This repair system has been designed consistent with the requirements of the original codes of construction (ANSI B31.1, 1967 Edition). The design calculation (Enclosure 1) qualifies the repair sleeve assembly for the loads applied during installation and operation. The calculation addresses the following:

1) The repair sleeve assembly is capable of restoring pressure boundary of localized pipe wall thinning that can be contained within a 3" diameter area.
2) The friction force created by the retaining bands between the repair assembly and the pipe is significantly larger than the hydrodynamic force of the flowing fluid and seismic loads, and will prevent it from being dislodged.
3) The host pipe can withstand the pressure exerted by the retaining bands during installation, the system design pressure, and the pressure due to thermal expansion/contraction of the retaining bands.

The design calculation determines the following:

1) Contact pressure between the retaining bands, EPDM elastomer seal and the pipe
2) Hoop stresses in the host pipe due to retaining band loads
3) Compressive stress in the retaining band
4) Minimum wall thickness required by the host pipe based on resultant forces of retaining bands
5) Thermal effects on the forces in the retaining band
6) The minimum contact force between the seal assembly and the pipe wall
7) Hydrodynamic loads on the seal assembly for all design basis flow conditions to ensure it stays in place
8) Seismic loads on the sleeve assembly
9) Abnormal loading condition
10) Maximum allowable through wall hole size on the pipe
11) Thermal cycles for the retaining bands and the gasket.

Table 1 below provides a summary of the results from the design calculation.

Table 1

Calculation Results Summary Table for Ductile Iron Pipe

	30 inch Ductile Iron	36 inch Ductile Iron
Maximum compressive stress of yield stress at installation in retaining band	$\frac{\sigma_{c\_chk}}{S_y} = 46.5\ \%$	$\frac{\sigma_{c\_chk}}{S_y} = 46.5\ \%$
Required minimum wall thickness of the host pipe to support sleeve assemblies	t_{DI_30min} = 0.387 in	t_{DI_36min} = 0.409 in
Minimum friction force available between the sleeve and the pipe wall to resist seismic and hydraulic loads follows	F_{fS_DI30} = 9019 lbf	F_{fS_DI36} = 9099 lbf
Hydrodynamic load on the assembly with an impact of 2	F_{HYD_30} = 236 lbf	F_{HYD_36} = 139 lbf
Hydrodynamic load on the assembly with an impact of 2 at sleeve invert condition	$F_{HYD\_ab\_30}$ = 305 lbf	$F_{HYD\_ab\_36}$ = 186 lbf
Axial direction seismic acceleration required to dislodge sleeve assembly	A_{S_DI30} = 82 g	A_{S_DI36} = 82.7 g
Alternating stress due to thermal fatigue	S_{ALT_DI30} = 5237 psi	S_{ALT_DI36} = 5.287 x 10^3 psi
Maximum flaw size at operating pressure	d_{flaw}:= 3.09in	d_{flaw} = 3.09 in

Results:

The calculation demonstrates this repair provides a mechanism to restore pressure boundary integrity by utilizing the reinforcing plate as the new pressure boundary for a locally degraded section of the piping.

This proposed repair system will be applied in cases where degradation has resulted in saltwater piping wall thickness falling below minimum design wall thickness values and is the result of corrosion initiated on the interior diameter of the saltwater piping. This proposed repair system will not be used in cases of discovered crack like flaws, through wall degradation, or on corrosion that initiated on the external diameter of the saltwater piping. Should any of those cases be discovered, additional analysis would be performed and a separate proposed repair alternative would have to be submitted.

Reconciliation

The original code of construction for the subject piping to be repaired is USAS B31.1, 1967 Edition. However the guidelines provided by USAS B31.1, 1967 Edition provide little guidance in the design of ductile cast iron piping. This code does allow ANSI/AWWA C115/A21.15 to be used as an alternative for ductile cast iron. The calculation of record for this piping utilizes design guidelines provided by the Ductile Iron Pipe Research Association that is consistent with the requirements of ANSI/AWWA C115/A21.15.

As a basis for design, AWWA Manual M11 "Design of Steel Piping" was used in assessing pressure boundary integrity load conditions. This code is consistent with the calculation of record that qualified the piping for its design basis conditions. This design code is consistent with the original codes of construction utilized in the design of the system. USAS B31.1, 1967 Edition, the overall code of construction, provides no direct guidance for the design of buried piping and in this case defaults to AWWA requirements by inference.

Key attributes of the proposed repair system include:

1) High Strength ASME SB-688 (AL6XN) material is utilized for all load carrying components.
2) ASME SB-688 is resistant to corrosion attack due to submersion in saltwater.
3) There is no welding required for installation.
4) There are no adverse effects to the systems hydraulic capacity.
5) Installation of the repair system will be performed with controlled procedures.
6) The repair system can easily be removed to allow inspection and monitoring of the deteriorated area.

The ASME Section XI, Appendix IX provides rules for the use of mechanical clamping devices and it is implied that these type mechanisms would be externally applied. However, the code does not consider modifications to non-steel piping systems currently in use in the nuclear fleet, for safety-related buried piping, such as Pre-Stressed Concrete Cylinder Pipe or ductile cast iron. The ductile cast iron piping utilized at Calvert Cliffs is currently not recognized by ASME Sections II, III, or XI and thus the owner must rely on guidance for repair and replacement activities from the original code of construction.

The style of the repair system to be used is similar to the compression style mechanical joints already in use in the piping system. The ASME Section XI addresses mechanical clamping devices. Mechanical clamps require that they be designed to resist the internal pressure by overcoming forces acting on the device. Components of a clamping device are subject to tensile forces as a result of pressure. The proposed repair system components are subject to more favorable compressive loads as internal pressures increases. The proposed repair system is not considered a clamp and is therefore not considered subject to the rules of ASME XI, Appendix IX.

The following provides a summary of the proposed repair systems:

1) The materials utilized in the repair system are non-corrosive when exposed to the saltwater in the Saltwater System.
2) The maximum size of the degraded area including projected growth will fit within a 3 inch diameter area.
3) No additional supports are required for the repair system. The component to be utilized relies only on the ductile cast iron piping for structural and pressure integrity.
4) The repair system has been designed for pressure boundary integrity only. The remaining non-degraded ductile cast iron pipe maintains full design structural capacity of the piping system.
5) The repair system utilized considers all design basis loading requirements including seismic and ensures that it will continue to perform its intended function during all those types of events.

a) The repair system design was evaluated for a design pressure of 50 psig and was assessed to consider the effect of prying actions due to system maximum flow. All stress levels were less than the allowable for Level A Service Limits.

6) The repair system to be utilized is designed in such a manner so as not to damage or adversely affect the existing ductile cast iron piping.

7) The intended use of the repair system is to repair localized degraded areas in the piping and is not designed to transmit longitudinal loads or a full circumferential severance of the piping.

8) When degradation is identified in the ductile cast iron pipe it will be characterized to ascertain whether the degradation is ID or OD initiated and the characterization will be considered in the projected degradation growth.

9) The evaluations conducted for this repair were completed in accordance with the original code of construction for the buried ductile cast iron Saltwater System piping, USAS B31.1, 1967 Edition as supplemented by the requirements of ANSI A21.1-1967 (AWWA C101-67) and ANSI A21.50-1976 (AWWA C150-1976).

10) The repair system will be installed in a piping that is continuously supported and the additional weight does not increase bending in the ductile cast iron pipe.

11) Any degradation identified that is due to erosion or corrosion of the thickness of the material at the load transfer area will be determined and checked against design criteria.

12) The constraining effects of the repair system have also been considered and there are no adverse effects from the installation of the repair system on the ductile cast iron pipe.

The internal mechanical seal (i.e., EPDM Rubber & Retaining Bands), upon which this design is based on, has been utilized as a corrosion barrier in numerous Class 3 systems throughout the industry for many years. These seals have ensured that the host pipes, in the area where they are installed, are isolated from the effects of the process fluid corrosive effects.

The installation of this proposed alternative repair is considered to arrest the growth of the corrosion since it will completely seal the degraded area from the corrosive fluid (saltwater). Calvert Cliffs will disassemble the first installed repair system and inspect the degraded area after two operating cycles. This inspection will include:

- A check of the retaining bands and backing ring for corrosion
- A check of the area under the sleeve for wetness
- A check for any damage of the liner
- A check for damage of the EPDM gasket

The results from this inspection will then be used to determine if any change in the periodicity of this action is warranted. In case of multiple installations, only one of the proposed repair systems will be disassembled while the rest will be visually inspected every other refueling outage during conduct of our current preventive maintenance task to inspect Saltwater System piping.

All degradation identified will be assessed on a case by case basis. Depending on the defect size the pressure plate may be altered to provide adequate strength to account for degradation outside of the design basis calculation. Appropriate changes will be made to the calculation to reconcile any changes to the pressure plate dimensions. Defects where the repair system is utilized will be characterized to ensure that the defect will be contained within the specified limits of the repair system. Subsequent inspections frequencies of the encapsulated degraded area will also be determined. Monitoring of the size of the degradation will be performed as required.

8. CONCLUSION

The installation of the proposed repair system provides a method to repair defects in buried Saltwater System piping that is not irreversible and allows the long-term monitoring of the degradation area. The pressure boundary capacity of the repair system has been demonstrated by analysis and corrosion resistant components have been utilized to eliminate the potential for degradation. As discussed in Section 7.0 the manner of repair and connectivity to the piping system is consistent with the methods utilized at pipe joints. The AL6XN material utilized in this repair ensures high resistance to saltwater corrosion and has been utilized in similar applications at other plants with no signs of deterioration. In addition this type of repair system has been demonstrated to function in service over ten years without issue.

Based on the above, Calvert Cliffs believes that the proposed repair system, when installed within the limitations of the design constraints, provides a reliable repair method that is consistent with the original code of construction. Also because the repair system can be easily removed and reinstalled it will allow for long-term monitoring of the defect condition as required and this capability addresses those concerns identified in 10 CFR 50.55a(b)(2)(xxv). These requirements are applicable to the repairs of future defects identified in buried portions of our 30 and 36 inch ISI Class 3, Saltwater System piping.

ATTACHMENT (2)

REGULATORY COMMITMENTS

ATTACHMENT (2)

REGULATORY COMMITMENTS

The table below lists the actions committed to in this submittal. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

Regulatory Commitments	Date
After Unit 1 RFO, establish a work order to inspect one installed Saltwater System sleeve assembly approved in RR-ISI-04-08, Revision 1, after two operating cycles. If no sleeve assembly installed during RFO, no action required. Create a new action item for subsequent Unit 1 RFO if Saltwater System piping inspection to be conducted.	5/1/2014
After Unit 2 RFO, establish a work order to inspect one installed Saltwater System sleeve assembly approved in RR-ISI-04-08, Revision 1, after two operating cycles. If no sleeve assembly installed during RFO, no action required. Create a new action item for subsequent Unit 2 RFO if Saltwater System piping inspection to be conducted.	5/1/2015