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

May 17, 2013

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
Response to Request for Additional Information, Re: Calvert Cliffs Relief Request RR-ISI-04-08 (TAC Nos. MF0568 and MF0569)

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 B. K. Vaidya (NRC) to G. H. Gellrich (CCNPP), dated March 18, 2013, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 - Request for Additional Information Regarding: Relief Request RR-ISI-04-08, Alternative for Mitigation of Buried Saltwater Piping Degradation, (TAC Nos. MF0568 and MF0569)

In Reference (a), Calvert Cliffs Nuclear Power Plant, LLC submitted a proposed alternative repair method (RR-ISI-04-08) for our buried Saltwater System piping. In Reference (b), the Nuclear Regulatory Commission issued a request for additional information (RAI) to support their review of Reference (a).

Attachment (1) contains our responses to Reference (b).

This letter contains no regulatory commitments.

A047
NRR

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

Very truly yours,

for
James J. Stanley
Manager-Engineering Services

JJS/KLG/bjd

Attachment: (1) Request for Additional Information: Relief Request RR-ISI-04-08
Enclosure: 1 Mechanical Sleeve Assembly Installation Procedure
2 Mechanical Sleeve Assembly Slides

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

ATTACHMENT (1)

REQUEST FOR ADDITIONAL INFORMATION:

RELIEF REQUEST RR-ISI-04-08

By letter dated January 17, 2013 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML 13022A048), Constellation Energy (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4000, at Calvert Cliffs Nuclear Power Plant, Units 1 and 2. The licensee proposed an alternative to mitigate the potential degradation in buried Saltwater System ductile cast iron piping as documented in Relief Request (RR)-ISI-04-08. To complete its review, the Nuclear Regulatory Commission (NRC) staff requests additional information as follows.

Design

RAI No. 1:

On Page 8 of the RR, the licensee stated that "... The internal mechanical seal (i.e., EPDM [Ethylene Propylene Diene Monomer] 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 ..." Discuss whether the subject sleeve design is the same as those that have been installed in the salt water environment in other nuclear plants. If yes, discuss the operating experience of the sleeve used in the nuclear plants and identify the nuclear plants. If not, discuss whether the proposed sleeve assembly has been tested for structural integrity and leak tightness under the same operating conditions as in the saltwater system in a full scale mock up.

CCNPP Note:

Enclosure 2 contains a drawing that shows the main components of the mechanical sleeve assembly. For clarification and consistency purposes, the terms shown in Enclosure 2 will be used throughout our responses to the Requests for Additional Information (RAIs). Use of these terms will in some cases be different than the term used in the RAI and in the vendor installation procedure (Enclosure 1). Not shown in Enclosure 2 is a thin rubber gasket that will be placed between the inner surface of the saltwater piping and the outer surface of the backing plate. The gasket is installed to prevent galvanic corrosion between the dissimilar metals.

CCNPP RESPONSE TO RAI NO. 1:

Following is a listing of nuclear plants known, as cited by the vendor of the mechanical sleeve assembly (Altran), to have installed EPDM internal mechanical sleeves that are similar in design to the proposed mechanical sleeve assembly for Calvert Cliffs.

Facility	System	Pipe Size & ~ Quantity*	Installation Date	Environment
Seabrook	Service Water	24", 65 Units	1995-2000	Saltwater
Millstone 1	Service Water	30", 30 Units	1995	Saltwater
Millstone 2	Service Water	24", 15 Units	1999	Saltwater
Millstone 3	Service Water	20-30", 20 Units	2000	Saltwater
Indian Point 3	Service Water	24", 60 Units	1999	Brackish Water
Salem U-1 & 2	Service Water	24", 200 Units	Mid 2000s	Brackish Water

* units = number of internal mechanical seals installed

Duke Energy's Catawba plant has been utilizing a similar designed system in their Circulating Water expansion joints that are located upstream and downstream at the inlet/outlet water box expansion joints. In one case there was a through wall hole or crack in the expansion joint. This was installed in September of 2001 and is still in place. The operating pressure for that system is around 60 psig.

RAI No. 2:

The licensee stated that the design pressure is 50 psig and the licensee's calculation used a temperature range from 32 degrees F to 95 degrees F. (1) Provide the pressure and temperature for various conditions such as the normal operation, emergency and faulted conditions. (2) Discuss whether the rubber material used for the gasket has been qualified for use under all temperature and pressure ranges that the subject pipe will experience. (3) Discuss how many years for which the gasket material is qualified under the salt water environment.

CCNPP RESPONSE TO RAI NO. 2:

The Saltwater System temperature varies in accordance with Chesapeake Bay temperature throughout the year. A review of past saltwater temperatures experienced here at Calvert Cliffs revealed that on rare occasions the temperature of the saltwater recorded a low of 30°F. Therefore the range for saltwater should be adjusted to 30°F to 95°F vice the stated range in our relief request of 32°F to 95°F. The small change is inconsequential. The temperature range of 30°F to 95°F and the design pressure of 50 psig bound the system's parameters during normal, emergency and faulted conditions.

The rubber used for the repair sleeve is EPDM and has a service life of 50 years in submerged conditions similar to those experienced at Calvert Cliffs. The operating history of the rubber in nuclear safety-related service water systems as identified above has been excellent and no deterioration of the rubber has been identified. The rubber is designed to withstand a non-steam environment temperature of up to 300°F. The general properties of the EPDM are as follows:

Tensile Strength	1,450 psi ASTM D412
Durometer Shore A	65 (+/-5) ASTM D2240
Elongation	350% 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 EPDM sleeve is qualified for use under all bounding temperature and pressure conditions for the Saltwater System.

RAI No. 3:

The licensee's calculation in Enclosure 1 to the RR showed that the retaining band thickness is 0.1875 inches. The backing plate thickness is 0.0598 inches. The gasket thickness is 0.3 inches. Provide the thickness of the cement liner, wedge, and shim. Provide the final cross sectional height (thickness) of the sleeve assembly.

CCNPP RESPONSE TO RAI NO. 3:

The maximum cross sectional height will be 0.7826 inches and is located in the area of the push tabs. The typical cross sectional height is 0.5473 inches around most of the circumference of the sleeve assembly (see Figure 1). It should be 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 inches (max) and 0.2973 inches (typical) when accounting for the removal of the 0.25 inch concrete liner.

RAI No. 4:

The sleeve assembly is not welded or glued to the inside surface of the pipe. It seems that salt water may seep into the crevice between the backing plate and inside surface of the pipe. Discuss how the sleeve assembly can prevent salt water from seeping into the crevice underneath the gasket.

CCNPP RESPONSE TO RAI NO. 4:

Prior to installing the mechanical sleeve assembly, the cement liner of the piping is removed for the entire length of the mechanical sleeve assembly. The ring shaped 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 EPDM sleeve (factory vulcanized to form one continuous piece and designed to fit the piping inner surface) 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 are positioned over the EPDM sleeve such that when they are expanded they hold the EPDM sleeve and backing plate in position. The ends of EPDM sleeve have grooved ribs. A retaining band is placed directly over the ribs at each end. 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. Operational history of similar components installed in service water systems at Seabrook, Indian Point Unit 3, Salem 1 & 2 and Millstones Units 2 & 3 have not shown a propensity for crevice corrosion to occur.

RAI No. 5:

On Page 5 of the RR, the licensee stated that "... The repair sleeve assembly is capable of restoring pressure boundary of localized pipe wall thinning that can be contained within a 3" diameter area ..." Based on this statement, it appears that the sleeve can only be installed for a wall thinning area or pin hole no more than 3 inches in diameter. After the sleeve is installed the flaw (degraded area) may grow and expand either laterally or through wall or in both directions. The NRC staff finds that the sleeve cannot be applied at a flaw that is already 3 inches in diameter at the time of installation unless the licensee inspects the flaw size frequently to ascertain that the flaw will not grow to more than 3 inches in diameter. The NRC staff thinks that the sleeve should be installed for a flaw that is less than 3 inches in diameter, for example, at X inches in diameter, because the flaw would grow to the limitation of 3 inches. However, the sleeve should be qualified for Y inches in diameter. The V-inch diameter should include the initial flaw size at the time of sleeve installation plus any future flaw growth projected to the end of the design life of the sleeve. If the flaw size is found to exceed the Y diameter during subsequent inspections, the sleeve will not be applicable and will have to be removed. The above argument assumes that the sleeve may fail in the future and the salt water may leak into the gasket and in contact with the flaw. Discuss the flaw size at the time of sleeve installation and the flaw size that the sleeve is qualified for application.

CCNPP RESPONSE TO RAI NO. 5:

If a flaw is found on the piping inner diameter and the flaw is determined to be due to corrosion, the mechanical sleeve assembly can be installed provided the flaw size does not exceed the allowable size of 3 inches in diameter. A flaw growth determination would not be necessary, since the sleeve will isolate the source of corrosion by preventing system fluid from coming in contact with the piping inner surface.

If a crack like flaw is found in the piping and we intend to install a repair assembly, a fracture mechanics analysis and a flaw growth calculation would have to be performed. However this 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, a separate proposed alternative repair would have to be submitted.

Additional degradations that are outside the scope of this proposed alternative repair include through wall degradation and degradations due to external corrosion.

RAI No. 6:

Degradation in the saltwater piping may be manifested in a cluster of wall thinning spots or pits that are not connected to each other (e.g., a shotgun pattern). Each of the spots/pits could be less than 3 inches in diameter. However, the total degraded area of the spots and pits may exceed 3 inches. Discuss whether the sleeve is applicable in this scenario.

CCNPP RESPONSE TO RAI NO. 6:

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. Shot gun pitting with small areas of degradation is in actuality a favorable condition as it relates to span stresses in the backing plate. It is not practical to predict the configuration of degraded areas and typically these conditions are addressed on a case by case basis. Calvert Cliffs 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, it will have to be addressed through the submittal of a separate proposed alternative repair.

RAI No. 7:

Table 1 of the RR shows that the required minimum wall thickness of the host pipe to support a sleeve assembly is 0.326 inches and 0.348 inches for the 30-inch and 36-inch diameter pipe, respectively. Confirm that the sleeve cannot be applied to a flaw whose surrounding pipe area has less wall thickness than these values. That is, the sleeve can be applied to a flaw that has a wall thickness less than 0.326 or 0.348 inches, but the wall thickness in the surrounding pipe area has to be greater than 0.326 or 0.348 inches to support the sleeve installation.

CCNPP RESPONSE TO RAI NO. 7:

Yes. The section of piping where the retaining bands are installed must maintain a minimum thickness of 0.326 inches and 0.348 inches for the 30-inch and 36-inch diameter pipe, respectively.

RAI No. 8:

Provide the duration of the proposed alternative (i.e., the time period of the sleeve design application).

CCNPP RESPONSE TO RAI NO. 8:

The limiting component (EPDM rubber sleeve) of this mechanical sleeve assembly has a service life of 50 years. Therefore the mechanical sleeve assembly's service life exceeds the duration of the units' licensed life (Unit 1 – 2034, Unit 2-2036).

Installation

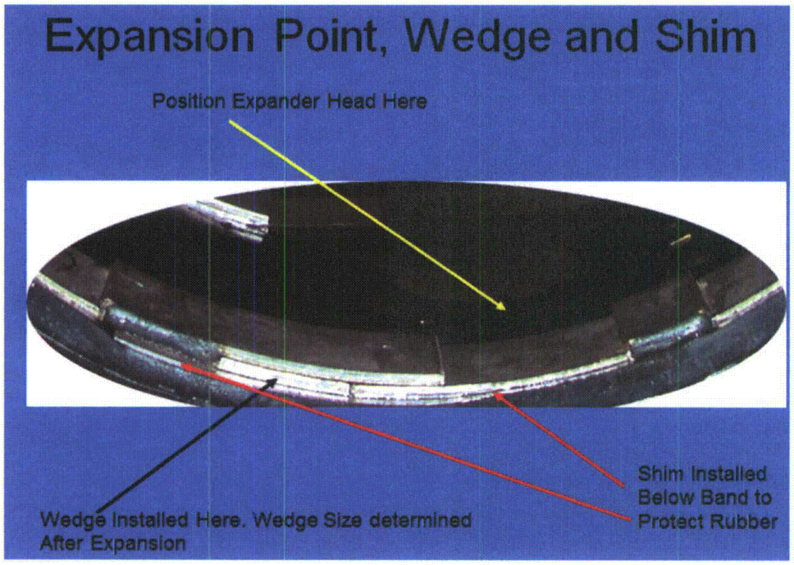
RAI No. 9:

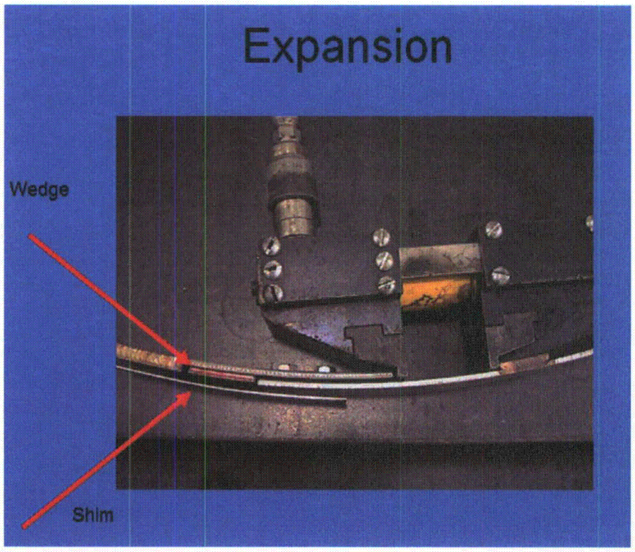
Provide a detailed description of the sleeve installation, including pre-installation inspection and preparation, installation, post-installation inspection, and acceptance criteria for the installation. (2) On page 4 of the RR the licensee stated that retaining bands are held in place by wedges. The drawing on page 2 of Attachment A to Enclosure 1 show the cross section of the wedge, push tabs and retaining band *but it is not clear how the wedge or push tabs hold down the retaining band. Provide a sketch of the wedge and how the wedge holds down the retaining bands. (3) The licensee stated that the retaining bands are expanded against the inside surface of the pipe. Clarify whether it is the expansion of the retaining bands or wedges that assist the retaining band in holding the gasket in place. (4) The drawing on page 2 of Attachment A shows a shim. However, the shim was not discussed on page 4 of the RR Discuss how the shim is installed and whether it supports any loading. (5) Confirm that the backing plate will not be hydraulically expanded against the pipe wall. Does the backing plate support any loading? (6) The drawing on page 3 of Attachment A to Enclosure 1 is illegible. Provide a legible drawing.*

<u>CCNPP RESPONSE TO RAI NO. 9</u>:

(1) An installation procedure is contained in Enclosure 1 that includes pre-installation, inspection, and post installation inspection. Note this procedure does not specifically call out the placement of the thin rubber gasket between the backing plate and the exposed ductile iron pipe surface.

(2) See the figures below for specifics on the wedge details and expansion process.





(3) The retaining bands are expanded as shown above. As the retaining bands expand they exert pressure on the EPDM rubber sleeve and create a leak tight seal against the pipe surface. Once the expansion pressure has been achieved within the acceptable range a wedge is placed into the gap between the push tabs and above the shim plate and the pressure is released from the hydraulic expander. It should be noted that a series of different width wedges are available to the installer to ensure as close as possible fit in the available space. This ensures that the expansion pressure applied to the retaining band is maintained within the acceptable range.

(4) The shim is installed under the retaining band, below the wedge and is located to protect the EPDM sleeve from the slight motions imparted during the expansion of the retaining band prior to the installation of the wedge.

(5) The backing plate will not be hydraulically expanded. The EPDM sleeve is placed over the backing plate. Then the two inner retaining bands are expanded to keep the backing plate in place.

(6) Figure 1 is provided showing a circumferential cross-section of the mechanical sleeve assembly.

RAI No. 10:

For a hole on the pipe, discuss the measures to prevent groundwater leaking from the outside surface into the pipe prior to installing the sleeve. For the wall thinning area on the inside surface of the pipe, discuss the measures applied to the wall thinning area prior to installing the sleeve.

CCNPP RESPONSE TO RAI NO. 10:

This 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.

RAI No. 11:

On Page 6 of the RR. the licensee stated that "... This proposed repair system will not be used in cases of discovered cracking or on corrosion that initiated on the external diameter of the saltwater piping ..." Discuss the degradation mechanisms and flaws that the proposed alternative will be applicable. Discuss whether the sleeve can be installed on the inside surface of an elbow.

CCNPP RESPONSE TO RAI NO. 11:

This proposed alternative repair is limited to corrosion related degradation that initiated on the interior wall of the saltwater piping. See RAI #5 response.

The proposed mechanical sleeve assembly is not designed for installation on the inside surface of an elbow.

RAI No. 12:

Provide a video of the sleeve installation if it is available or a website link for the video that the NRC staff can access and view so that the NRC staff can understand exactly how the sleeve will be assembled in the pipe.

CCNPP RESPONSE TO RAI NO. 12:

Enclosure 2 contains a presentation which depicts the main pieces of the mechanical sleeve assembly. It also demonstrates how the retaining bands are radially expanded to keep the EPDM sleeve and backing plate tightly against the pipe.

Examination

RAI No. 13:

Section 4 of the RR stated that the licensee will use Broadband Electromagnetic (BEM) examination to inspect the saltwater system piping to determine pipe conditions. Discuss whether BEM will be used in the future ISI. If yes, discuss whether BEM can detect a flaw that is hidden behind a sleeve assembly.

CCNPP RESPONSE TO RAI NO. 13:

Broadband Electromagnetic (BEM) examination was used on buried saltwater piping during Unit 2s 2013 refueling outage as part of our site's Buried Piping Inspection Program. This method was utilized to obtain reasonable assurance of the structural and leakage integrity of our buried saltwater piping in accordance with the guidelines of NEI 09-14. The results of the inspection revealed no areas of degradation that would necessitate the installation of this proposed mechanical sleeve assembly. Calvert Cliffs does not have any current plans to use BEM examination in the foreseeable future. However should conditions change or warrant the use of BEM, it would be reconsidered. Calvert Cliffs will continue its ongoing practice of visually inspecting all areas of our saltwater piping within a four year (two refueling outages) period.

RAI No. 14:

On page 8 of the RR, the licensee stated that it will disassemble the first installed repair system and inspect the degraded area after two operating cycles. In case of multiple installations, the licensee will only disassemble one of the proposed repair systems 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 subsequent inspection frequencies of the encapsulated degraded area will also be determined. Monitoring of the size of the degradation will be performed as required. (1) Discuss exactly how often the sleeve will be inspected after the first inspection and what type of inspection will be conducted (e.g., disassembly inspection or visual inspection without disassembly). (2) Discuss how often monitoring of the size of the degradation will be performed and the monitoring method. (3) Explain how the visual examination can determine whether a sleeve assembly is acceptable for continued operation because the visual examination may not be able to determine whether salt water has or has not leaked into the crevice behind the backing plate without disassembly.

CCNPP RESPONSE TO RAI NO. 14:

(1) All installed mechanical 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 mechanical 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.

(2) The design of this mechanical sleeve assembly is to fully isolate the area of degradation from the source (saltwater) of the corrosion. With the source of corrosion isolated, the area of degradation is not expected to increase over time. Therefore the need for further examination is not required.

(3) As indicated above, the visual inspections (without disassembly) will focus on observing signs of abnormal conditions of wear on the mechanical sleeve assembly. 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 results from this disassembly would be evaluated 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.

RAI No. 15:

On page 8, the licensee stated that during the future inspections, it will disassemble the sleeve assembly and check the retaining bands and backing ring for corrosion, the liner under the sleeve for wetness, and any damage of the liner. The rubber ribs on the gasket may be deformed after they are being pressed against the pipe by the retaining bands. It appears that once the gasket is used in the sleeve assembly and removed for inspection, it should not be re-used. The retaining bands are fit into the pipe wall by hydraulic expander which means that they may be plastically deformed after installation. After disassembly, it appears that they should not be re-used also. (1) After disassembling the sleeve for inspection, discuss whether the new or old parts will be used for retaining bands, gasket, wedge and backing plate to re-install the sleeve assembly. (2) Discuss the conditions that would cause the retaining band, gasket and back plate to be replaced. (3) Discuss whether the wedge and push tab will be examined during the future inspections.

CCNPP RESPONSE TO RAI NO. 15:

(1) 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, shims AL6XN (ASME SB-688) materials were chosen for their corrosion resistance in saltwater applications. AL6XN has an excellent operating history in US nuclear plants where it has been installed in safety-related saltwater cooling systems. The EPDM rubber utilized has also been designed for a 50 year life. Calvert Cliffs does not anticipate the disassembly and re-assembly to require the need for replacement parts due to degraded conditions of the components.

(2) As stated above, the retaining bands, backing plate and wedge materials were selected based on industry experience and the known properties of the AL6XN (ASME SB-688) material not to degrade or corrode in service water (saltwater) submersion conditions. 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. However long term installation of similar type retaining bands utilizing ALXN (ASME SB-688) materials installed at other service water cooled plants have not shown a propensity for crevice corrosion to occur. 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. However this is not considered likely as the Saltwater System is protected by traveling screens that limit the size of materials from entering the system to less than 0.375 inches in diameter. There are no internal sources for sharp objects to be generated within the Saltwater System. Calvert Cliffs, as part of a well-planned disassembly and re-assembly evolution, will have spare parts available if required.

(3) The push tabs primary function is to apply the expansion load during the installation process. The wedge is required to be in place to ensure the expansion load on the retaining band is maintained for

design basis loading conditions. Future inspections performed on the push tab and wedge would include visual examination for any indication of degradation or corrosion.

Analysis

The following questions are related to licensee's Calculation 11-2357-C-003 in Enclosure 1 of the January 17, 2013 submittal.

RAI No. 16:

(1) In section 2.0 of the Calculation, Assumption number 5 stated that "... It is assumed that during the abnormal operating condition, the upstream retaining band will be lost and the sleeve will fold back on itself..." However, in Section 4.5 of the Calculation, the analysis assumed that three upstream retaining bands are lost and only one retaining band remains. Clarify the discrepancy between the assumption number 5 and the analysis performed in Section 4.5. (2) Assumption 10 stated that "... A maximum of long term stress relaxation of EPDM gasket is assumed to be 12% ..." Provide the technical basis of 12 percent stress relaxation. Clarify how many years are considered as the "long term." (3) It seems that the 12 percent is also applied to the stress relaxation of the retaining bands. This implies that the compressive stresses of the retaining bands may be relaxed and the gasket may reduce its contact on the pipe inside wall in the future. This may cause salt water to seep into the crevice between the backing plate and pipe inside surface or in a worse scenario, the retaining bands may dislodge from the pipe inside wall. Discuss how the sleeve design addresses the problem of stress relaxation of the retaining bands.

CCNPP RESPONSE TO RAI NO. 16:

(1) The intent of assumption No. 5 and Section 4.5 was to demonstrate the retaining strength of the retaining bands and secondly that in the case of some unknown event that the sleeve assembly would not become free and flow downstream and block a vital piece of equipment. This evaluation was performed to address any potential concerns with the ability of the Saltwater System to perform its design basis flow requirement.

(2) 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. In general cold flow or creep of the rubber under load is limited to this window under a given load. The effect of creep on other rubber gasket material used within the plant is similar. 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.

(3) The 12 percent relaxation of the retaining bands is utilized 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.

RAI No. 17:

On Page 8 of the Calculation, the licensee calculated the pipe inside diameter as 30.90 inches and 37.04 inches for the 30-inch and 36 inch pipe, respectively. It appears that these diameters did not consider the cement liner thickness. On page 9 of the calculation, it appears that the licensee calculated *the retaining band outside diameter without considering cement liner thickness. (1) Provide the cement liner thickness. (2) Explain why the cement liner thickness was not considered in the retaining band outside diameter calculations. (3) Explain why the design drawing on page 2 of Attachment A to the Calculation also did not include the cement liner as part of pipe inside surface.*

CCNPP RESPONSE TO RAI NO. 17:

Calvert Cliffs will remove the cement mortar liner in the area where the mechanical sleeve assembly is to be installed. The dimensions provided are for the internal diameter of the piping without the cement mortar liner. 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. 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, which 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."

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.

It should be 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 intent is to mitigate any corrosion from occurring in any interstitial gap between the edge of the seal and the cement mortar liner.

RAI No. 18:

Section 4.5 of the Calculation analyzed a postulated abnormal condition where 3 of the 4 retaining bands (the upstream bands) are dislodged and the sleeve is held in place by one remaining retaining band. The gasket would fold back over the remaining retaining band. The NRC staff finds that the calculation in Section 4.5 is an ideal case. Under the actual field condition the pipe will be clogged by the loose gasket, retaining bands, wedges and backing plate as discussed in the following estimates. The NRC staff estimated that cross-sectional area of the inside diameter for the 30-inch pipe (this pipe size is used as an example) is about 750 square inches (ID is 30.90 inches). The circumference of the 30-inch pipe considering the sleeve thickness is about 95 inches based on an ID of 30.30 inches. The width of the gasket is about 20 inches. However. the gasket is assumed to be held by one retaining band (the band's width is 2 inches). The width of gasket that would be loose from the pipe wall would be 18 inches (20 - 2 = 18). The area of the loose gasket is 1710 square inches (95" x 18"). The backing plate has a width of 14 inches and its area is 1330 square inches (14" x 95"). The gasket or backing plate area size is much greater than the cross-sectional area of the pipe. The likely scenario is that the loose gasket and backing plate will restrict the fluid flow severely. (1) Discuss how the loose part(s) in the saltwater *system pipe can be identified. Is there an alarm in the control room to alert the operator? (2) Identify the potential components and equipment downstream of the saltwater system that may be affected by the loose parts. (3) Discuss the worst case safety consequence caused by the loose parts, considering the entire sleeve is dislodged from the pipe wall. (4) Discuss possible operator actions that could avert the serious damage to the downstream components, given a dislodged sleeve.*

CCNPP RESPONSE TO RAI NO. 18:

(1) In the unlikely event that the rubber sleeve, retaining bands, or backing plate becomes loose parts in the Saltwater System, there are flow alarms in the control room that would indicate if the flow is significantly blocked in the saltwater supply header or the individual Service Water Heat Exchangers (SRW HX). If the loose parts become lodged in the SRW HX strainers and they restrict the operation of the strainer, there is also a strainer trouble alarm in the control room and a valve mis-position alarm locally mounted near each strainer/SRW HX pair. 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 (CC HX) which also has flow indication in the Control Room. The low flow would be noted and acted upon as part of the test procedure. During the flow verification testing there is a plant operator at the CC HX to record pressure drop and the high pressure drop would be noted. 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. There is also a strainer, located upstream of the ECCS Pump Room Air Cooler that has a high dp alarm in the Control Room.

(2) a. SRW HX. SRW HX Strainers are located upstream of each SRW HX. There are two SRW HX/strainer pairs per saltwater header as noted above. Loose parts affecting the SRW HX Strainer performance will set off alarms in the Control Room.

b. CC HX. There is one CC HX per saltwater header. Loose parts affecting CC HX performance would be noted during the weekly flow verification performed by Operations.

c. ECCS Pump Room Cooler Strainer. There is one ECCS Pump Room Air Cooler per saltwater header. Loose parts affecting strainer performance would trigger a high pressure drop alarm in the Control Room.

(3) In the unlikely event that the entire mechanical sleeve assembly is dislodged from the pipe wall, it would likely end up at the SRW HX strainer as during normal operation, the majority of the flow in the system is directed through the SRW HX. The sleeve would become lodged in the strainer, likely affecting its operation as the strainer flushes approximately once per hour. If the operation of the strainer is impeded, a "strainer trouble alarm" would be seen in the control room, and a local alarm would indicate that the proper strainer operation was stopped by mispositioned valves. The worst consequence is a reduction in flow to the SRW HX. Since 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 in our design basis.

If there is a concurrent flow verification being performed when the entire sleeve is dislodged (minimal exposure as this is performed approximately once per week for < ½ an hour) the sleeve could end up at the CC HX, where it would block the tube sheet and reduce flow. This would be immediately noted as part of the flow verification. Since 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 in our design basis.

It is not possible for the entire sleeve to reach the ECCS Pump Room Air Cooler strainer because the lines to the strainer are 8 inches in diameter.

(4) No serious damage would result to the downstream components from the sleeve becoming dislodged. If the SRW HX strainer operation is blocked, the strainer cycle is stopped, alarms would be received by the control room, and maintenance would be performed to return the strainer to service by removing the sleeve.

Component cooling heat exchanger would not experience serious damage; 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 CC HX would be removed from service, opened and the sleeve retrieved. The sleeve is not expected to make it to the ECCS Pump Room Air Cooler strainer, but they can also be removed from service and cleaned.

System Leakage Test

RAI No. 19:

The RR did not specify a system leakage test after the sleeve is installed. Discuss whether a system leakage test will be performed in accordance with the ASME Code, Section XI, IWA-5244 or IWD-5000. If a system leakage test will not be performed, discuss how the licensee can ensure that the sleeve will perform its intended function.

CCNPP RESPONSE TO RAI NO. 19:

Following installation of the sleeve the Calvert Cliffs' buried Saltwater System piping will be tested using the IWA-5000 System Pressure Tests criteria of IWA-5244(b) as a VT-2 visual exam cannot be performed. The required flow measurements of the weekly flow verification test ensure the system can perform its intended function and that flow during operation is not impaired as a result of a failed mechanical sleeve assembly.

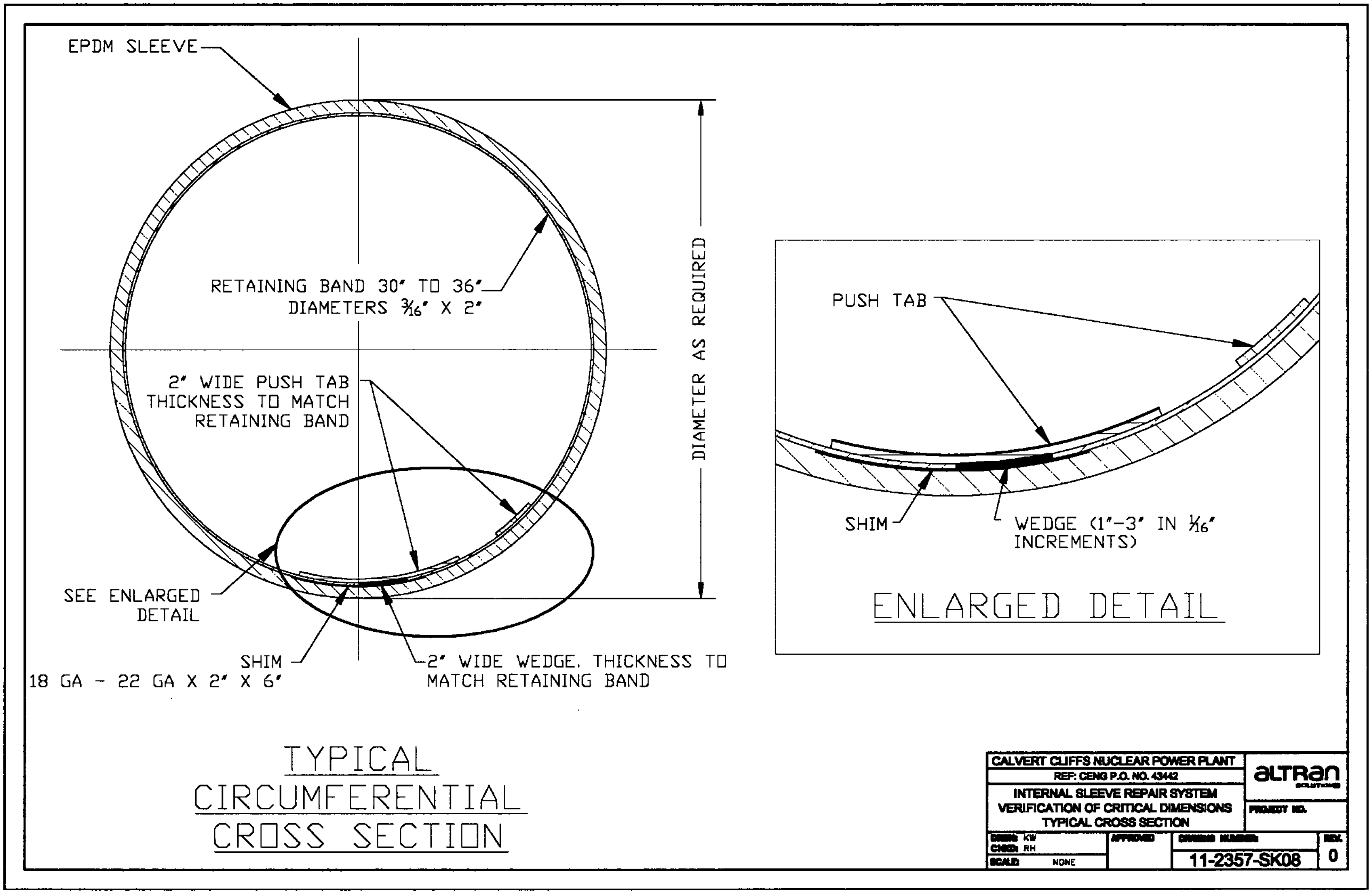

EPDM SLEEVE
RETAINING BAND 30" TO 36" DIAMETERS 3/16" X 2"
2" WIDE PUSH TAB THICKNESS TO MATCH RETAINING BAND
SEE ENLARGED DETAIL
SHIM 18 GA - 22 GA X 2" X 6"
2" WIDE WEDGE, THICKNESS TO MATCH RETAINING BAND
DIAMETER AS REQUIRED
TYPICAL CIRCUMFERENTIAL CROSS SECTION
PUSH TAB
SHIM
WEDGE (1"-3" IN 1/16" INCREMENTS)
ENLARGED DETAIL
CALVERT CLIFFS NUCLEAR POWER PLANT
REF: CENG P.O. NO. 43442
INTERNAL SLEEVE REPAIR SYSTEM
VERIFICATION OF CRITICAL DIMENSIONS
TYPICAL CROSS SECTION
altran
KW
RH
NONE
11-2357-SK08
0

FIGURE 1

ENCLOSURE 1

Mechanical Sleeve Assembly Installation Procedure

Calvert Cliffs Nuclear Power Plant, LLC
May 17, 2013

Installation Procedure
For
30” and 36” Diameter
Internal Sleeve Piping Repair Systems

Procedure No. 11-2357-P-004
Revision 1
Volume 1 of 1

Prepared for:

Constellation Energy
Calvert Cliffs Nuclear Power Plant
Ref: PO No. 434424

December, 2011

ALTRAN
SOLUTIONS

NEW YORK / PHILADELPHIA · BOSTON
ATLANTA · BALTIMORE · SAN FRANCISCO

Report Record

altran Report No.: 11-2357-P-004 Rev. No.: 1 Sheet No. 2

QA Status: Quality Grade ☒, Commercial Grade ☐, Other ☐ Total Pages: 16

Title: Installation Procedure for 30" and 36" Diameter Internal Sleeve Piping Repair Systems

Client: Constellation Energy Facility: Calvert Cliffs Nuclear Power Plant

Revision Description: Revised Purpose/Scope on page 5 and added 2.2.6 on page 6. Edited sections 5.7, 5.11 and 5.12. Added page 8A. Attachment D updated.

Computer runs are identified on a Computer File Index : Yes ☐ N/A ☒

Error reports are evaluated by: Date:

Computer use is affected by error notices. No ☐, Yes ☐ (if yes, attach explanation)

Originator(s)	Date	Verifier(s)	Date
Elena Wapner Mechanical Engineer	1/27/12	Robert Hammelmann Mechanical Engineer	1/27/12

Verification: Verification is performed in accordance with EOP 3.4 as indicated below

☒ Design review as documented on the following sheet or

☐ Alternate calculation as documented in attachment or

☐ Qualification testing as documented in attachment or

APPROVAL FOR RELEASE:

PROJECT MANAGER: Robert W. Hammelmann Date: 1/27/12

ALTRAN

Report Record

Report No.:	11-2357-P-004	Rev. No.:	0	Sheet No.	2A

QA Status: Quality Grade ☒, Commercial Grade ☐, Other ☐ Total Pages: 14

Title: Installation Procedure for 30" and 36" Diameter Internal Sleeve Piping Repair Systems

Client: Constellation Energy Facility: Calvert Cliffs Nuclear Power Plant

Revision Description: Initial Issue

SUPERSEDED

Computer runs are identified on a Computer File Index : Yes ☐ N/A ☒

Error reports are evaluated by: Date:

Computer use is affected by error notices: No ☐, Yes ☐ (if yes, attach explanation)

Originator(s)	Date	Verifier(s)	Date
Robert W. Hammelmann Mechanical Engineer	29 DEC 11	John A. Charest Program Manager	1-4-2012

Verification: Verification is performed in accordance with EOP 3.4 as indicated below

☒ Design review as documented on the following sheet or

☐ Alternate calculation as documented in attachment or

☐ Qualification testing as documented in attachment or

APPROVAL FOR RELEASE:

PROJECT MANAGER: Robert W. Hammelmann Date: 04 JAN 12 altran **Verification**

Report No. 11-2357-P-004 Rev. 1 Sheet: 3

Verification Considerations (in accordance with EOP 3.4)

		Initial
1.	The inputs come from an appropriate and controlled source, and are clearly referenced.	RWH
2.	The inputs from uncontrolled sources or assumptions are properly justified and documented.	RWH
3.	The inputs or assumptions that are not adequately justified are identified for later confirmation.	N/A
4.	Design, analysis, testing, examination, and acceptance criteria are specified and complied with.	RWH
5.	Appropriate interface control was administered during the process of this report.	RWH
6.	The computer programs used are authorized for use and/or properly verified.	N/A
7.	Applicable codes, standards, or regulatory requirements are properly specified and complied with.	RWH
8.	The specified tests and examinations were performed by personnel with appropriate qualifications.	N/A
9.	All tests and examinations were performed in accordance with written procedures.	N/A
10.	Specimens are controlled by identification number and their traceability is maintained.	N/A
11.	The calibration of instrumentation is acceptable and properly recorded.	N/A
12.	The instruments that are used are recorded by name and identification number.	N/A
13.	The report is neat and legible and suitable for reproduction.	RWH
14.	The formatting and technical requirements of applicable procedures are complied with.	RWH
15.	Critical numerical computations have been checked in detail.	N/A
16.	The endorsements of all originators and verifiers have been properly recorded.	RWH
17.	Appropriate construction, operation, and/or maintenance considerations have been considered.	RWH
18.	The conclusions satisfy stated objectives, and they are consistent with the input.	N/A
19.	All material specified are compatible with their service environment.	RWH
20.	Procedural requirements for report revisions and subsequent reviews are complied with.	RWH

Clarify significant comments:

All comments are resolved and incorporated into the report except as noted here:

[signature] 1/27/12 [signature] 1/27/12

Originator's Concurrence Date Verifier's Concurrence Date

Table of Contents

1.0 PURPOSE / SCOPE

This document provides guidance for the installation of 30" and 36" diameter Internal Sleeve Piping Repair Systems. The internal sleeve repair system components are to be installed in portions of the piping system that are designated as Below Ground, installed in accordance with CCNPP Piping Spec M-600, Class LC2. For the diameters listed above, the DI piping material is ASTM A-377, ANSI A21.51, Pressure Class 4 with cement-mortar lining applied to a nominal thickness of ¼" per ANSI A21.4. The sleeve repair system cannot be used on the cast iron spool pieces listed in Spec M-600. In the case where the repair system will become part of the structural integrity of the pipe, the cement-mortar lining should be removed for the length of the seal. The exposed pipe needs to be sealed with an epoxy-type coating in accordance with station procedure.

1

2.0 RESPONSIBILITIES

2.1. Altran Solutions

2.1.1 Altran Solutions is the source of supply for the sleeve repair systems. Altran has provided a Commercial Grade Dedication Plan, supporting calculations and ASME Section XI Repair / Replacement Plan governing the use of these items at Calvert Cliffs Nuclear Power Plant.

2.1.2 Altran Solutions' QA Approved Installation Contractor (the Contractor) shall install the sleeve repair systems. The Installation Contractor is specifically qualified for the installation of these components. All personnel involved with the installation shall have training records (Attachment A) that will be included with the field installation records required to support 10CFR50 QA Plan requirements.

2.1.3 The Contractor shall provide all task-specific equipment needed to install the sleeve repair systems.

2.2 Calvert Cliffs

2.2.1 Calvert Cliffs Section XI Repair/Replacement Coordinator shall develop the job-specific Repair/Replacement Plan and/or Work Orders needed for installation of the sleeve repair systems.

2.2.2 Calvert Cliffs Quality Assurance Department shall perform all inspections and ensure that the size and location of all base-metal flaws are listed on the Work Order documents prior to installation.

2.2.3 Calvert Cliffs Maintenance Department shall specify and ensuring that all necessary procedures for confined space entry and foreign material exclusion have been identified to the Contractor. If the conditions of the cement mortar lining adjacent to the repair require refurbishment, Maintenance shall perform this activity in advance of the sleeve installation.

2.2.4 Calvert Cliffs Training Department shall ensure that all Contractor Personnel have received any site-specific training needed (i.e. confined space / foreign material exclusion) to perform the installation.

2.2.5 Calvert Cliffs Safety Department shall ensure safe working conditions for the installation Contractor, and control access / egress at the point of entry in the piping system.

2.2.6 Calvert Cliffs shall determine if the repair system installation will become part of the structural integrity of the pipe. In that case the cement-mortar lining should be removed for the length of the seal. The exposed pipe needs to be sealed with an epoxy-type coating in accordance with station procedure. 1

3.0 REFERENCES

3.1 Altran Solutions "Commercial Grade Dedication Plan No. 11-2357-001, Rev 0."

3.2 Altran Solutions "ASME Section XI Repair / Replacement Plan No. 11-2357-SXI-003."

3.3 Altran Solutions, "Calculation No. 11-2357-C-002, Rev 0."

4.0 PREREQUISITES FOR USE OF SLEEVE REPAIR SYSTEM

The following activities shall be performed prior to commencing work and recorded as having been completed on the Sleeve Repair Installation Checklist, Attachment C.

4.1. Review of Certification, Equipment and Pre-Job Briefing

The Contractor's field supervisor shall verify that all applicable personnel have been trained in the installation of the sleeve repair system. The "Altran Installer Certification" (Attachment A) must be completed and attached to the installation records. It is the Contractor's responsibility to ensure that equipment is in acceptable condition, and to attend any pre-job briefings requested by CCNPP personnel.

4.2 The Contractor shall provide a listing of all tools to be used inside the FME boundary, and that all consumables (i.e. hydraulic oil, lubricants, markers, etc.) have been approved by CCNPP.

4.3 The Contractor shall confer with CCNPP's Safety Coordinator to ensure that preparations have been made for emergency rescue situations. In the event of an emergency, under no circumstance should the attendant enter the confined space until help has arrived, and then only with the proper rescue equipment. Attendants participating in the rescue effort must have received specialized training in confined space rescue techniques. Rescues are to be accomplished using emergency rescue carts or trolleys with a lifeline attached. At no time should the attendant exert any pulling force on the anatomy of the person being rescued. The piping must always be cleaned to the point that transportation carts (emergency and work carts) can ride on their wheels without encumbrance due to obstructions or main debris.

4.4 The location and extent of the flaw requiring repair shall be communicated to the Contractor in accordance with CCNPP's ASME Section XI Plan and corrective action reporting procedures.

5.0 SLEEVE REPAIR SYSTEM - INSTALLATION PROCEDURE

Note: Utilize the Installation Checklist (Attachment C) to record and document that the installation conforms to the requirements of this procedure.

5.1 Prior to entry to the piping, confirm that all Safety measures required are in place at the point of access / egress.

5.2 The Contractor shall inspect all sleeve repair system hardware and verify the tagging provided conforms to the installation (30" sleeve / 36" sleeve). Record tag number.

5.3 Upon entry to the piping and during all work activities, verify that the piping has been dewatered and is properly ventilated.

5.4 If any unanticipated or unexpected alarm, noise, vibration, odor or excessive leakage is observed, personnel shall immediately exit and remain outside the confined space until the condition is identified and rectified.

5.5 Upon reaching the flaw area perform an inspection of pipe interior to ensure that the inside surfaces of the cement mortal lining of the SW pipe are free from substantial defects that could affect the performance of the sleeve repair system.

5.6 Remove all dirt, scale, and other debris from the pipe walls in areas where the sleeve is to be installed. These cleaning operations shall be accomplished by hand brushing and scraping, pneumatic wire brushes, and/or oil-free air jet. All high/low surface imperfections (i.e. dirt, scale, and other debris) running axially through or part way through the sealing surface must be removed prior to installation of the sleeve. Any joint gaps or deep imperfections must be repaired by CCNPP Maintenance in accordance with plant procedures.

5.7 The reinforcement plate and gasket shall be centrally located over the flaw. The terminal ends of the reinforcement plate should be away from the flaw. Mark the intended locations of the edges of the reinforcement plate and lip seals of the gasket on the pipe ID to clearly define the sleeve installation positions. **Refer to Attachment D for additional detail.** 1

5.8 Position and manually expand the reinforcement plate within the pipe ID at the location defined in Step 5.6.

5.9 Lubricate the inside surface of the reinforcement plate to facilitate even distribution of the hydraulic forces that will be imposed by expansion of the retaining bands.

5.10 Position the gasket over the reinforcement plate at the location defined in Step 5.6.

5.11 Lubricate the surface of the gasket where the reinforcement plate retaining bands will be placed. Position the reinforcement plate retaining bands equidistant from the centerline and a minimum of 2" from the edge of the flaw. Insert metal shims underneath the wedge area for each band prior to installing the retaining bands. These shims protect the gasket as the bands are expanded. The metal shims can be bent slightly to match the internal curvature of the gasket.

5.12 Expand the near-side retaining band using the hydraulic expander, holding maximum pressure as specified on Attachment B for a minimum of two minutes. 1

5.13 Install the largest locking piece (wedge) in the exposed gap between the expanded band ends. The wedge size shall be selected so as to create an interference fit. Remove the installation tool.

5.14 Repeat Steps 5.11 and 5.12 for the far-side reinforcement plate retaining band.

5.15 Lubricate the seal band channels at the outboard locations on the gasket. Install the gasket retaining bands at each location. Repeat Steps 5.11 and 5.12 for each of the near-side and far-side gasket retaining bands.

5.16 Allow a minimum of 30 minutes after the first expansion of the bands to allow for material flow (creep) of the elastomeric gasket. Reset the installation tool and perform a second expansion of each band. Replace the wedges with wider wedges, as required, to maintain the interference fit.

5.17 Perform a final examination of all gasket surfaces for any damage that could have potentially occurred during installation. Remove and replace the sleeve repair system if damaged.

5.18 Remove all installation tools and unused wedges from the area in accordance with FME policy.

6.0 SLEEVE REPAIR SYSTEM – COMMISSIONING RECORDS

6.1 The sleeve repair system is a passive device that when installed in accordance with this procedure requires no additional inspections prior to returning the SW system to service.

6.2 Upon completion of each sleeve installation, the Contractor's Installation Supervisor shall ensure that all data and verification requirements pertinent to the installation (as shown on Attachments A and C) are filled out with copies transmitted to CCNPP Work Control Supervisor and Altran's Project Manager.

6.3 A full-flow system performance test may be required after installation. Refer to the ASME Section XI Repair / Replacement Plan for additional details.

Attachment A

INSTALLER CERTIFICATION
TRAINING VERIFICATION

Altran Qualified Installer

I acknowledge that I have been given a copy and trained on the Altran Solutions 30" / 36" Sleeve Installation Procedure.

____

Company Name

____

Employee Signature   Date

____

Altran Solutions Trainer Signature   Date

Attachment B

Recommended Expander Pressure

PIPE SIZE (INCHES)	Max. Expander Pressure (psi)	Recommended Band Thickness (inches) AL6XN	304 Stainless Steel	316L Stainless Steel	A36 Carbon Steel	1020 Carbon Steel
Standard Expander						
12	1100	1/8	1/8	1/8	1/8	1/8
12	1500	3/16	3/16	3/16	3/16	3/16
16	1500	1/8	1/8	1/8	1/8	1/8
16	2000	3/16	3/16	3/16	3/16	3/16
18	1500	1/8	1/8	1/8	1/8	1/8
18	2000	3/16	3/16	3/16	3/16	3/16
20	2500	3/16	3/16	3/16	3/16	3/16
20	3000	1/4	1/4	1/4	1/4	1/4
24	3200	3/16	3/16	3/16	3/16	3/16
24	3500	1/4	1/4	1/4	1/4	1/4
30	3200	3/16	3/16	3/16	3/16	3/16
30	3500	1/4	1/4	1/4	1/4	1/4
36	3500	3/16	3/16	3/16	3/16	3/16
36	3800	1/4	1/4	1/4	1/4	1/4
42	3500	3/16	3/16	3/16	3/16	3/16
42	3800	1/4	1/4	1/4	¼	1/4
48	3800	3/16	3/16	3/16	3/16	3/16
48	4000	1/4	1/4	1/4	1/4	1/4
54	4000	3/16	3/16	3/16	3/16	3/16
54	4300	1/4	1/4	1/4	1/4	
60	4400	1/4	1/4	1/4	1/4	
72	4500	1/4	1/4	1/4	1/4	
78	4500	1/4	1/4	1/4	1/4	
84	4600	1/4	1/4	1/4	1/4	
96	4600	1/4	1/4	1/4	1/4	
108	4800	1/4	1/4	1/4	1/4	
120	4800	3/8	3/8	3/8	3/8	
138	4800	3/8	3/8	3/8	3/8	
216	5000	3/8	3/8	3/8	3/8	

Material Yield Strength (psi)	45000	30000	25000	36000	63700
Band Width 2 inches					
Shims–18 Ga. Material					

ATTACHMENT C
Installation Record / Verification Sheet
Sheet 1 of 3

Reference: **CCNPP WO Number: _______________ / Date: ________**

Printed Name	Signature	Crew Function	Date

The following prerequisite activities shall be verified as completed prior to commencing the installation of the sleeve repair system.

Procedure Step	Activity	Completed (initials)	Date
4.1	Contractor representative at pre-job briefing		
4.2	Verify the list of all tools and parts to be used inside piping has been transmitted to FME.		
4.3	Record name Safety Coordinator and date of safety review. Name: ______________ Date: ______________		
4.4	Attach Corrective Action Report or NDE results indicating size and location of flaw.		

ATTACHMENT C
Installation Record / Verification Sheet
Sheet 2 of 3

The following installation activities shall be verified as having been completed during installation of the sleeve repair system.

Procedure Step	Activity	Completed (initials)	Date
5.1	Contractor verifies that safety measures are in place at the point of access / egress.		
5.2	Contractor verifies that sleeve repair components are undamaged. Record tag number: _______________		
5.3	Piping dewatered and properly ventilated.		
5.4	Precaution only	N/R	N/R
5.5-5.6	Contractor verifies that inside wall of piping has been cleaned and / or repaired to an acceptable condition.		
5.7	Flaw location has been marked (by CCNPP). Position of reinforcement plate and gasket are marked on ID.		
5.8-5.10	Reinforcement plate has been located in marked position over flaw, satisfactorily lubricated and gasket installed.		
5.11-5.14	**Note: Refer to installation drawing (Attachment "D") to identify position and nomenclature of retention bands.** Install reinforcement plate retaining bands and shims. Document the hydraulic installation tool used. Hydraulic Tool S/N _________________ Record hydraulic pressure during expansion and wedge sizes used for initial installation. Hydraulic Pressure Band "A" ___________psig Wedge Size, Band "A" _________ in. Hydraulic Pressure Band "B" ___________psig Wedge Size, Band "B" _________ in.		

ATTACHMENT C
Installation Record / Verification Sheet
Sheet 3 of 3

5.15	Install gasket retaining bands and shims. Record hydraulic pressure during expansion and wedge sizes used for initial installation. Hydraulic Pressure Band "C" ___________psig Wedge Size, Band "C" ________ in. Hydraulic Pressure Band "D" ___________psig Wedge Size, Band "D" ________ in.		
5.16	Record completion time of Activity 5.15.________ **Note: Wait a minimum of 30 minutes before initiating Activity 5.16.** Record Starting time of Activity 5.16. _________ Record hydraulic pressure and wedge sizes used during final installation. Hydraulic Pressure Band "A" ___________psig Wedge Size, Band "A" ________ in. Hydraulic Pressure Band "B" ___________psig Wedge Size, Band "B" ________ in. Hydraulic Pressure Band "C" ___________psig Wedge Size, Band "C" ________ in. Hydraulic Pressure Band "D" ___________psig Wedge Size, Band "D" ________ in.		
5.17	Perform final examination of gasket surfaces. Verify satisfactory installation has been completed.		
5.18	Verify all installation tools and FME have been removed from piping.		

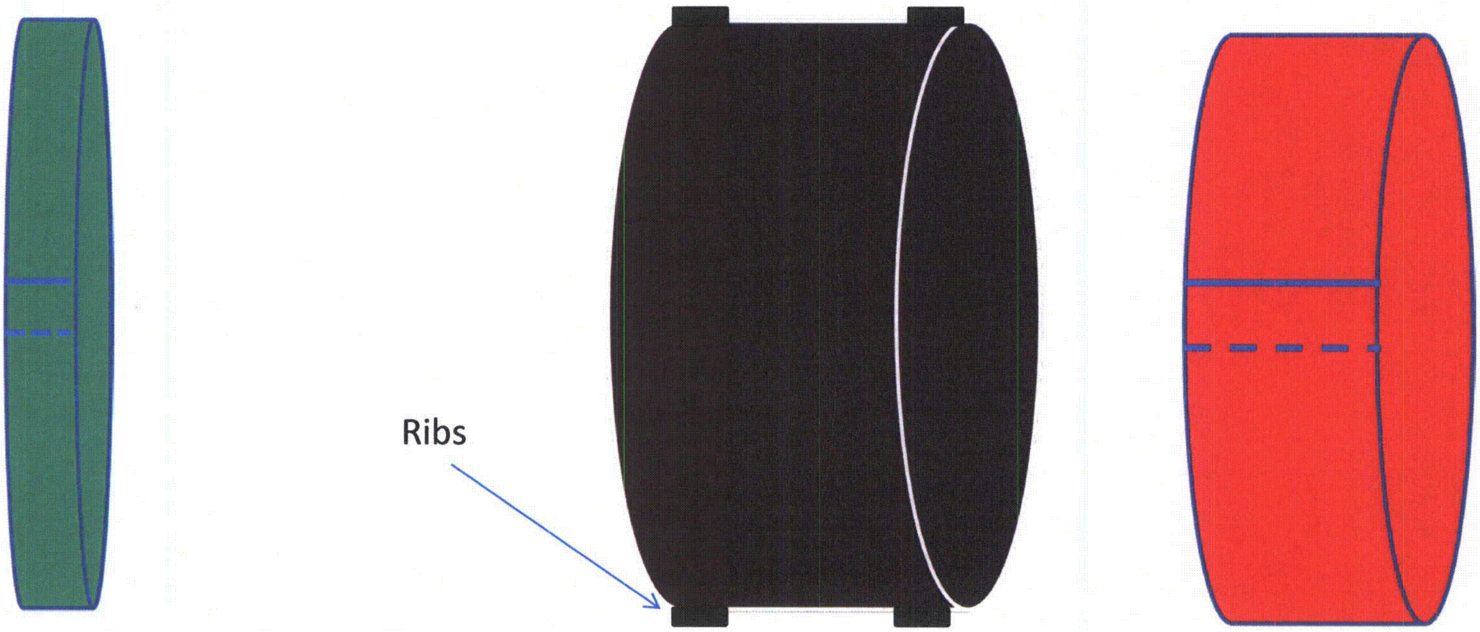
Attachment D

Attachment D intentionally not provided as drawing shown is of poor visual quality. Drawing is similar to Figure 2 contained in our Relief Request of January 17, 2013.

ENCLOSURE 2

Mechanical Sleeve Assembly Slides

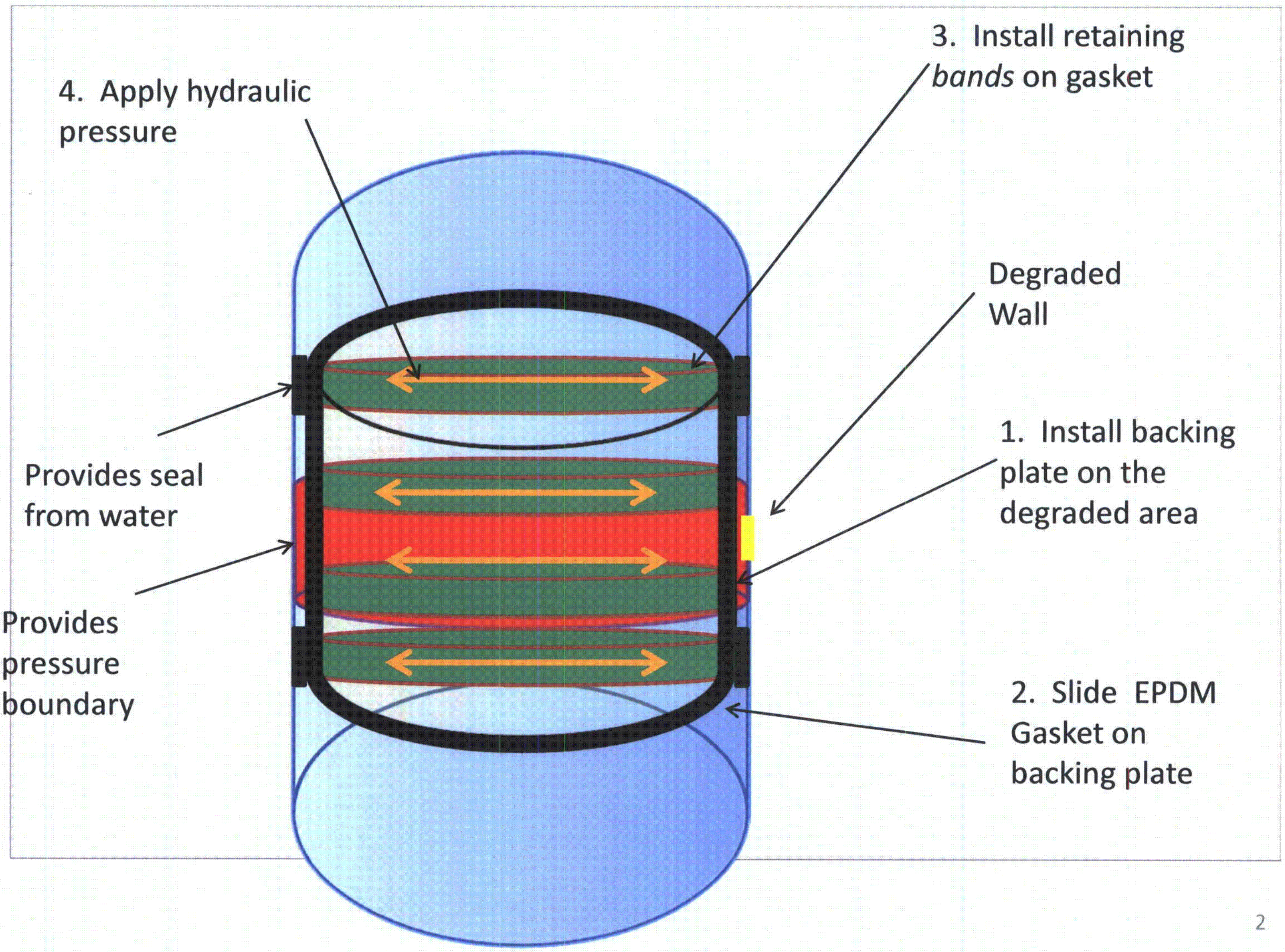
Mechanical Sleeve Assembly



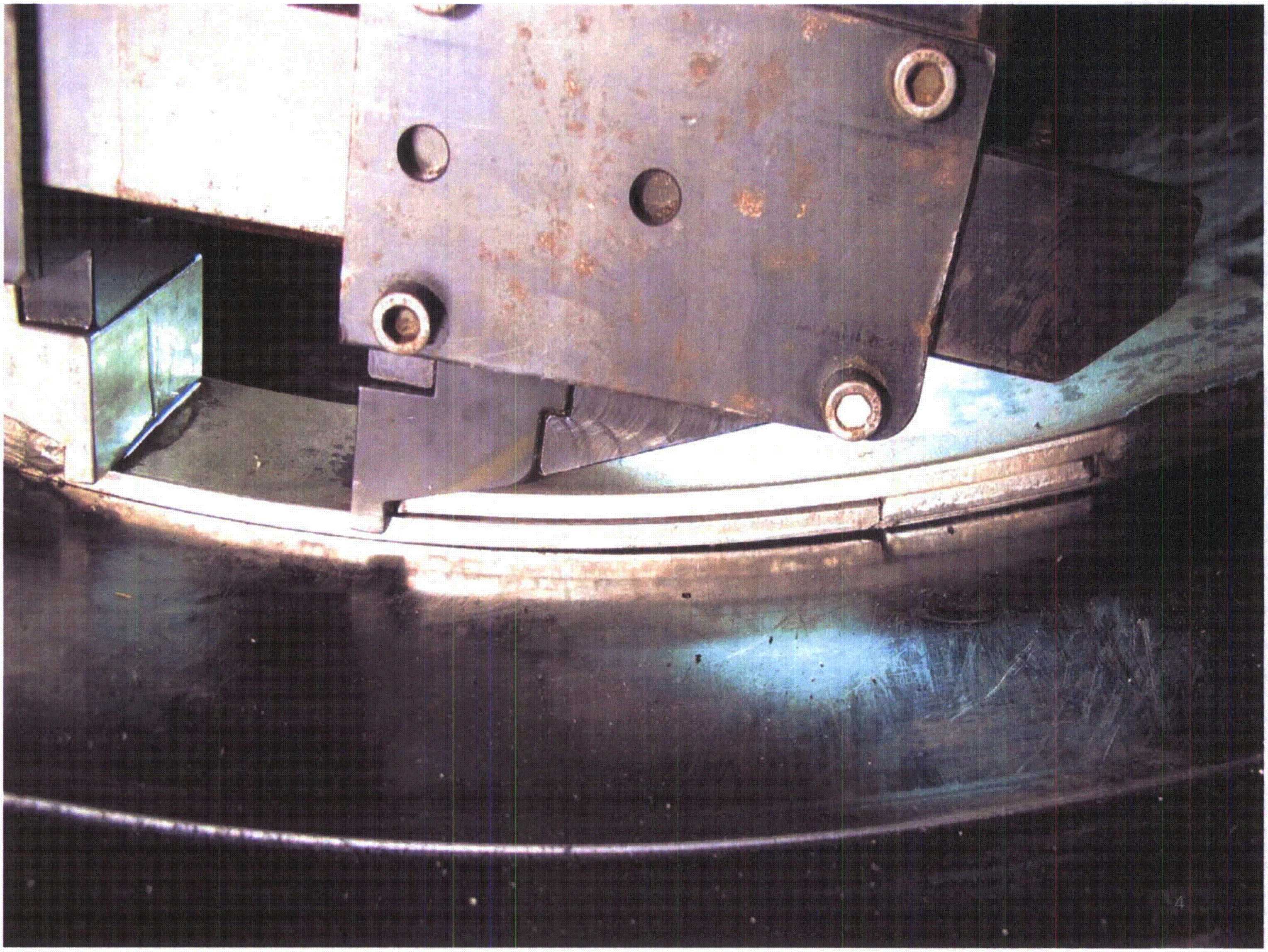
Retaining Bands (4)

EPDM Sleeve

Backing Plate


3. Install retaining *bands* on gasket
4. Apply hydraulic pressure
Degraded Wall
1. Install backing plate on the degraded area
Provides seal from water
Provides pressure boundary
2. Slide EPDM Gasket on backing plate


3/16" HT-834298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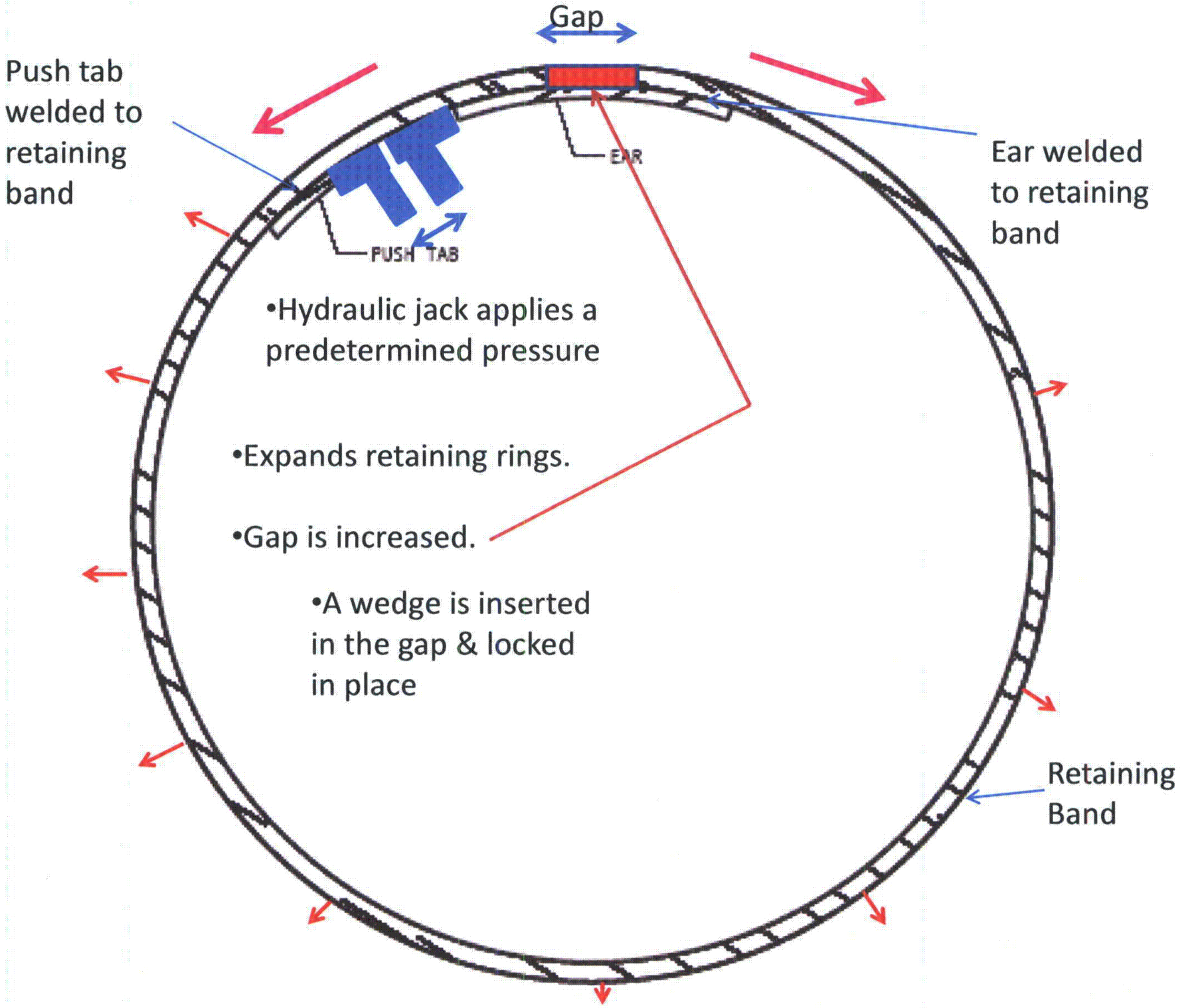
Gap
Push tab welded to retaining band
EAR
PUSH TAB
Ear welded to retaining band
•Hydraulic jack applies a predetermined pressure
•Expands retaining rings.
•Gap is increased.
•A wedge is inserted in the gap & locked in place
Retaining Band