From: <john.hufnagel@exeloncorp.com>
To: <dja1@nrc.gov>, <gvc@nrc.gov>
Date: 11/28/2005 10:34:13 PM
Subject: AMP Program Basis Documents - Batch 2

Donnie/Greg,

Here is the batch of PBDs that we had indicated we would provide today (Batch 2). As I understand from discussion with each of you, the better format (between Word and our PDF files) for you to receive them in, for both review and docketing purposes, is Word. Therefore, attached please find the following PBDs in Word format: B.1.02 (Water Chemistry), B.1.22 (Fuel Oil Chemistry), B.1.08 (BWR Penetrations), B.1.19 (Fire Protection), B.1.31 (Structures Monitoring), B.1.01 (ASME Section XI IWB, IWC, IWD), B.1.17 (Compressed Air Monitoring) and B.1.25 (Selective Leaching).

Note that these eight files have been "write" protected to prevent inadvertent revisions to the files. This should not preclude viewing, copying, pasting, etc. Let us know if there are any problems.

Also attached here is a PDF file containing an updated answer to Audit question AMP-147, indicating the additional program basis documents that have now been provided to assist the Auditors in continuing their Audit activities. If you need to create a different version of PDF for docketing, we suggest printing this two page file and having your Document staff scan/create that file for docketing.

<<FINAL PBD B.1.02 Water Chemistry Rev 0.doc>> <<FINAL PBD B.1.22 Fuel Oil Chemistry jmr.doc>>
<<Final PBD B.1.08 Penetrations Rev 0 112105.doc>> <<FINAL PBD B.1.19 Fire Protection.doc>>
<<Final PBD B.1.31 Structures Monitoring jmr.doc>> <<Final PBD B.1.1 ASME XI IWBCD.doc>>
<<Final PBD B.1.17 Compressed Air.doc>>
<<Final PBD B.1.25 Selective Leaching rev 0.doc>> <<11-28-05 Update to Q&A AMP-147.pdf>>

Please let us know if there are any questions or problems with these files, or with any questions or comments. Thanks.

- John.

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Final PBD B.1.08 Penetrations Rev 0 112105.doc		150528
FINAL PBD B.1.19 Fire Protection.doc		207872
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PROGRAM BASIS DOCUMENT

PBD-AMP-B.1.02

Revision 0

WATER CHEMISTRY

GALL PROGRAM XI.M2 - WATER CHEMISTRY

Prepared By: ______________________

Reviewed By: ______________________

Program Owner Review: ______________________

Technical Lead Approval: ______________________

Revision History:

Revision	*Prepared by:*	*Reviewed by:*	*Program Owner:*	*Approved by:*
0	*Shannon Rafferty*	*Mark Miller*	*Mike Ford*	*Don Warfel*
Date				

Summary of Revisions:

Rev. Number	Reason for the Revision(s)
0	Initial Issue

TABLE OF CONTENTS

1.0 PURPOSE

1.1 Purpose

The purpose of this Program Basis Document is to document and evaluate those activities of the Oyster Creek Water Chemistry aging management program that are credited for managing the aging of piping, piping components, piping elements, heat exchangers and other miscellaneous components (such as supports, fuel storage & handling equipment, reactor internals, etc.) as part of Oyster Creek License Renewal to meet the requirements of the License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

This includes the following:

- The identification of the scope of the program;
- The evaluation of program elements against NUREG-1801;
- The review of Operating Experience to demonstrate program effectiveness;
- The identification of required program enhancements; and
- The identification of Oyster Creek documents required to implement the program.

This Program Basis Document identifies and describes the basis for the Water Chemistry aging management program and associated activities credited for managing the aging of piping, piping components, piping elements, heat exchangers and other miscellaneous components that are exposed to treated water to keep peak levels of various contaminants below system-specific limits based on industry-recognized guidelines of BWRVIP-130: "BWR Vessel and Internals Project BWR Water Chemistry Guidelines" for the prevention or mitigation of loss of material, reduction of heat transfer and cracking aging effects.

1.2 Methodology

The nuclear power plant License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," describes the License Renewal process and provides requirements for the contents of License Renewal Applications. 10 CFR 54.21(a)(3) states:

"For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the Current Licensing Basis (CLB) for the period of extended operation."

The NRC and the industry identified 10 program elements that are useful in describing an aging management program and then demonstrating its effectiveness. These program elements are described in Appendix A.1, Section A.1.2.3 of the Standard Review Plan. NUREG-1801 uses these program elements in Section XI to describe acceptable aging management programs.

This Program Basis Document provides a comparison of the credited Oyster Creek program with the elements of the corresponding NUREG-1801 Chapter XI program XI.M2 Water Chemistry. Project Level Instruction PLI-8 "Program Basis Documents" prescribes the methodology for evaluating Aging Management Programs. An evaluation of Oyster Creeks aging management program criteria or activities to those of the NUREG-1801 program elements is performed and a conclusion is reached concerning consistency for each individual program element. A demonstration of overall program effectiveness is made after all program elements are evaluated. Required program enhancements are documented. An overall determination is made as to consistency with the program description in NUREG-1801.

2.0 PROGRAM DESCRIPTION

2.1 Program Description

<u>NUREG-1801:</u>

The main objective of this program is to mitigate damage caused by corrosion and stress corrosion cracking (SCC). The water chemistry program for boiling water reactors (BWRs) relies on monitoring and control of reactor water chemistry based on industry guidelines such as the boiling water reactor vessel and internals project (BWRVIP)-29 (Electric Power Research Institute [EPRI] TR-103515) or later revisions. The BWRVIP-29 has three sets of guidelines: one for primary water, one for condensate and feedwater, and one for control rod drive (CRD) mechanism cooling water. The water chemistry program for pressurized water reactors (PWRs) relies on monitoring and control of reactor water chemistry based on industry guidelines for primary water and secondary *water chemistry such as EPRI TR-105714, Rev. 3 and TR-102134, Rev. 3 or later revisions.*

The water chemistry programs are generally effective in removing impurities from intermediate and high flow areas. The Generic Aging Lessons Learned (GALL) report identifies those circumstances in which the water chemistry program is to be augmented to manage the effects of aging for license renewal. For example, the water chemistry program may not be effective in low flow or stagnant flow areas. Accordingly, in certain cases as identified in the GALL Report, verification of the effectiveness of the chemistry control program is undertaken to ensure that significant degradation is not occurring and the component's intended function will be maintained during the extended period of operation. As discussed in the GALL Report for these specific cases, an acceptable verification program is a one-time inspection of selected components at susceptible locations in the system.

Oyster Creek:

The Water Chemistry aging management program is an existing program whose activities consist of measures that are used to manage aging of piping, piping components, piping elements, heat exchangers and other miscellaneous components (such as supports, fuel storage & handling equipment, reactor internals, etc.) exposed to reactor water, steam, condensate and feedwater, control rod drive water, demineralized water storage tank water (DWST), condensate storage tank water (CST), torus water, and spent fuel pool water. Reactor water, condensate, control rod drive, feedwater, demineralized water storage tank, condensate tank, torus and spent fuel pool water is classified as treated water for aging management. The program activities provide for monitoring and controlling of water chemistry using station procedures and processes to mitigate damage caused by corrosion and stress corrosion cracking (SCC) based on BWRVIP-130: "BWR Vessel and Internals Project BWR Water Chemistry Guidelines," 2004 Revision for the prevention or mitigation of loss of material, reduction of heat transfer and cracking aging effects. Specific differences between BWRVIP-29 and BWRVIP-130 are discussed in Section 3.1 "Scope of Program." The water chemistry program is also credited for mitigating loss of material and cracking for components exposed to sodium pentaborate, auxiliary steam and boiler treated water environments. The Standby Liquid Control system contains a treated water and sodium pentaborate solution controlled in accordance with plant procedures and Technical Specifications. The Heating and Process Steam system contains boiler treated water and auxiliary steam that is controlled in accordance with plant procedures.

As specified by NUREG-1801, the water chemistry program may not be effective in low flow or stagnant flow areas. The One-Time Inspection (B.1.24) aging management program includes provisions specified by NUREG-1801 for verification of chemistry control and confirmation of the absence of loss of material and cracking in stagnant flow areas in piping systems and components to ensure that significant degradation is not occurring and the components intended function will be maintained during the extended period of operation.

2.2 Overall NUREG-1801 Consistency

The Oyster Creek Water Chemistry aging management program is an existing program that is consistent with NUREG-1801 aging management program XI.M2, Water Chemistry with exceptions as described in 2.3 below.

2.3 Summary of Exceptions to NUREG-1801

The existing Oyster Creek Water Chemistry program is found to be adequate to support the extended period of operation with the following exceptions.

1) NUREG-1801 indicates that water chemistry control is in accordance with BWRVIP-29 for water chemistry in BWRs. BWRVIP-29 references the 1996 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines." The Oyster Creek water chemistry program is based on BWRVIP-130, which is the 2004 Revision of "BWR Water Chemistry Guidelines." EPRI periodically updates the water chemistry guidelines, as new information becomes available. The NRC has acknowledged in the Dresden and Quad Cities SER on page 3-12 that the staff has previously reviewed implementation of Revision 2 of the EPRI BWR Water Chemistry Guidelines as documented in NUREG-1769, "Safety Evaluation Report Related to the License Renewal of Peach Bottom Atomic Power Station, Units 2 and 3". Therefore, the staff finds the use of revision 2 to be acceptable.

2) In transitioning from TR-103515-R2 to BWRVIP-130, Oyster Creek has reviewed BWRVIP-130 and has determined that the most significant difference from revision 2 is that a recent policy of the U.S. nuclear industry commits each nuclear utility to

adopting the responsibilities and processes on the management of materials aging issues described in "*NEI 03-08: Guideline for the Management of Materials Issues.*" Section 1 of the BWR Water Chemistry Guidelines specifies which portions of the document are "*Mandatory,*" "*Needed,*" or "*Good Practices,*" using the classification described in NEI 03-08. A new section (section 7) has been added and contains recommended goals for water chemistry optimization. These are "good practice" recommendations for targets that plants may use in optimizing water chemistry that balances the conflicting requirements of materials, fuel and radiation control. Significant time and expense may be required to meet these targets; thus efforts to achieve these goals should be considered in the context of the overall strategic plan for the plant. Therefore, Oyster Creek is not committing to obtaining these targets. All other changes do not change the original intent of revision 2 implementation.

3) NUREG-1801 indicates that hydrogen peroxide is monitored to mitigate degradation of structural materials. The Oyster Creek program does not monitor for hydrogen peroxide because the rapid decomposition of hydrogen peroxide makes reliable data exceptionally difficult to obtain and BWRVIP-130 Section 6.3.3, "Water Chemistry Guidelines for Power Operation," does not address monitoring for hydrogen peroxide. Hydrogen addition to feedwater has been applied in order to mitigate occurrence of IGSCC of structural materials by suppressing the formation of hydrogen peroxide. The hydrogen addition has accomplished an Electrochemical Corrosion Potential (ECP) value less than -230mV, SHE (Standard Hydrogen Electrode). By maintaining a low ECP less than -230mV, SHE, the reactor water chemistry minimizes the effects from hydrogen peroxide below the threshold that prompted the issue raised in NUREG 1801. Oyster Creek uses the ISI program to investigate whether structural degradation in potentially affected locations is ongoing. Oyster Creek's ISI program provides for condition monitoring of the reactor vessel, reactor internal components and ASME Class 1 pressure retaining components in accordance with ASME Section XI, Subsection IWB. Indications and relevant conditions detected during examinations are evaluated in accordance with ASME Section XI Articles IWB-3000, for Class 1.

4) NUREG-1801 indicates that dissolved oxygen is monitored. Consistent with the guidance provided in BWRVIP-130, condensate storage tank, demineralized water storage tank

water, spent fuel pool water and torus water are not sampled for dissolved oxygen. The Oyster Creek chemistry procedures require monitoring of conductivity, chlorides, sulfates and total organic carbon (TOC) in accordance with limits set by BWRVIP-130 as an alternate method for ensuring component integrity.

5) NUREG-1801 indicates that water quality (pH and conductivity) is maintained in accordance with established guidance. However, per BWRVIP-130, "BWR Water Chemistry Guidelines," Section 8.2.1.11, pH measurement accuracy in most BWR streams is generally suspect because of the dependence of the instrument reading on ionic strength of the sample solution. In addition, the monitoring of pH is not discussed in BWRVIP-130, Appendix B for condensate storage tank, demineralized water storage tank, or torus water. pH is not monitored for torus water, however pH is monitored in the CST & DWST. Alternate methods are applied to monitor the water chemistry of the torus in lieu of direct pH measurements. The Oyster Creek chemistry procedures require monitoring of conductivity, chlorides and sulfates in accordance with limits set by BWRVIP-130.

6) Aging of Standby Liquid Control (SBLC) system components not in the reactor coolant pressure boundary section of SBLC system relies on monitoring and control of SBLC makeup water chemistry. The makeup water is monitored in lieu of the storage tank, because the sodium pentaborate that is maintained in the storage tank would mask most of the chemistry parameters monitored. The effectiveness of the water chemistry program will be verified by a one-time inspection of the SBLC system as discussed in the One-Time Inspection (B.1.24) aging management program.

2.4 Summary of Enhancements to NUREG-1801

None. The existing Oyster Creek Water Chemistry aging management program is found to be adequate to support the extended period of operation with no enhancements.

3.0 EVALUATIONS AND TECHNICAL BASIS

Note

This section is organized by quoting the relevant NUREG-1801 Chapter XI program element (September 2005 version) followed by the related Oyster Creek program attributes and a conclusion of the comparison. Where applicable, the NUREG-1801 program element was separated into logical sub-elements and addressed accordingly.

Implementing procedure references are included in ( ) for information purposes. This information from the source procedure has been either directly extracted from the procedure or summarized for inclusion into this PBD.

3.0 Scope of Program

NUREG-1801:

The program includes periodic monitoring and control of known detrimental contaminants such as chlorides, fluorides (PWRs only), dissolved oxygen, and sulfate concentrations below the levels known to result in loss of material or cracking. Water chemistry control is in accordance with industry guidelines such as BWRVIP-29 (EPRI TR-103515) for water chemistry in BWRs, EPRI TR-105714 for primary water chemistry in PWRs, and EPRI TR-102134 for secondary water chemistry in PWRs.

Oyster Creek:

The program includes periodic monitoring and control of known detrimental contaminants such as chlorides, dissolved oxygen, and sulfate concentrations below the levels known to result in loss of material or cracking. Additionally the program minimizes buildup of deposits in treated water, which results in control of heat transfer capabilities. Water chemistry control is in accordance industry guidelines such as BWRVIP-130 for water chemistry in BWRs.

The September '05 GALL update recommends BWRVIP-29 (1996), which is TR-103515-R1, or later revisions, which would be BWRVIP-130. Therefore OC can say that they are in compliance with the GALL since the OC LRA is being compared with the September '05 GALL. However, the exception will still be taken in order to allow for the explanation of the differences between TR-103515-R2, which has been previously approved by the NRC in NUREG-1769, and Revision 3, which is BWRVIP-130, as described below.

Differences between the 2000 Revision and 2004 Revision

(BWRVIP-130) were evaluated during preparation of the LRA. The comparisons demonstrate that use of the 2004 Revision (BWRVIP-130) of the water chemistry guidelines provides acceptable guidance as it is based on updated industry experience.

The 2004 Revision of the BWR Water Chemistry Guidelines was issued in October 2004. The guidelines were revised to:

1) Identify which portions of the document are mandatory, needed, or good practice considerations consistent with Nuclear Energy Institute (NEI) guidelines for the management of material issues

2) Update the technical basis for water chemistry control of Intergranular Stress Corrosion Cracking (IGSCC) using recent industry experience

3) Discuss the effects of Noble Metal Chemical Application (NMCA) and zinc injection on radiation fields using recent industry experience

4) For Reactor Water (HWC or HWC +NMCA - Power Operation) a monthly copper sample is now required (OC was already performing this)

5) For Reactor Water NWC (Normal Water Chemistry) a monthly copper sample was added

6) An Action Level 1 limit of -230 was added for ECP, but no monitoring frequency has been defined

7) For Feedwater and Condensate, an integrated Feedwater Total Zinc was added as a parameter, limit defined based on plant chemistry (0.4 ppb for NMCA plants). OC has guidance from our fuel vendor (GE) that enables zinc injection up to 0.8 ppb with a goal of 0.6 ppb.

8) Strengthen the discussion of corrosion-related fuel failures including control of zinc, iron, and copper levels

9) The Recommended BWR Chemistry Database Parameters (Table 8-1) has changed a few frequencies from 2/D to 1/D (Table 5-1 in BWRVIP-79) as follows:

    - Reactor Coolant, Reactor Temp & Conductivity 2/D to 1/D
    - Phosphate, Sodium, Calcium & Magnesium were added to the table

- Zinc changed from 1/M to 1/W
- Monitoring of ^{3}H and $^{199}Au^{m}$ (S/I) were added at 1/M and 2/M respectively
- Co (S/I) and Zn (S/I) changed from 2/M to 1/W
- RWCU Flow and Conductivity changed from 2/D to 1/D
- Chromium (S/I) was added to Feedwater at 1/M.

10) Address the possibility that IGSCC may be reduced with continued operation if the Action Levels are exceeded

11) Add recommended goals for optimizing water chemistry that balances conflicting requirements of materials, fuel, and radiation control

12) Relax recommended surveillance frequencies for some parameters to reduce operating cost without creating a significant adverse impact on plant chemistry

13) Update the discussion on BWR transient effects on IGSCC

14) Include methods for adjusting conductivity measurements based on the presence of ionic species

15) Add a new appendix covering ultrasonic fuel cleaning.

16) Chemical parameters, frequency of measurement, Action Levels, and limits remain essentially unchanged except as follows:

- The Action Level definitions were clarified to provide additional guidance for addressing chemistry transients, including the establishment of an action time period for the most severe out of limit conditions (Action Level 3).
- For reactor water during startup/hot standby, dissolved oxygen and NMCA were moved from control to diagnostic parameters (limits and measurement frequencies remained unchanged). Also, insoluble iron was removed as a diagnostic parameter. However, it remains part of the suspended corrosion products monitoring of reactor feedwater/condensate prior to initiation of significant feedwater flow or at completion of cleanup.
- For reactor feedwater/condensate during startup/hot standby, suspended corrosion products was moved from

control to diagnostic parameters. The limits and measurement frequency remain unchanged.

- Auxiliary water chemistry guidelines remain unchanged except for the addition of phosphate as a diagnostic parameter for Demineralized Water Storage Tanks (DWST) and Condensate Storage Tanks (CSTs) and the lowering of the conductivity limit for the spent fuel pool.

In summary, no significant changes to critical program elements have resulted in adopting the 2004 Revision of the water chemistry guidelines (BWRVIP-130). The technical basis and guidance have been updated at each revision to include additional industry experience.

The OC LRA notes the Plant Chemistry Program relies upon the 2004 Revision of the guidelines (EPRI TR-1008192, BWRVIP-130) and not BWRVIP-29 as specified in the GALL. The LRA further notes differences between earlier revisions and the 2000 revision of the water chemistry guidelines were previously found acceptable by the NRC because the 2000 Revision is based on updated industry experience. The OC LRA notes the 2004 Revision was similarly based on updated industry experience.

Additionally, in Appendix B.1.02 of the LRA, exception 2 states, "A new section (section 7) has been added and contains recommended goals for water chemistry optimization. These are "good practice" recommendations for targets that plants may use in optimizing water chemistry that balances the conflicting requirements of materials, fuel and radiation control. Significant time and expense may be required to meet these targets; thus efforts to achieve these goals should be considered in the context of the overall strategic plan for the plant. Therefore, Oyster Creek is not committing to obtaining these targets." Exelon, as a corporation, has determined that they are not going to obtain all of the "good practices" stated in the new revision. This determination was based on fact that these "good practice" recommendations are targets that plants may use in optimizing water chemistry that balances the conflicting requirements of materials, fuel and radiation control. An example of this is the fact that too much FW zinc can be harmful to fuel, however beneficial for radiation field control. Oyster Creek establishes an optimum zinc program to protect the fuel as well as manage the radiation control. This is an example of not necessarily achieving all of the good practice goals, rather optimizing the total program.

The intent of the exception is to state that Oyster Creek is implementing BWRVIP-130 rather than BWRVIP-79. Exelon Corporation will implement the "good practices" that are applicable to each station and will be beneficial to the total water chemistry optimization program. All of the good practices are not applicable or achievable by Oyster Creek; therefore they are not able to meet all of the good practices recommended in BWRVIP-130. All of the Exelon Corporate/implementing procedures have been revised with the supporting evaluations to be in compliance with BWRVIP-130.

Primary water chemistry monitors and controls known detrimental contaminants such as chlorides, dissolved oxygen, and sulfate concentrations in accordance with procedure BWRVIP-130. **(Reference: CY-AB-120-100, CY-AB-120-120 and CY-AB-120-130)**

CST and DWST chemistry monitors and controls known detrimental contaminants such as chlorides and sulfate concentrations in accordance with BWRVIP-130 **(Reference: CY-AB-120-200)**

Spent fuel pool chemistry periodic monitoring for detrimental contaminants such as chlorides and sulfates along with conductivity are controlled in accordance with BWRVIP-130. **(Reference: CY-AB-120-300)**

Condensate & Feedwater chemistry monitors for detrimental contaminants such as chlorides and sulfates concentrations in accordance BWRVIP-130. **(Reference: CY-AB-120-110)**

Torus chemistry monitors and controls known detrimental contaminants such as chlorides and sulfate concentrations in accordance with BWRVIP-130. **(Reference: CY-AB-120-310)**

Control Rod Drive chemistry monitors for conductivity and dissolved oxygen in accordance with BWRVIP-130. **(Reference CY-AB-120-320)**

Auxiliary Boiler chemistry monitors for detrimental contaminants such as sulfate, copper, iron and phosphate in accordance with industry standards. **(Reference CY-AB-120-420 and Industry Standards 4.2.6 & 4.2.7 below)**

Aging of Standby Liquid Control (SBLC) system components not in the reactor coolant pressure boundary section of SBLC system relies on monitoring and control of SBLC makeup water chemistry. The makeup water is monitored in lieu of the liquid poison tank, because the sodium pentaborate that is maintained in the liquid poison tank would mask most of the chemistry parameters monitored. The effectiveness of the water chemistry program will be verified by a one-time inspection of the SBLC system as discussed in the One-Time Inspection (B.1.24) aging management program.

The Oyster Creek Water Chemistry aging management program manages the effects of aging for the systems, components, materials, and environments listed in Table 5.2. The implementing documents for this aging management program are listed in Table 5.1 and are described throughout the individual program element discussions. The commitment numbers under which these implementing documents are being revised are contained within the listings in Table 5.1.

Exceptions to NUREG-1801, Element 1:

1) NUREG-1801 indicates that water chemistry control is in accordance with BWRVIP-29 for water chemistry in BWRs. BWRVIP-29 references the 1996 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines." The Oyster Creek water chemistry program is based on BWRVIP-130, which is the 2004 Revision of "BWR Water Chemistry Guidelines." EPRI periodically updates the water chemistry guidelines, as new information becomes available. The NRC has acknowledged in the Dresden and Quad Cities SER on page 3-12 that the staff has previously reviewed implementation of Revision 2 of the EPRI BWR Water Chemistry Guidelines as documented in NUREG-1769, "Safety Evaluation Report Related to the License Renewal of Peach Bottom Atomic Power Station, Units 2 and 3". Therefore, the staff finds the use of revision 2 to be acceptable.

2) In transitioning from TR-103515-R2 to BWRVIP-130, Oyster Creek has reviewed BWRVIP-130 and has determined that the most significant difference from revision 2 is that a recent policy of the U.S. nuclear industry commits each nuclear utility to adopting the responsibilities and processes on the management of materials aging issues described in "NEI 03-08: Guideline for the Management of Materials Issues." Section 1 of the BWR Water Chemistry Guidelines specifies which portions of the document are "Mandatory," "Needed," or "Good Practices," using the classification described in NEI 03-08. A new section

(section 7) has been added and contains recommended goals for water chemistry optimization. These are "good practice" recommendations for targets that plants may use in optimizing water chemistry that balances the conflicting requirements of materials, fuel and radiation control. Significant time and expense may be required to meet these targets; thus efforts to achieve these goals should be considered in the context of the overall strategic plan for the plant. Therefore, Oyster Creek is not committing to obtaining these targets. All other changes do not change the original intent of revision 2 implementation.

3) NUREG-1801 indicates that hydrogen peroxide is monitored to mitigate degradation of structural materials. The Oyster Creek program does not monitor for hydrogen peroxide because the rapid decomposition of hydrogen peroxide makes reliable data exceptionally difficult to obtain and BWRVIP-130 Section 6.3.3, "Water Chemistry Guidelines for Power Operation," does not address monitoring for hydrogen peroxide. Hydrogen addition to feedwater has been applied in order to mitigate occurrence of IGSCC of structural materials by suppressing the formation of hydrogen peroxide. The hydrogen addition has accomplished an Electrochemical Potential (ECP) value less than -230mV, SHE (Standard Hydrogen Electrode). By maintaining a low ECP less than -230mV, SHE, the reactor water chemistry minimizes the effects from hydrogen peroxide below the threshold that prompted the issue raised in NUREG 1801. Oyster Creek uses the ISI program to investigate whether structural degradation in potentially affected locations is ongoing. Oyster Creek's ISI program provides for condition monitoring of the reactor vessel, reactor internal components and ASME Class 1 pressure retaining components in accordance with ASME Section XI, Subsection IWB. Indications and relevant conditions detected during examinations are evaluated in accordance with ASME Section XI Articles IWB-3000, for Class 1.

4) NUREG-1801 indicates that dissolved oxygen is monitored. Consistent with the guidance provided in BWRVIP-130, condensate storage tank, demineralized water storage tank water, spent fuel pool water and torus water are not sampled for dissolved oxygen. The Oyster Creek chemistry procedures require monitoring of conductivity, chlorides, sulfates and total organic carbon (TOC) in accordance with limits set by BWRVIP-130 as an alternate method for ensuring component integrity.

5) NUREG-1801 indicates that water quality (pH and conductivity)

is maintained in accordance with established guidance. However, per BWRVIP-130, "BWR Water Chemistry Guidelines," Section 8.2.1.11, pH measurement accuracy in most BWR streams is generally suspect because of the dependence of the instrument reading on ionic strength of the sample solution. In addition, the monitoring of pH is not discussed in BWRVIP-130, Appendix B for condensate storage tank, demineralized water storage tank, or torus water. pH is not monitored for torus water, however pH is monitored in the CST & DWST. Alternate methods are applied to monitor the water chemistry of the torus in lieu of direct pH measurements. The Oyster Creek chemistry procedures require monitoring of conductivity, chlorides and sulfates in accordance with limits set by BWRVIP-130.

6) Aging of Standby Liquid Control (SBLC) system components not in the reactor coolant pressure boundary section of SBLC system relies on monitoring and control of SBLC makeup water chemistry. The makeup water is monitored in lieu of the storage tank, because the sodium pentaborate that is maintained in the storage tank would mask most of the chemistry parameters monitored. The effectiveness of the water chemistry program will be verified by a one-time inspection of the SBLC system as discussed in the One-Time Inspection (B.1.24) aging management program.

Enhancements to NUREG-1801, Element 1:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 1, Scope of Program with exceptions as described above.

3.1 Preventive Actions

NUREG-1801:

a) *The program includes specifications for chemical species, sampling and analysis frequencies, and corrective actions for control of reactor water chemistry.*

b) *System water chemistry is controlled to minimize contaminant concentration and mitigate loss of material due to general, crevice and pitting corrosion and cracking caused by SCC. For BWRs, maintaining high water purity reduces susceptibility to*

SCC.

Oyster Creek:

a) The program includes specifications for chemical species, sampling and analysis frequencies, and corrective actions for control of reactor water chemistry. Specifications for chemical species, sampling, analysis frequencies, and action levels are in accordance with BWRVIP-130. **(Reference: CY-AB-120-100, CY-AB-120-110, CY-AB-120-120, CY-AB-120-130, CY-AB-120-200, CY-AB-120-320, CY-AB-120-300, CY-AB-120-310, CY-AA-120-420 and CY-OC-120-110)**

b) System water chemistry is controlled in accordance with BWRVIP-130 to minimize contaminant concentration and mitigate loss of material due to general, crevice and pitting corrosion and cracking caused by SCC. **(Reference: CY-AB-120-100, CY-AB-120-110, CY-AB-120-120, CY-AB-120-130, CY-AB-120-200, CY-AB-120-320, CY-AB-120-300, CY-AB-120-310, CY-AA-120-420 and CY-OC-120-110)**

Exceptions to NUREG-1801, Element 2:

None.

Enhancements to NUREG-1801, Element 2:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 2, Preventive Actions.

3.2 Parameters Monitored or Inspected

NUREG-1801:

a) The concentration of corrosive impurities listed in the EPRI guidelines discussed above, which include chlorides, fluorides (PWRs only), sulfates, dissolved oxygen, and hydrogen peroxide, are monitored to mitigate degradation of structural materials. Water quality (pH and conductivity) is also maintained in accordance with the guidance. Chemical species and water quality are monitored by inprocess methods or through sampling. The chemical integrity of the samples is maintained and verified to ensure that the method of sampling and storage will not cause a change in the concentration of the chemical *species in the samples.*

b) *BWR Water Chemistry: The guidelines in BWRVIP-29 (EPRI TR-103515) for BWR reactor water recommend that the concentration of chlorides, sulfates, and dissolved oxygen are monitored and kept below the recommended levels to mitigate corrosion. The two impurities, chlorides and sulfates, determine the coolant conductivity; dissolved oxygen, hydrogen peroxide, and hydrogen determine electrochemical potential (ECP). The EPRI guidelines recommend that the coolant conductivity and ECP are also monitored and kept below the recommended levels to mitigate SCC and corrosion in BWR plants. The EPRI guidelines in BWRVIP-29 (TR-103515) for BWR feedwater, condensate, and control rod drive water recommend that conductivity, dissolved oxygen level, and concentrations of iron and copper (feedwater only) are monitored and kept below the recommended levels to mitigate SCC. The EPRI guidelines in BWRVIP-29 (TR-103515) also include recommendations for controlling water chemistry in auxiliary systems: torus/pressure suppression chamber, condensate storage tank, and spent fuel pool.*

Oyster Creek:

a) The concentration of corrosive impurities listed in the EPRI guidelines, which include chlorides, sulfates, dissolved oxygen, and hydrogen peroxide, are monitored to mitigate degradation of structural materials. Water quality (pH and conductivity) is also maintained in accordance with the guidance. Chemical species and water quality are monitored by in process methods or through sampling. The chemistry integrity of the samples is maintained and verified to ensure that the method of sampling and storage will not cause a change in the concentration of the chemical species in the samples. **(Reference: CY-AB-120-100, CY-AB-120-110, CY-AB-120-120, CY-AB-120-130, CY-AB-120-200, CY-AB-120-320, CY-AB-120-300, CY-AB-120-310, CY-AA-120-420 and CY-OC-120-110)**

b) The guidelines in BWRVIP-130 for BWR reactor water recommend that the concentration of chlorides, sulfates, and dissolved oxygen are monitored and kept below the recommended levels to mitigate corrosion. The two impurities, chlorides and sulfates, determine the coolant conductivity; dissolved oxygen, hydrogen peroxide, and hydrogen determine electrochemical potential (ECP). The EPRI guidelines recommend that the coolant conductivity and ECP are also monitored and kept below the recommended levels to mitigate

SCC and corrosion in BWR plants. Oyster Creek monitors ECP directly with ECP probes in the B Recirculation Loop, via the RWCU system as described on BWRVIP-79 Figure 5.5. Oyster Creek uses reactor water dissolved oxygen as a secondary parameter to ensure that mitigation is maintained in the recirculation loops. **(Reference: CY-AB-120-100, Revision 7, Step 4.3.2.1and 4.3.3.2.A).**

The EPRI guidelines in BWRVIP-130 for BWR feedwater, condensate, and control rod drive water recommends that conductivity, dissolved oxygen level, and concentrations of iron and copper (feedwater only) are monitored and kept below the recommended levels to mitigate SCC. The EPRI guidelines in BWRVIP-130 also include recommendations for controlling water chemistry in auxiliary systems: torus/pressure suppression chamber, condensate storage tank, and spent fuel pool.

Reactor water chemistry monitors and controls known detrimental contaminants in accordance with BWRVIP-130. **(Reference: CY-AB-120-100, CY-AB-120-120, and CY-AB-120-130)** CST and DWST chemistry monitors and controls known detrimental contaminants such as chlorides and sulfate concentrations in accordance with BWRVIP-130. **(Reference: CY-AB-120-200)** Spent fuel pool chemistry controls known detrimental contaminants in accordance with BWRVIP-130. **(Reference: CY-AB-120-300)** Torus chemistry monitors and controls known detrimental contaminants such as chlorides and sulfate concentrations in accordance with BWRVIP-130 **(Reference: CY-AB-120-310)** Condensate & Feedwater chemistry monitors for detrimental contaminants such as chlorides and sulfates concentrations in accordance BWRVIP-130. **(Reference: CY-AB-120-110)** Control Rod Drive chemistry monitors for conductivity and dissolved oxygen in accordance with BWRVIP-130. **(Reference CY-AB-120-320)** Auxiliary Boiler chemistry monitors for detrimental contaminants such as sulfate, copper, iron and phosphate in accordance with industry standards. **(Reference CY-AB-120-420 and Industry Standards 4.2.6 & 4.2.7 below)**

Conductivity and dissolved oxygen of the reactor coolant is continuously monitored to provide indication of abnormal conditions and the presence of impurities in accordance with BWRVIP-130. **(Reference: CY-AB-120-1000)** BWRVIP-118 and BWRVIP-62 both recommend that the hydrogen injection rate should be set to maintain a molar ratio of 3:1 at the location to be protected. **(Reference: CY-AB-120-1000 Section 5.3.1.4.A)** For the Exelon BWR program this is defined as the upper downcomer as defined in BWRVIP-62 p.2, 2nd paragraph under "Background" & BWRVIP-118 Section 4.12 Bullet #8. Oyster Creek maintains a Molar Ratio of 3:1, and even achieves a conservative Molar Ratio of 4:1 in various regions. The target injection rate for each BWR is Molar Ration of 3:1. **(Reference: Table 5-4 of CY-AB-120-1000)**

Monitoring the ECP of stainless steel exposed to reactor coolant in the recirculation line or at the RWCU inlet is the most direct means of assuring IGSCC mitigation of targeted components. The ECP is to be maintained below -230 mV (SHE). The measurement is to be made continuously. The noble metals surface loading also must be maintained above 0.1 micrograms/cm^2 to assure protection.

Exelon has chosen a strategy that uses ECP or the measured molar ratio of hydrogen to oxygen as the primary indicator of IGSCC mitigation with proof of sufficient catalyst loading. If ECP is unavailable, the measured molar ratio of hydrogen to oxygen can be used as an alternate indicator of protection. To assure that an adequate excess of hydrogen relative to oxygen is present to reduce the ECP below -230 mV (SHE) at target locations during power operation, the measured reactor water hydrogen to oxygen molar ratio will be maintained at greater than 3 at all plants during hydrogen injection. It also must be verified that a sufficient noble metals loading is present on targeted system surfaces. When ECP equipment is operational, a monitoring frequency of once per cycle is sufficient for benchmarking purposes.

Conductivity and dissolved oxygen of the CRD water are continuously monitored to provide indication of abnormal conditions and the presence of impurities in accordance with BWRVIP-130. **(Reference: CY-AB-120-320)** CST and DWST water conductivity are monitored weekly in accordance with BWRVIP-130. **(Reference: CY-AB-120-200)** Spent fuel pool water conductivity is monitored weekly in accordance with BWRVIP-130. **(Reference: CY-AB-120-300)** Conductivity of the torus water is monitored quarterly to provide indication of abnormal conditions and the presence of impurities in accordance with BWRVIP-130. **(Reference: CY-AB-120-310)**

Oyster Creek does monitor pH in the CST and DWST. Alternate methods are applied to monitor the water chemistry of the torus in lieu of direct pH measurements. The Oyster Creek chemistry procedures require monitoring of conductivity, chlorides and sulfates in accordance with limits set by EPRI BWRVIP-130.

The Oyster Creek procedures set goal values, which are below the limit values set by EPRI BWRVIP-130. When a monitored parameter exceeds the goal values, the procedure requires that the values be confirmed, corrective action be taken to return the parameter to the desired range, and that increased sampling be performed to verify the effectiveness of the corrective action to address the abnormal chemistry condition.

<u>Exceptions to NUREG-1801, Element 3:</u>

1) NUREG-1801 indicates that water chemistry control is in accordance with BWRVIP-29 for water chemistry in BWRs. BWRVIP-29 references the 1996 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines." The Oyster Creek water chemistry program is based on BWRVIP-130, which is the 2004 Revision of "BWR Water Chemistry Guidelines." EPRI periodically updates the water chemistry guidelines, as new information becomes available. The NRC has acknowledged in the Dresden and Quad Cities SER on page 3-12 that the staff has previously reviewed implementation of Revision 2 of the EPRI BWR Water Chemistry Guidelines as documented in NUREG-1769, "Safety Evaluation Report Related to the License Renewal of Peach Bottom Atomic Power Station, Units 2 and 3". Therefore, the staff finds the use of revision 2 to be acceptable.

2) In transitioning from TR-103515-R2 to BWRVIP-130, Oyster Creek has reviewed BWRVIP-130 and has determined that the most significant difference from revision 2 is that a recent policy of the U.S. nuclear industry commits each nuclear utility to adopting the responsibilities and processes on the management of materials aging issues described in "*NEI 03-08: Guideline for the Management of Materials Issues.*" Section 1 of the BWR Water Chemistry Guidelines specifies which portions of the document are "*Mandatory,*" "*Needed,*" or "*Good Practices,*" using the classification described in NEI 03-08. A new section (section 7) has been added and contains recommended goals for water chemistry optimization. These are "good practice" recommendations for targets that plants may use in optimizing

water chemistry that balances the conflicting requirements of materials, fuel and radiation control. Significant time and expense may be required to meet these targets; thus efforts to achieve these goals should be considered in the context of the overall strategic plan for the plant. Therefore, Oyster Creek is not committing to obtaining these targets. All other changes do not change the original intent of revision 2 implementation.

3) NUREG-1801 indicates that hydrogen peroxide is monitored to mitigate degradation of structural materials. The Oyster Creek program does not monitor for hydrogen peroxide because the rapid decomposition of hydrogen peroxide makes reliable data exceptionally difficult to obtain and BWRVIP-130 Section 6.3.3, "Water Chemistry Guidelines for Power Operation," does not address monitoring for hydrogen peroxide. Hydrogen addition to feedwater has been applied in order to mitigate occurrence of IGSCC of structural materials by suppressing the formation of hydrogen peroxide. The hydrogen addition has accomplished an Electrochemical Corrosion Potential (ECP) value less than -230mV, SHE (Standard Hydrogen Electrode). By maintaining a low ECP less than -230mV, SHE, the reactor water chemistry minimizes the effects from hydrogen peroxide below the threshold that prompted the issue raised in NUREG 1801. Oyster Creek uses the ISI program to investigate whether structural degradation in potentially affected locations is ongoing. Oyster Creek's ISI program provides for condition monitoring of the reactor vessel, reactor internal components and ASME Class 1 pressure retaining components in accordance with ASME Section XI, Subsection IWB. Indications and relevant conditions detected during examinations are evaluated in accordance with ASME Section XI Articles IWB-3000, for Class 1.

4) NUREG-1801 indicates that dissolved oxygen is monitored. Consistent with the guidance provided in BWRVIP-130, condensate storage tank, demineralized water storage tank water, spent fuel pool water and torus water are not sampled for dissolved oxygen. The Oyster Creek chemistry procedures require monitoring of conductivity, chlorides, sulfates and total organic carbon (TOC) in accordance with limits set by BWRVIP-130 as an alternate method for ensuring component integrity.

5) NUREG-1801 indicates that water quality (pH and conductivity) is maintained in accordance with established guidance. However, per BWRVIP-130, "BWR Water Chemistry Guidelines," Section 8.2.1.11, pH measurement accuracy in

most BWR streams is generally suspect because of the dependence of the instrument reading on ionic strength of the sample solution. In addition, the monitoring of pH is not discussed in BWRVIP-130, Appendix B for condensate storage tank, demineralized water storage tank, or torus water. pH is not monitored for torus water, however pH is monitored in the CST & DWST. Alternate methods are applied to monitor the water chemistry of the torus in lieu of direct pH measurements. The Oyster Creek chemistry procedures require monitoring of conductivity, chlorides and sulfates in accordance with limits set by BWRVIP-130.

Enhancements to NUREG-1801, Element 3:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 3, Parameters Monitored or Inspected with exceptions as described above.

3.3 Detection of Aging Effects

NUREG-1801:

This is a mitigation program and does not provide for detection of any aging effects. In certain cases as identified in the GALL Report, inspection of select components is to be undertaken to verify the effectiveness of the chemistry control program and to ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation.

Oyster Creek:

This is a mitigation program and does not provide for detection of any aging effects, such as loss of material and cracking.

Components exposed to CST water will be included in the one-time inspection program to verify the effectiveness of CST and DWST chemistry. Components exposed to torus water will be included in the one-time inspection program to verify the effectiveness of torus chemistry. One-time inspections ensure that significant degradation is not occurring and the component intended function is maintained during the extended period of operation.

Aging of Standby Liquid Control (SBLC) system components not in the reactor coolant pressure boundary section of SBLC system relies on monitoring and control of SBLC makeup water chemistry. The makeup water is monitored in lieu of the liquid poison tank, because the sodium pentaborate that is maintained in the liquid poison tank would mask most of the chemistry parameters monitored. The effectiveness of the water chemistry program will be verified by a one-time inspection of the SBLC system as discussed in the One-Time Inspection (B.1.24) aging management program.

GALL Report Section VII, "Auxiliary System," for the Boral neutron-absorbing sheets, states that a plant specific aging management program would have to be evaluated. It has been determined that the only aging effect of Boral is loss of material due to corrosion. Its aging management program is Water Chemistry. Oyster Creek procedure 1002.6 "Oyster Creek Spent Fuel Rack In-Service Surveillance and Management Program for Boraflex Racks" is performed to verify the integrity of the Boraflex Neutron Absorber Material test samples installed in Oyster Creek fuel racks. No further inspections are required.

Components exposed to reactor coolant, which are covered under NUREG-1801, Chapter IV.C1, "Reactor Coolant Pressure Boundary," do not require verification of the chemistry control program effectiveness. However, components exposed to treated water (Feedwater, Condensate and Spent Fuel Pool) , outside the reactor coolant pressure boundary, require a one-time inspection to verify chemistry effectiveness and confirm the absence of loss of material due to general, crevice, or pitting corrosion and the absence of cracking due to IGSCC at locations of stagnant flow conditions.

For the isolation condenser, NUREG 1801 requires XI.M1, ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD; water chemistry controls; and other augmentation activities. The ISI program and augmentation activities provide the required verification of the effectiveness of RCS chemistry controls on the isolation condenser.

For reactor vessel components, periodic inspections are performed in accordance with the ASME Section XI Inspection Program and the BWR Vessel Internals Aging Management Program. These programs verify chemistry control program effectiveness.

For reactor internal components, periodic inspections are performed in accordance with the BWR Vessel Internals Aging Management Program. This program verifies chemistry control program effectiveness.

Exceptions to NUREG-1801, Element 4:

Aging of Standby Liquid Control (SBLC) system components not in the reactor coolant pressure boundary section of SBLC system relies on monitoring and control of SBLC makeup water chemistry. The makeup water is monitored in lieu of the storage tank, because the sodium pentaborate that is maintained in the storage tank would mask most of the chemistry parameters monitored. The effectiveness of the water chemistry program will be verified by a one-time inspection of the SBLC system as discussed in the One-Time Inspection (B.1.24) aging management program.

Enhancements to NUREG-1801, Element 4:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 4, Detection of Aging Effects with exceptions as described above.

3.4 Monitoring and Trending

NUREG-1801:

The frequency of sampling water chemistry varies (e.g., continuous, daily, weekly, or as needed) based on plant operating conditions and the EPRI water chemistry guidelines. Whenever corrective actions are taken to address an abnormal chemistry condition, increased sampling is utilized to verify the effectiveness of these actions.

Oyster Creek:

The frequency of sampling water chemistry varies (e.g., continuous, daily, weekly, or as needed) based on plant operating conditions and the EPRI water chemistry guidelines provided in BWRVIP-130. *Whenever corrective actions are taken to address an abnormal chemistry condition, increased sampling is utilized to verify the effectiveness of these actions.* **(Reference: CY-AB-120-100, CY-AB-120-110, CY-AB-120-120, CY-AB-120-130, CY-AB-**

120-200, CY-AB-120-320, CY-AB-120-300, CY-AB-120-310, CY-AA-120-420 and CY-OC-120-110)

Exceptions to NUREG-1801, Element 5:

None.

Enhancements to NUREG-1801, Element 5:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 5, Monitoring and Trending.

3.5 Acceptance Criteria

NUREG-1801:

a) *Maximum levels for various contaminants are maintained below the system specific limits as indicated by the limits specified in the corresponding EPRI water chemistry guidelines.*

b) *Any evidence of aging effects or unacceptable water chemistry results is evaluated, the root cause identified, and the condition corrected.*

Oyster Creek:

a) Maximum levels for various contaminants are maintained below the system specific limits as indicated by the limits specified in BWRVIP-130 water chemistry guidelines. Any evidence of the presence of aging effects or unacceptable water chemistry results is evaluated, the root cause identified, and the condition corrected. **(Reference: CY-AB-120-100, CY-AB-120-110, CY-AB-120-200, CY-AB-120-320, CY-AB-120-300, CY-AB-120-310, CY-AA-120-420)**

b) Any evidence of the presence of aging effects or unacceptable water chemistry results is evaluated, the root cause identified, and the condition corrected. Evaluations are performed if discrepant conditions are found to exist and an Issue Report (IR) is initiated to document the concern in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program **(Reference: CY-AB-120-100, CY-AB-120-110, CY-AB-120-200, CY-AB-120-320, CY-AB-120-300, CY-AB-120-310, CY-AA-120-420)** The corrective action process ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence.

Exceptions to NUREG-1801, Element 6:

None.

Enhancements to NUREG-1801, Element 6:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 6, Acceptance Criteria.

3.6 Corrective Actions

NUREG-1801:

When measured water chemistry parameters are outside the specified range, corrective actions are taken to bring the parameter back within the acceptable range and within the time period specified in the EPRI water chemistry guidelines. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

Oyster Creek:

Actions outlined meet the guidelines in EPRI BWRVIP-130 for timely correction of chemistry transients. Evaluations are performed if discrepant conditions are found to exist and an Issue Report (IR) is initiated to document the concern in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The corrective action process ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence.

Exceptions to NUREG-1801, Element 7:

None.

Enhancements to NUREG-1801, Element 7:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 7, Corrective Actions.

3.7 Confirmation Process

NUREG-1801:

Following corrective actions, additional samples are taken and analyzed to verify that the corrective actions were effective in returning the concentrations of contaminants such as chlorides, fluorides, sulfates, dissolved oxygen, and hydrogen peroxide to within the acceptable ranges. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process.

Oyster Creek:

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. Increased sampling is performed when contaminants are found to be outside of their acceptable ranges. Sampling continues until the concentrations are returned to their normal limits.

Exceptions to NUREG-1801, Element 8:

None.

Enhancements to NUREG-1801, Element 8:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 8, Confirmation Process.

3.8 Administrative Controls

NUREG-1801:

See Item 8, above.

Oyster Creek:

See Item 8, above.

Exceptions to NUREG-1801, Element 9:

None.

Enhancements to NUREG-1801, Element 9

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 9, Administrative Controls.

3.9 Operating Experience

NUREG-1801:

The EPRI guideline documents have been developed based on plant experience and have been shown to be effective over time with their widespread use. The specific examples of operating experience are as follows:

BWR: Intergranular stress corrosion cracking (IGSCC) has occurred in small- and large diameter BWR piping made of austenitic stainless steels and nickel-base alloys. Significant cracking has occurred in recirculation, core spray, residual heat removal (RHR) systems, and reactor water cleanup (RWCU) system piping welds. IGSCC has also occurred in a number of vessel internal components, including core shroud, access hole cover, top guide, and core spray spargers (Nuclear Regulatory Commission [NRC] Bulletin 80-13, NRC Information Notice [IN] 95-17, NRC Generic Letter [GL] 94-03, and NUREG-1544). No occurrence of SCC in piping and other components in standby liquid control systems exposed to sodium pentaborate solution has ever been reported (NUREG/CR-6001).

Oyster Creek:

Review of industry operating experience has confirmed that intergranular stress corrosion cracking (IGSCC) has occurred in small- and large diameter BWR piping made of austenitic stainless steels and nickel-base alloys. Significant cracking has occurred in recirculation, core spray, residual heat removal (RHR) systems, and reactor water cleanup (RWCU) system piping welds. IGSCC has also occurred in a number of vessel internal components, including core shroud, access hole cover, top guide, and core spray spargers (Nuclear Regulatory Commission [NRC] Bulletin 80-13, NRC Information Notice [IN] 95-17, NRC Generic Letter [GL] 94-03, and NUREG-1544). No occurrence of SCC in piping and other components in standby liquid control systems exposed to sodium pentaborate solution has ever been reported (NUREG/CR-6001). A review of plant operating experience at Oyster Creek shows that the Water Chemistry program has been effective in maintaining the water quality to the requirements of the EPRI water quality guidelines. The EPRI guideline documents have been developed based on plant experience and have been shown to be effective over time with their widespread use.

Operating experience, both internal and external, is used in two ways at Oyster Creek to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Oyster Creek. The first way in which operating experience is used is through the Oyster Creek Operating Experience process. The Operating Experience process screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The second way is through the process for managing programs. This process requires the review of program related operating experience by the program owner.

Both of these processes review operating experience from both external and internal (also referred to as in-house) sources. External operating experience may include such things as INPO documents (e.g., SOERs, SERs, SENs, etc.), NRC documents (e.g., GLs, LERs, INs, etc.), Westinghouse documents (e.g., TBs, etc.), General Electric documents (e.g., RCSILs, SILs, TILs, etc.), and other documents (e.g., 10CFR Part 21 Reports, NERs, etc.). Internal operating experience may include such things as event investigations, trending reports, and lessons learned from in-house events as captured in program notebooks, self-assessments, and in the 10 CFR Part 50, Appendix B corrective action process.

Demonstration that the control of water chemistry successfully manages the effects of aging is achieved through objective evidence that shows that loss of material, reduction of heat transfer and mitigation of intergranular stress corrosion cracking (IGSCC) is being adequately managed in piping and other components. The following examples of operating experience provide objective evidence that the Water Chemistry program is effective in assuring that intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation:

1) Oyster Creek was able to used only one RWCU Pump to maintain reactor water sulfates below 2 ppb for the summer months of 2003. Usually 2 pumps are used to control sulfates however OC was able to achieve set goals that summer with only one pump.

2) Torus water conductivity was found to be at an elevated conductivity. Readings have been above the 'goal' value (less than or equal to 3 uS/cm) but less than the limit (5 uS/cm). The cause was identified to be the quarterly core spray surveillances that cause increase iron levels in the torus, which then increase conductivity. Several plans were developed, including demineralizing the torus in 1R21, which will allow the goal value to be obtained. These plans will be presented to the plant health committee for site approval and sponsorship. Hydrogen Water Chemistry (HWC) and Noble Metal Chemical Addition (NMCA) were implemented in 1992 and 2002, respectively, in order to mitigate IGSCC.

The operating experience of Water Chemistry program did not show any adverse trend in performance. However, the Water Chemistry program has identified instances where parameters were outside the established specifications. Increased sampling and actions to bring the parameters back into specification were initiated. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and a corrective action plan is developed to preclude repetition. Some examples are as follows:

1) The demineralized water system was contaminated with radioactivity due to a cross-connection with the fuel pool. The system was flushed and use of demineralized water required chemistry sampling to ensure that the water was 'clean'. A plan was developed to sample the demineralized water system from many locations. The completion of this plan enabled the demineralized water system to be declared 'clean' again.

2) There have been some instances of reactor water sulfate levels exceeding Action Level 1 limits of 5 ppb. When this occurred increased sampling was performed and corrective actions (such as placing the 2nd RWCU pump in service) were implemented.

3) A resin ingress caused by failure of the underdrain system

occurred in one of the condensate demineralizers. This event was entered into the corrective action process and the apparent cause was determined to be due to incomplete work in the underdrain installation four years prior. (CAP O2002-1280)

Based on mitigative techniques such as the implementation of hydrogen water chemistry and noble metal water chemistry as well as timely identification and resolution of adverse parameters, there is sufficient confidence that the implementation of the Water Chemistry will effectively manage aging effects through the period of extended operation.

3.10 Conclusion

The Oyster Creek Water Chemistry aging management program is credited for managing the effects of aging for the systems, components, materials, and environments listed in Table 5.2. The Oyster Creek Water Chemistry program's elements have been evaluated against NUREG-1801 in Section 3.0. Program exceptions have been identified in Section 2.3. Program enhancements have been identified in Section 2.4. The implementing documents and commitment numbers for this aging management program are listed in Table 5.1. The relevant operating experience has been reviewed and a demonstration of program effectiveness is provided in Section 3.10.

Based on the above, the continued implementation of the Oyster Creek Water Chemistry aging management program provides reasonable assurance that mitigation of loss of material, reduction of heat transfer and cracking aging effects are adequately managed so that the intended functions of components within the scope of license renewal are maintained during the period of extended operation.

4.0 References

4.1 Generic to Aging Management Programs

4.1.1 10 CFR 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*

4.1.2 10 CFR 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*

4.1.3 NUREG-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants*, Revision 1,

dated September 2005

4.1.4 NUREG-1801, *Generic Aging Lessons Learned (GALL) Report*, Revision 1, dated September 2005

4.2 Industry Standards

4.2.1 EPRI BWRVIP-130: *BWR Vessel and Internals Project BWR Water Chemistry Guidelines* - 2004 Revision, Final Report, October 2004

4.2.2 EPRI BWRVVIP-79 (TR-103515-R2), *BWR Water Chemistry Guidelines* – 2000 Revision, Final Report, February 2000

4.2.3 NEI 03-08: *Guideline for the Management of Materials Issues*

4.2.4 EPRI BWRVIP-62: *BWR Vessel and Internals Project Technical Basis for Inspection Relief for BWR Internal Components with Hydrogen Injection (TR-108705)* - Final Report, December 1998

4.2.5 EPRI BWRVIP-118: *BWR Vessel and Internals Project NMCA Experience Report and Applications Guidelines,* 2003 Revision

4.2.6 AMSE ISBN-0-7918-1204-9, *Consensus on Operating Practices for the Control of Feedwater and Boiler Water Chemistry in Modern Industrial Boilers*

4.2.7 *Auxiliary Boiler Assessment Peach Bottom Atomic Power Station*, Final Report, December 19, 2001

4.3 Oyster Creek Program References

None.

5.0 TABLES

5.1 Aging Management Program Implementing Documents

Procedure Number	Procedure Title	Commitment No.	Status
CY-AB-120-1000	BWR Chemistry Optimization	330592.02.12	ACC/ASG
CY-AB-120-1100	Reactor Water Hydrogen Water Chemistry, Noble Chem and Zinc Injections	330592.02.13	ACC/ASG

CY-AB-120-320	Control Rod Drive Water Chemistry	330592.02.11	ACC/ASG
CY-AB-120-310	Suppression Pool/Torus Chemistry	330592.02.10	ACC/ASG
CY-AB-120-300	Spent Fuel Pool	330592.02.09	ACC/ASG
CY-AB-120-200	Storage Tanks Chemistry	330592.02.08	ACC/ASG
CY-AB-120-130	BWR Shutdown Chemistry	330592.02.07	ACC/ASG
CY-AB-120-120	BWR Startup Chemistry	330592.02.06	ACC/ASG
CY-AB-120-110	Condensate and Feedwater Chemistry	330592.02.05	ACC/ASG
CY-AB-120-100	Reactor Water Chemistry	330592.02.04	ACC/ASG
CY-AA-120-420	Auxiliary Boiler Chemistry	330592.02.03	ACC/ASG
CY-OC-120-110	Chemistry Limits and Frequencies	330592.02.02	ACC/ASG

5.2 Aging Management Review Results

SSC Name	Structure and/or Component	Material	Environment	Aging Effect
Component Supports Commodity Group	Supports for ASME Class MC Components (support members, welds, bolted connections, support anchorage to building structure)	Stainless Steel	Treated Water < 140F	Loss of Material
Component Supports Commodity Group	Supports for ASME Class MC Components (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Treated Water <140F	Loss of Material
Component Supports Commodity Group	Supports for ASME Class 2 and 3 Piping and Components (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Treated Water < 140F	Loss of Material
Component Supports Commodity Group	Supports for ASME Class 2 and 3 Piping and Components (support members, welds, bolted connections, support anchorage to building structure)	Stainless Steel	Treated Water < 140F	Loss of Material
Condensate System	Restricting Orifice	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Condensate System	Pump Casing	Cast Iron	Treated Water (Internal)	Loss of Material
Condensate System	Thermowell	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Condensate System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Condensate System	Valve Body	Cast Iron	Treated Water (Internal)	Loss of Material
Condensate System	Heat Exchangers	Carbon and low alloy steel - Tube side components	Treated Water (Internal)	Loss of Material
Condensate System	Strainer Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Condensate System	Tanks	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Condensate System	Sensor Element	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Condensate System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material

Condensate System	Flow Element	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Condensate System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Condensate System	Filter Housing	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Condensate System	Tanks	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate System	Strainer Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Condensate System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Condensate Transfer System	Pump Casing	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Valve Body	Aluminum	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Valve Body	Aluminum Bronze	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Valve Body	Aluminum	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Restricting Orifice	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Restricting Orifice	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Restricting Orifice	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Gauge Snubber	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material

Condensate Transfer System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Tanks	Aluminum	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Piping and fittings	Aluminum	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Piping and fittings	Aluminum	Treated Water <140F (Internal)	Loss of Material
Condensate Transfer System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Containment Spray System	Thermowell	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Containment Spray System	Pump Casing	Carbon and low alloy steel	Treated Water < 140F (External)	Loss of Material
Containment Spray System	Strainer (ECCS Suction)	Stainless Steel	Treated Water < 140F (External)	Loss of Material
Containment Spray System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Containment Spray System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Containment Spray System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Containment Spray System	Pump Casing	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Containment Spray System	Strainer (ECCS Suction)	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Containment Spray System	Strainer (ECCS Suction)	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Containment Spray System	Strainer (ECCS Suction)	Stainless Steel	Treated Water < 140F (External)	Loss of Material
Containment Spray System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Containment Spray System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Containment Vacuum Breakers	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Containment Vacuum Breakers	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material

Control Rod Drive System	Valve Body	Brass	Treated Water (Internal)	Loss of Material
Control Rod Drive System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Control Rod Drive System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Control Rod Drive System	Filter	Stainless Steel	Treated Water < 140F (External)	Loss of Material
Control Rod Drive System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Control Rod Drive System	Accumulator	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Control Rod Drive System	Strainer	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Strainer	Stainless Steel	Treated Water < 140F (External)	Loss of Material
Control Rod Drive System	Strainer Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Control Rod Drive System	Filter	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Filter Housing	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Gauge Snubber	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Pump Casing	Stainless Steel (CRD pump)	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Restricting Orifice	Stainless Steel	Treated Water <140F (Internal)	Loss of Material

Control Rod Drive System	Restricting Orifice	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Control Rod Drive System	Strainer Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Control Rod Drive System	Accumulator	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Control Rod Drive System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Core Spray System	Restricting Orifice	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Core Spray System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Core Spray System	Cyclone Separator	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Gauge Snubber	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Restricting Orifice	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Core Spray System	Sight Glasses	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Pump Casing (Main and Booster Pumps)	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Valve Body	CASS	Treated Water (Internal)	Cracking Initiation and Growth
Core Spray System	Thermowell	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Pump Casing (Fill Pumps)	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material

Core Spray System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Core Spray System	Valve Body	CASS	Treated Water (Internal)	Loss of Material
Core Spray System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Core Spray System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Emergency Service Water System	Heat Exchangers (Containment Spray)	Carbon and low alloy steel (Shell Side Components)	Treated Water (Internal)	Loss of Material
Emergency Service Water System	Heat Exchangers (Containment Spray)	Titanium (Tubes)	Treated Water (External)	Reduction of Heat Transfer
Emergency Service Water System	Heat Exchangers (Containment Spray)	Titanium (Tubes)	Treated Water (External)	Loss of Material
Feedwater System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Feedwater System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Feedwater System	Flow Element	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Flow Element	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Filter Housing	Stainless Steel	Treated Water (Internal)	Loss of Material
Feedwater System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Thermowell	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Dissolution Column	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Strainer Body	Stainless Steel	Treated Water (Internal)	Loss of Material

Feedwater System	Pump Casing	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Flow Element	Stainless Steel	Treated Water (Internal)	Loss of Material
Feedwater System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Expansion Joint	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Feedwater System	Heat Exchangers	Carbon and low alloy steel - Tube Side Components	Treated Water (Internal)	Loss of Material
Feedwater System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Feedwater System	Piping and fittings	Chrome Moly steels	Treated Water (Internal)	Loss of Material
Feedwater System	Expansion Joint	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Feedwater System	Piping and fittings	Chrome Moly steels	Treated Water (Internal)	Loss of Material
Feedwater System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Thermowell	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Feedwater System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Fuel Storage and Handling Equipment	Fuel Preparation Machine	Stainless Steel	Treated Water < 140F (External)	Loss of Material
Fuel Storage and Handling Equipment	Fuel Grapple/Mast	Stainless Steel	Treated Water < 140F (External)	Loss of Material
Fuel Storage and Handling Equipment	Spent Fuel Storage Racks	Stainless Steel	Treated Water < 140F (External)	Loss of Material
Fuel Storage and Handling Equipment	Cask Drop Protection Cylindrical Structure	Stainless Steel	Treated Water < 140F	Loss of Material
Fuel Storage and Handling Equipment	Fuel Preparation Machine	Aluminum	Treated Water < 140F (External)	Loss of Material
Heating & Process Steam System	Strainer Body	Carbon and low alloy steel	Auxiliary Steam (Internal)	Loss of Material

Heating & Process Steam System	Sight Glasses	Carbon and low alloy steel	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Strainer Body	Cast Iron	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Steam Trap	Cast Iron	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Steam Trap	Cast Iron	Auxiliary Steam (Internal)	Loss of Material
Heating & Process Steam System	Soot Blowers	Carbon and low alloy steel	Auxiliary Steam (Internal)	Loss of Material
Heating & Process Steam System	Flow Element	Stainless Steel	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Restricting Orifice	Stainless Steel	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Coolers (Sample)	Copper	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Strainer Body	Carbon and low alloy steel	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Valve Body	Carbon and low alloy steel	Auxiliary Steam (Internal)	Loss of Material
Heating & Process Steam System	Valve Body	Stainless Steel	Auxiliary Steam (Internal)	Loss of Material
Heating & Process Steam System	Tanks - Deaerator CH-T-2, Condensate Return Unit T-13-1, Heating Boiler Condensate Storage Tank T-13-2, Heating Boiler Flash Tank T-13-3	Carbon and low alloy steel	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Valve Body	Stainless Steel	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Valve Body	Carbon and low alloy steel	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Pump Casing - Condensate Return Pumps P-13-1A/B, Chemical Feed Addition Pumps CH-P-6A/B, Boiler No. 1 Feed Pumps CH-P-4A/B, Boiler No. 2 Feed Pumps CH-P-3A/B, Deaerator Feed Pumps CH-P-5A/B, Chemical Recirc Pump CH-P-10	Cast Iron	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Valve Body	Stainless Steel	Auxiliary Steam (Internal)	Cracking Initiation and Growth
Heating & Process Steam System	Valve Body	Cast Iron	Auxiliary Steam (Internal)	Loss of Material

Heating & Process Steam System	Valve Body	Stainless Steel	Boiler Treated Water (Internal)	Cracking Initiation and Growth
Heating & Process Steam System	Piping and fittings	Stainless Steel	Auxiliary Steam (Internal)	Loss of Material
Heating & Process Steam System	Piping and fittings	Carbon and low alloy steel	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Tanks - Deaerator CH-T-2, Condensate Return Unit T-13-1, Heating Boiler Condensate Storage Tank T-13-2, Heating Boiler Flash Tank T-13-3	Carbon and low alloy steel	Auxiliary Steam (Internal)	Loss of Material
Heating & Process Steam System	Restricting Orifice	Stainless Steel	Boiler Treated Water (Internal)	Cracking Initiation and Growth
Heating & Process Steam System	Flow Element	Stainless Steel	Boiler Treated Water (Internal)	Cracking Initiation and Growth
Heating & Process Steam System	Valve Body	Cast Iron	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Piping and fittings	Carbon and low alloy steel	Auxiliary Steam (Internal)	Loss of Material
Heating & Process Steam System	Piping and fittings	Stainless Steel	Auxiliary Steam (Internal)	Cracking Initiation and Growth
Heating & Process Steam System	Piping and fittings	Stainless Steel	Boiler Treated Water (Internal)	Cracking Initiation and Growth
Heating & Process Steam System	Piping and fittings	Stainless Steel	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Pump Casing - Chemical Addition Pump CH-P-11	Stainless Steel	Boiler Treated Water <140F (Internal)	Loss of Material
Heating & Process Steam System	Strainer Body	Cast Iron	Auxiliary Steam (Internal)	Loss of Material
Isolation Condenser System	Thermowell	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth

Isolation Condenser System	Heat Exchangers (isolation condensers)	Carbon and low alloy steel (Shell Side Components)	Treated Water <140F (Internal)	Loss of Material
Isolation Condenser System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Isolation Condenser System	Heat Exchangers (isolation condensers)	Stainless Steel (Tubes)	Treated Water < 140F (External)	Reduction of Heat Transfer
Isolation Condenser System	Heat Exchangers (isolation condensers)	Stainless Steel (Tubes)	Treated Water (Internal)	Reduction of Heat Transfer
Isolation Condenser System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Isolation Condenser System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Isolation Condenser System	Thermowell	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Isolation Condenser System	Thermowell	Stainless Steel	Treated Water (Internal)	Loss of Material
Isolation Condenser System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Isolation Condenser System	Gauge Snubber	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Isolation Condenser System	Heat Exchangers (isolation condensers)	Stainless Steel (Tubes and Tube Side Components)	Treated Water < 140F (External)	Loss of Material
Isolation Condenser System	Heat Exchangers (isolation condensers)	Stainless Steel (Tubes and Tube Side Components)	Treated Water (Internal)	Loss of Material
Isolation Condenser System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Isolation Condenser System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Stainless Steel	Steam (Internal)	Loss of Material
Isolation Condenser System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Isolation Condenser System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material

Isolation Condenser System	Valve Body	CASS	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	CASS	Treated Water (Internal)	Loss of Material
Isolation Condenser System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Isolation Condenser System	Heat Exchangers (isolation condensers)	Stainless Steel (Tubes and Tube Side Components)	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	CASS	Steam (Internal)	Loss of Material
Isolation Condenser System	Valve Body	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	Stainless Steel	Steam (Internal)	Loss of Material
Isolation Condenser System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	CASS	Steam (Internal)	Cracking Initiation and Growth
Main Steam System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Steam System	Condensing chamber	Stainless Steel	Steam (Internal)	Loss of Material
Main Steam System	Piping and fittings	Carbon and low alloy steel	Treated Water (External)	Loss of Material
Main Steam System	Condensing chamber	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Main Steam System	Sparger (Y-Quencher)	Carbon and low alloy steel	Treated Water (External)	Loss of Material
Main Steam System	Piping and fittings	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Valve Body	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Steam System	Valve Body (Bypass Valves)	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material

Main Steam System	Condensing chamber	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Steam System	Coolers (Sample)	Stainless Steel (Tube Side Components)	Steam (Internal)	Loss of Material
Main Steam System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Steam System	Condensing chamber	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Steam System	Condensing chamber	Stainless Steel	Treated Water (Internal)	Loss of Material
Main Steam System	Flow Element (Main Steam Line)	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Sparger (Y-Quencher)	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Steam System	Steam Trap	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Steam System	Coolers (Sample)	Stainless Steel (Tube Side Components)	Steam (Internal)	Cracking Initiation and Growth
Main Steam System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Main Steam System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Main Steam System	Flow Element (Main Steam Line)	CASS	Steam	Loss of Material
Main Steam System	Steam Trap	Chrome Moly steels	Steam (Internal)	Loss of Material
Main Steam System	Flow Element (Main Steam Line)	CASS	Steam	Cracking Initiation and Growth
Main Steam System	Valve Body (Steam Chest)	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Eductor	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Condensing chamber	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Flow Element (Main Steam Line)	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Main Steam System	Piping and fittings	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Gauge Snubber	Stainless Steel	Treated Water <140F (Internal)	Loss of Material

Main Steam System	Steam Trap	Chrome Moly steels	Treated Water (Internal)	Loss of Material
Main Steam System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Main Steam System	Strainer Body	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Steam Trap	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Valve Body	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Steam System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Expansion Joint	Stainless Steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Restricting Orifice	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Valve Body	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Turbine Casing	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Steam Trap	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Expansion Joint	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Flow Element	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Tanks	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Tanks	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Pump Casing	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Flow Element	Stainless Steel	Treated Water (Internal)	Loss of Material

Main Turbine and Auxiliary System	Flexible Hose	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Expansion Joint	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Heat Exchangers	Carbon and low alloy steel - Shell side component	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Expansion Joint	Stainless Steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Steam Trap	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Thermowell	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Thermowell	Stainless Steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Valve Body	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Valve Body	Stainless Steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Thermowell	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Valve Body	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Heat Exchangers	Carbon and low alloy steel - Shell side component	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Piping and fittings	Stainless Steel	Steam (Internal)	Loss of Material

Main Turbine and Auxiliary System	Restricting Orifice	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Restricting Orifice	Stainless Steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Strainer Body	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Strainer Body	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Steam Trap	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Thermowell	Stainless Steel	Steam (Internal)	Loss of Material
Main Turbine and Auxiliary System	Thermowell	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Flow Element	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Thermowell	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Strainer Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Strainer Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Turbine and Auxiliary System	Strainer Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Flexible Hose	Stainless Steel	Treated Water (Internal)	Loss of Material
Main Turbine and Auxiliary System	Heat Exchangers	Carbon and low alloy steel - Shell side component	Steam (Internal)	Loss of Material
Noble Metals Monitoring System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Noble Metals Monitoring System	Flow Element	Stainless Steel	Treated Water (Internal)	Loss of Material
Noble Metals Monitoring System	Sensor Element	Stainless Steel	Treated Water (Internal)	Loss of Material
Noble Metals Monitoring System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Noble Metals Monitoring System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Nuclear Boiler Instrumentation	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth

Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Steam (Internal)	Loss of Material
Nuclear Boiler Instrumentation	Condensing chamber	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Nuclear Boiler Instrumentation	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Nuclear Boiler Instrumentation	Gauge Snubber	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Nuclear Boiler Instrumentation	Condensing chamber	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Condensing chamber	Stainless Steel	Treated Water (Internal)	Loss of Material
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Condensing chamber	Stainless Steel	Steam (Internal)	Loss of Material
Post-Accident Sampling System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Post-Accident Sampling System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Post-Accident Sampling System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Post-Accident Sampling System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Post-Accident Sampling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Post-Accident Sampling System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Post-Accident Sampling System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Post-Accident Sampling System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth

Post-Accident Sampling System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Post-Accident Sampling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Primary Containment	Thermowells	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Primary Containment	Thermowells	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Process Sampling System	Flexible Hose	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Process Sampling System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Process Sampling System	Sensor Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Process Sampling System	Thermowell	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Process Sampling System	Coolers	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Process Sampling System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Process Sampling System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Process Sampling System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Building	Fuel Pool Gates	Aluminum	Treated Water < 140F (External)	Loss of Material
Reactor Building	Fuel Pool Liner	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Building	Fuel Pool Skimmer Surge Tank Liner	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Building	Fuel Pool Liner	Stainless Steel	Treated Water <140F (Internal)	Cracking
Reactor Building Closed Cooling Water System	Coolers (Shutdown Cooling Pumps)	Copper (Seal Cooler Tubes)	Treated Water (Internal)	Reduction of Heat Transfer
Reactor Building Closed Cooling Water System	Heat Exchangers (Shutdown Cooling)	Stainless Steel (Tubes)	Treated Water (Internal)	Reduction of Heat Transfer
Reactor Building Closed Cooling Water System	Heat Exchangers (Shutdown Cooling)	Stainless Steel (Tubes)	Treated Water <140F (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Shutdown Cooling)	Stainless Steel (Tube Sheet)	Treated Water <140F	Loss of Material

Reactor Building Closed Cooling Water System	Heat Exchangers (Shutdown Cooling)	Carbon Steel (Tube Side Components)	Treated Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Fuel Pool Cooling)	Carbon Steel (Tubes)	Treated Water (Internal)	Reduction of Heat Transfer
Reactor Building Closed Cooling Water System	Heat Exchangers (Fuel Pool Cooling)	Carbon Steel (Tubes)	Treated Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Fuel Pool Cooling)	Carbon Steel (Tube Side Components)	Treated Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Augmented Fuel Pool Cooling)	Stainless Steel (Plates)	Treated Water (Internal)	Reduction of Heat Transfer
Reactor Building Closed Cooling Water System	Heat Exchangers (Augmented Fuel Pool Cooling)	Carbon Steel (Covers, Nozzles)	Treated Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Shutdown Cooling Pumps)	Copper (Seal Cooler Tubes and Tube Side Components)	Treated Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Augmented Fuel Pool Cooling)	Stainless Steel (Plates)	Treated Water < 140F (Internal)	Loss of Material
Reactor Head Cooling System	Valve Body	CASS	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Reactor Head Cooling System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Head Cooling System	Valve Body	CASS	Treated Water (Internal)	Loss of Material
Reactor Head Cooling System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Piping and fittings	Stainless Steel	Steam (Internal)	Loss of Material
Reactor Head Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Head Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Head Cooling System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Head Cooling System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material

Reactor Head Cooling System	Restricting Orifice	Stainless Steel	Steam (Internal)	Loss of Material
Reactor Head Cooling System	Restricting Orifice	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Restricting Orifice	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Reactor Head Cooling System	Restricting Orifice	Stainless Steel	Steam (Internal)	Loss of Material
Reactor Head Cooling System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Reactor Internals	Shroud Support Structure	Nickel Alloy	Treated Water	Cracking Initiation and Growth
Reactor Internals	Control Rod Drive Assembly (Housing and Guide Tube)	CASS	Treated Water >482F (Internal)	Cracking Initiation and Growth
Reactor Internals	Incore Neutron Monitor Dry Tubes,Guide Tubes, & Housings	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Shroud Repairs (tie rods and lug/clevis assemblies)	Nickel Alloy	Treated Water	Cracking Initiation and Growth
Reactor Internals	Control Rod Drive Assembly (Housing and Guide Tube)	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Core Plate (Lower Core Grid) Wedges	Nickel Alloy	Treated Water	Cracking Initiation and Growth
Reactor Internals	Core Shroud	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Core Plate (Lower Core Grid)	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Shroud Support Structure	Nickel Alloy	Treated Water	Cracking Initiation and Growth
Reactor Internals	Core Spray Lines, Thermal Sleeves, Spray Rings (Sparger), and Spray Nozzles	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Fuel Support Piece	CASS	Treated Water >482F	Cracking Initiation and Growth
Reactor Internals	Core Spray Line Spray Nozzle Elbows	CASS	Treated Water >482F	Cracking Initiation and Growth
Reactor Internals	Fuel Support Piece	CASS	Treated Water >482F	Cracking Initiation and Growth
Reactor Internals	Core Shroud	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Shroud Repairs (tie rods and lug/clevis assemblies)	Stainless Steel	Treated Water	Cracking Initiation and Growth

Reactor Internals	Core Spray Lines, Thermal Sleeves, Spray Rings (Sparger), and Spray Nozzles	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Core Spray Lines, Thermal Sleeves, Spray Rings (Sparger), and Spray Nozzles	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Control Rod Drive Assembly (Housing and Guide Tube)	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Top Guide (Upper Core Grid)	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Internals	Core Spray Ring (Sparger) Repair Hardware	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzle Thermal Sleeves (CRD Return Line)	Stainless Steel	Treated Water	Cracking Initiation and Growth
Reactor Pressure Vessel	Vessel Shell Flange	Carbon and low alloy steel (with stainless steel cladding)	Steam (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzle (Bottom head drain)	Carbon and low alloy steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzle (Bottom head drain)	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Reactor Pressure Vessel	Nozzle Safe Ends (Feedwater & Main Steam)	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Reactor Pressure Vessel	Nozzles (Feedwater)	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Reactor Pressure Vessel	Nozzles (Main Steam)	Carbon and low alloy steel	Steam (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzles (Main Steam)	Carbon and low alloy steel	Steam (Internal)	Loss of Material
Reactor Pressure Vessel	Nozzles (Recirculation Inlet & Outlet)	Carbon and low alloy steel (with stainless steel cladding)	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Vessel Shell Attachment Welds	Nickel Alloy	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Penetrations (Instrumentation including safe ends)	Nickel Alloy	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzle Safe Ends (Recirculation Inlet & outlet)	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Penetrations (CRD Stub Tubes)	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzles (Feedwater)	Carbon and low alloy steel	Treated Water (Internal)	Cracking Initiation and Growth

Reactor Pressure Vessel	Nozzles (Isolation Condenser)	Carbon and low alloy steel (with stainless steel cladding)	Steam (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzle Thermal Sleeves (Feedwater Nozzle)	Nickel Alloy	Treated Water	Cracking Initiation and Growth
Reactor Pressure Vessel	Penetrations (CRD Stub Tubes)	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzles (Core Spray)	Carbon and low alloy steel (with stainless steel cladding)	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzle Safe Ends (Core Spray, Isolation Condenser & CRD Return)	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzle Safe Ends (Feedwater & Main Steam)	Carbon and low alloy steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Vessel Bottom Head	Carbon and low alloy steel (with stainless steel cladding)	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Penetrations (Standby Liquid Control)	Nickel Alloy	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Penetrations (Instrumentation including safe ends)	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Top Head Enclosure (Head & Nozzles)	Carbon and low alloy steel (with stainless steel cladding)	Steam (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Top Head Flange	Carbon and low alloy steel (with stainless steel cladding)	Steam (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Vessel Shell (Upper, upper intermediate, lower intermediate, lower, and belt line welds)	Carbon and low alloy steel (with stainless steel cladding)	Treated Water >482F (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Valve Body	CASS	Treated Water >482F (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Pump Casing	CASS	Treated Water >482F (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material

Reactor Recirculation System	Valve Body	CASS	Treated Water >482F (Internal)	Loss of Material
Reactor Recirculation System	Flow Element	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Reactor Recirculation System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Recirculation System	Flow Element	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Recirculation System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Recirculation System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Recirculation System	Pump Casing	CASS	Treated Water >482F (Internal)	Loss of Material
Reactor Recirculation System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Recirculation System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Thermowell	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Recirculation System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Thermowell	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Heat Exchangers (Cleanup Regenerative)	Stainless Steel (Tube Side Components)	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Valve Body	CASS	Treated Water >482F (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Valve Body	Copper Alloy	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Auxiliary Pump)	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Recirc Pumps)	Stainless Steel	Treated Water <140F (Internal)	Loss of Material

Reactor Water Cleanup System	Heat Exchangers (Cleanup Non-Regenerative)	Stainless Steel (Tube Side Components)	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Gauge Snubber	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Heat Exchangers (Cleanup Regenerative)	Stainless Steel (Tube Side Components)	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Heat Exchangers (Cleanup Non-Regenerative)	Stainless Steel (Tube Side Components)	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Valve Body	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Heat Exchangers (Cleanup Regenerative)	Stainless Steel (Shell Side Components)	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Coolers (Cleanup Pre-coat Pump)	Stainless Steel (Tube Side Components)	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Valve Body	CASS	Treated Water >482F (Internal)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Carbon and low alloy steel	Treated Water < 140F (External)	Loss of Material
Reactor Water Cleanup System	Valve Body	CASS	Treated Water >482F (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Heat Exchangers (Cleanup Regenerative)	Stainless Steel (Shell Side Components)	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Demineralizer (Cleanup Demineralizer)	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Sensor Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material

Reactor Water Cleanup System	Valve Body	CASS	Treated Water >482F (Internal)	Loss of Material
Reactor Water Cleanup System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Thermowell	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Restricting Orifice	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Tanks (Cleanup Filter Sludge Receiver)	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Tanks (Cleanup Filter and Precoat Tank)	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Tanks (Cleanup Filter Aid Mix Tank)	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Filter Precoat Pump)	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Sight Glasses	Carbon and low alloy steel (Body)	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Sight Glasses	Stainless Steel (Body)	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Strainer Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Strainer Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Tanks (Cleanup Recirc. Pump Surge Tank)	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Tanks (Cleanup Backwash Tank)	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Filter Housing (Cleanup Filter)	Carbon Steel (with elastomer lining)	Treated Water <140F (Internal)	Loss of Material

Reactor Water Cleanup System	Pump Casing (Cleanup Filter Aid Pumps)	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Sludge Pump)	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Shutdown Cooling System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Flow Element	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Restricting Orifice	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Thermowell	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Shutdown Cooling System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Shutdown Cooling System	Flow Element	Stainless Steel	Treated Water (Internal)	Loss of Material
Shutdown Cooling System	Restricting Orifice	Stainless Steel	Treated Water (Internal)	Loss of Material
Shutdown Cooling System	Flow Element	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Shutdown Cooling System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Shutdown Cooling System	Restricting Orifice	Stainless Steel	Treated Water (Internal)	Loss of Material
Shutdown Cooling System	Pump Casing	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Shutdown Cooling System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Shutdown Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Shutdown Cooling System	Valve Body	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Shutdown Cooling System	Restricting Orifice	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth

Shutdown Cooling System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Pump Casing (Fuel Pool Cooling Pumps & Augmented Fuel Pool Cooling Pumps)	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Thermowells	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Valve Body	Aluminum	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Diffuser	Aluminum	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Piping and fittings	Aluminum	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Valve Body	Aluminum	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Piping and fittings	Aluminum	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Diffuser	Aluminum	Treated Water < 140F (External)	Loss of Material
Spent Fuel Pool Cooling System	Piping and fittings	Aluminum	Treated Water < 140F (External)	Loss of Material
Spent Fuel Pool Cooling System	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Spent Fuel Pool Cooling System	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material

Standby Liquid Control System (Liquid Poison System)	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Standby Liquid Control System (Liquid Poison System)	Tanks (Liquid Poison Test Tank)	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Standby Liquid Control System (Liquid Poison System)	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Accumulator	Alloy Steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Tanks (Liquid Poison Tank)	Stainless Steel	Sodium Pentaborate (Internal)	Cracking Initiation and Growth
Standby Liquid Control System (Liquid Poison System)	Tanks (Liquid Poison Tank)	Stainless Steel	Sodium Pentaborate (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Valve Body	Stainless Steel	Sodium Pentaborate (Internal)	Cracking Initiation and Growth
Standby Liquid Control System (Liquid Poison System)	Piping and fittings	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Pump Casing	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Piping and fittings	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Valve Body	Stainless Steel	Sodium Pentaborate (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Flow Element	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Piping and fittings	Stainless Steel	Sodium Pentaborate (Internal)	Cracking Initiation and Growth
Standby Liquid Control System (Liquid Poison System)	Thermowell	Stainless Steel	Sodium Pentaborate (Internal)	Cracking Initiation and Growth
Standby Liquid Control System (Liquid Poison System)	Valve Body	Carbon and low alloy steel	Treated Water <140F (Internal)	Loss of Material

Standby Liquid Control System (Liquid Poison System)	Valve Body	Stainless Steel	Treated Water <140F (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Thermowell	Stainless Steel	Sodium Pentaborate (Internal)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Piping and fittings	Stainless Steel	Sodium Pentaborate (Internal)	Loss of Material
Water Treatment & Distr. System	Flexible Hose	Stainless Steel	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Valve Body	Cast Iron	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Restricting Orifice	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Flow Meter	Cast Iron	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Filter Housing (including Purifier M-12-1)	Stainless Steel	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Tanks (including Hot Water Heater H-12-1)	Aluminum	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Restricting Orifice	Stainless Steel	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Flow Element	Aluminum	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Valve Body	Aluminum	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Piping and fittings	Aluminum	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Piping and fittings	Carbon and low alloy steel	Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Valve Body	Stainless Steel	Treated Water (Internal)	Loss of Material

6.0 ATTACHMENTS

6.1 Appendix A

6.2 Appendix B

PROGRAM BASIS DOCUMENT

PBD-AMP-B.1.22

Revision 0

FUEL OIL CHEMISTRY

GALL PROGRAM XI.M30 – FUEL OIL CHEMISTRY

Prepared By:

Reviewed By:

Program Owner Review:

Technical Lead Approval:

Revision History:

Revision	*Prepared by:*	*Reviewed by:*	*Program Owner:*	*Approved by:*
0	*Mark A. Miller*	*Stu Getz*	*Bob Artz*	*Don Warfel*
Date				

Summary of Revisions:

Rev. Number	Reason for the Revision(s)
0	Initial Issue

TABLE OF CONTENTS

1.0 PURPOSE AND METHODOLOGY

1.1 Purpose

The purpose of this Program Basis Document is to document and evaluate those activities of the Oyster Creek Fuel Oil Chemistry aging management program that are credited for managing fuel oil contaminants and aging effects as part of Oyster Creek License Renewal to meet the requirements of the License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

This includes the following:

- The identification of the scope of the program;
- The evaluation of program elements against NUREG-1801;
- The review of Operating Experience to demonstrate program effectiveness;
- The identification of required program enhancements; and
- The identification of Oyster Creek documents required to implement the program.

1.2 Methodology

The nuclear power plant License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," describes the License Renewal process and provides requirements for the contents of License Renewal Applications. 10 CFR 54.21(a)(3) states:

"For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the Current Licensing Basis (CLB) for the period of extended operation."

The NRC and the industry identified 10 program elements that are useful in describing an aging management program and then demonstrating its effectiveness. These program elements are described in Appendix A.1, Section A.1.2.3 of the Standard Review Plan. NUREG-1801 uses these program elements in Section XI to describe acceptable aging management programs.

This Program Basis Document provides a comparison of the credited Oyster Creek program with the elements of the corresponding NUREG-1801 Chapter XI program XI.M30, Fuel Oil Chemistry. Project Level Instruction PLI-8 "Program Basis Documents" prescribes the methodology for evaluating Aging Management Programs. An evaluation of Oyster Creeks aging management program criteria or activities to those of the NUREG-1801 program elements is performed and a conclusion is reached concerning consistency for each individual program element. A demonstration of overall program effectiveness is made after all program elements are evaluated. Required program enhancements are documented. An overall determination is made as to consistency with the program description in NUREG-1801.

2.0 PROGRAM DESCRIPTION

2.1 Program Description

NUREG-1801:

a) *The program includes (a) surveillance and maintenance procedures to mitigate corrosion and (b) measures to verify the effectiveness of an aging management program (AMP) and confirm the insignificance of an aging effect.*

b) *Fuel oil quality is maintained by monitoring and controlling fuel oil contamination in accordance with the plant's technical specifications and the guidelines of the American Society for Testing Materials (ASTM) Standards D 1796, D 2276, D 2709, D6217, and D 4057.*

c) *Exposure to fuel oil contaminants, such as water and microbiological organisms, is minimized by periodic draining or cleaning of tanks and by verifying the quality of new oil before its introduction into the storage tanks.*

d) *However, corrosion may occur at locations in which contaminants may accumulate, such as tank bottoms. Accordingly, the effectiveness of the program is verified to ensure that significant degradation is not occurring and the component's intended function will be maintained during the extended period of operation. Thickness measurement of tank bottom surfaces is an acceptable verification program.*

Oyster Creek:

a) The Fuel Oil Chemistry aging management program is an existing program that will be enhanced to assure adequate management of aging effects as described in NUREG-1801, Chapter XI, Program XI.M30, Fuel Oil Chemistry. The enhanced Fuel Oil Chemistry aging management program includes surveillance and maintenance activities that mitigate corrosion by providing assurance that contaminants are maintained at acceptable levels in fuel oil for systems and components within the scope of Licensing Renewal. The enhanced program also includes internal tank inspections to verify the program's effectiveness and confirm the insignificance of an aging effect.

b) The fuel oil tanks within the scope of license renewal are maintained by monitoring and controlling fuel oil contaminants in accordance with Oyster Creek fuel oil specifications and guidelines of the American Society for Testing and Materials (ASTM). Fuel oil sampling activities meet the intent of ASTM D 4057-95 (2000). Fuel oil will be routinely sampled and analyzed for particulate contamination in accordance with modified ASTM Standard D 2276-00, Method A (the alternative methods of ASTM D 6217 will not be used), for the presence of water and sediment in accordance with ASTM Standard D 2709-96 (ASTM D 1796 is intended for testing higher viscosity fuels and is not applicable to the fuel oil used at Oyster Creek), and for bacteria. Fuel oil sampling and analysis is performed in accordance with approved procedures for new fuel and stored fuel.

c) Fuel oil tanks are periodically drained of accumulated water and sediment and will be periodically drained, cleaned, and internally inspected. The program provides for testing of new fuel oil prior to adding the fuel oil to the storage tank to ensure that the fuel oil has not been contaminated with substances that would have an immediate detrimental impact of diesel engine combustion.

d) Enhanced inspection activities verify the effectiveness of the program by ensuring that significant degradation is not occurring and the component's intended function will be maintained during the extended period of operation. Inspection activities will include the use of ultrasonic techniques for determining tank bottom thicknesses should there be any evidence of corrosion or pitting.

2.2 Overall NUREG-1801 Consistency

The Oyster Creek Fuel Oil Chemistry is an existing program that is consistent with NUREG-1801 aging management program XI.M30, Fuel Oil Chemistry with exceptions and enhancements as described in 2.3 and 2.4 below.

2.3 Summary of Exceptions to NUREG-1801

NUREG-1801 states in XI.M30 that the fuel oil aging management program is in part based on the fuel oil purity and testing requirements of the plant's Technical Specifications that are based on the Standard Technical Specifications of NUREG-1430 through NUREG-1433. Oyster Creek has not adopted the Standard Technical Specifications as described in these NUREGs, however, the Oyster Creek fuel oil specifications and procedures invoke similar requirements for fuel oil purity and fuel oil testing as described by the Standard Technical Specifications. These include testing requirements for new fuel oil (API gravity, kinematic viscosity, water and sediment) prior to adding the new fuel to the storage tank to ensure that the oil has not been contaminated with substances that would have an immediate detrimental impact on diesel engine combustion, and, testing of new fuel after adding it to the storage tank to confirm that the remaining fuel oil properties are within specification requirements. Oyster Creek fuel oil activities also provide for the trending of particulate contamination in new and stored fuel oil. Water and Sediment is drained periodically (quarterly) from the Emergency Diesel Generator Fuel Storage Tank. This periodicity exceeds the Standard Technical Specifications requirements of "once every [31] days", however, it is aligned with the requirements of Regulatory Guide 1.137 which states that a quarterly basis is sufficient unless accumulated condensation is suspected (in which case a monthly basis is appropriate). *This is a new exception based on the reconciliation of this aging management program from the draft January 2005 GALL to the approved September 2005 GALL.*

NUREG-1801 indicates that fuel oil tanks should be sampled for water and sediment, biological activity, and particulate on a periodic basis and that multilevel sampling of tanks should be performed. It also states that fuel oil tanks should be periodically drained of accumulated water and sediment, and, periodically drained, cleaned, and internally inspected. Multilevel sampling, tank bottom sampling, draining, cleaning, and internal inspection of the Emergency Diesel Generator (EDG) Day Tanks are not routinely performed at Oyster Creek. The EDG Day Tanks do not have the capability of being sampled, however, these tanks are supplied directly from the EDG Fuel Storage Tank, which is routinely (weekly) sampled and analyzed. The EDG Day Tanks are small in size (130 gallons) and experience a high turnover rate of the fuel stored within as a result of routine engine operations. During Emergency Diesel Generator load testing, approximately 200 gallons of fuel oil will be consumed (approximately 1 hour of operation @ 200 gallons/hour). Depending on the day tank level (normal level is "above 1/4 full"), the day tank contents may turn over multiple times during load testing which is performed every 14 days. Stratification of fuel is not likely to occur in the EDG Day Tanks due to the high turnover rate. Additionally, the Emergency Diesel Generator Day Tanks are skid mounted on the Emergency Diesel Generator skid and are enclosed within the Emergency Diesel Generator enclosure, which is maintained at a constant temperature during cold periods through operation of the Emergency Diesel Generator keepwarm system. Maintaining a constant temperature during cold periods minimizes Emergency Diesel Generator Day Tank thermal cycling and reduces the potential for condensation formation within the Day Tanks. Therefore, the periodic draining of water and sediment from the bottom of the Day Tanks, and, the periodic internal inspections are not necessary.

Oyster Creek has not committed to ASTM D 4057-95 (2000) for manual sampling standards:

- Sampling of the Emergency Diesel Generator Fuel Storage Tank, although not directly comparable to any of the tank sampling methods described in ASTM D 4057-95 (2000), ensures that a multilevel sample and a bottom sample are obtained. The EDG Fuel Storage Tank is equipped with a sample station that includes two (2) sample recirculation pumps and sample collection points located internal to the tank at several tank elevations, thus making the Emergency Diesel Generator Fuel Storage Tank sample station effective for obtaining multilevel samples. Tank bottom samples are obtained through a sample line located ½" off of the bottom of the tank sump.
- Fire Pond Diesel Fuel Tank samples are obtained from the tank fuel oil outlet line located 4" off of the bottom of the tanks. The Fire Pond Diesel Fuel Tanks are each 2.1 cu meter (550 gallons) capacity. Spot sampling requirements in ASTM D 4057-95 (2000) for tanks less than or equal to 159 cu meter include a single sample from the middle (a distance of one-half of the depth of liquid below the liquid's surface). Although the actual sample location is lower in the tank than prescribed by the ASTM, the lower elevation is

more likely to contain contaminants and water and sediment which tend to settle in the tank, thus making this an effective spot sampling location. Bottom samples from the Fire Pond Diesel Fuel Tanks are taken off of the tank drain located on the bottom of the tank.

Oyster Creek does not add corrosion inhibitors to fuel oil. The analysis for particulate contaminants using modified ASTM D 2276-00 Method A is sufficient for the detection of corrosion products at an early stage. Fuel contaminants and degradation products will normally settle to the tank bottom where they would be detected by routine analysis or by periodic draining of water and sediment from the storage tank bottoms.

2.4 Summary of Enhancements to NUREG-1801

The Oyster Creek Fuel Oil Chemistry program will be enhanced to include the following:

- Routine analysis for particulate contamination using modified ASTM D 2276-00 Method A on fuel oil samples from the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank.
- Analysis for particulate contamination using modified ASTM D 2276-00 Method A on new fuel oil.
- Analysis for water and sediment using ASTM D 2709-96 for Fire Pond Diesel Fuel Tank bottom samples.
- Analysis for bacteria to verify the effectiveness of biocide addition in the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank.
- Periodic draining, cleaning, and inspection of the Fire Pond Diesel Fuel Tanks and the Main Fuel Oil Tank (already performed for the Emergency Diesel Generator Fuel Storage Tank). Inspection activities will include the use of ultrasonic techniques for determining tank bottom thicknesses should there be any evidence of corrosion or pitting.

Enhancements will be implemented prior to the period of extended operation.

3.0 EVALUATIONS AND TECHNICAL BASIS

<u>Note</u>

This section is organized by quoting the relevant NUREG-1801 Chapter XI program element (September 2005 version) followed by the related Oyster Creek program attributes and a conclusion of the comparison. Where applicable, the NUREG-1801 program element was separated into logical sub-elements and addressed accordingly.

Implementing procedure references are included in **( )** for information purposes. This information from the source procedure has been either directly extracted from the procedure or summarized for inclusion into this PBD.

3.0 Scope of Program

<u>NUREG-1801:</u>

The program is focused on managing the conditions that cause general, pitting, and microbiologically-influenced corrosion (MIC) of the diesel fuel tank internal surfaces in accordance with the plant's technical specifications (i.e., NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433) on fuel oil purity and the guidelines of ASTM Standards D1796, D2276, D2709, D6217, and D4057. The program serves to reduce the potential of exposure of the tank internal surface to fuel oil contaminated with water and microbiological organisms.

<u>Oyster Creek:</u>

The enhanced fuel oil chemistry activities rely on plant specifications and procedures for fuel oil purity and on sampling, analysis, and periodic tank bottom draining of water and sediment to reduce the potential of exposure of the tank internal surface to fuel oil contaminated with water and microbiological organisms thereby mitigating the loss of material due to general corrosion, pitting corrosion, and MIC aging mechanisms **(Reference: Specification SP-1302-38-010, Procedure Number 327.1, 828.7, CY-OC-120-1107, CY-OC-130-7001, 636.4.003, 636.4.013 and recurring task work orders R0801584, R0801586, R2044252, and R2045449).** The enhanced program also provides for periodic tank internal inspections to detect potential degradation **(Reference: recurring task work orders R2042556, R2060569, and R2060570).**

The scope of coverage includes the following:

- Emergency Diesel Generator (EDG) Fuel Storage Tank

- Emergency Diesel Generator (EDG) Day Tanks
- Fire Pond Diesel Fuel Tanks
- Main Fuel Oil Tank

The Oyster Creek Fuel Oil Chemistry aging management program manages the aging effect of loss of material for the systems, components, and environments listed in Table 5.2. The implementing documents for this aging management program are listed in Table 5.1 and are described throughout the individual program element discussions. The commitment numbers under which these implementing documents are being revised are contained within the listings in Table 5.1.

<u>Exceptions to NUREG-1801, Element 1:</u>

NUREG-1801 states in XI.M30 that the fuel oil aging management program is in part based on the fuel oil purity and testing requirements of the plant's Technical Specifications that are based on the Standard Technical Specifications of NUREG-1430 through NUREG-1433. Oyster Creek has not adopted the Standard Technical Specifications as described in these NUREG's, however, the Oyster Creek fuel oil specifications and procedures invoke similar requirements for fuel oil purity and fuel oil testing as described by the Standard Technical Specifications. These include testing requirements for new fuel oil (API gravity, kinematic viscosity, water and sediment) prior to adding the new fuel to the storage tank to ensure that the oil has not been contaminated with substances that would have an immediate detrimental impact on diesel engine combustion, and, testing of new fuel after adding it to the storage tank to confirm that the remaining fuel oil properties are within specification requirements. Oyster Creek fuel oil activities also provide for the trending of particulate contamination in new and stored fuel oil. Water and Sediment is drained periodically (quarterly) from the Emergency Diesel Generator Fuel Storage Tank. This periodicity exceeds the Standard Technical Specifications requirements of "once every [31] days", however, it is aligned with the requirements of Regulatory Guide 1.137 which states that a quarterly basis is sufficient unless accumulated condensation is suspected (in which case a monthly basis is appropriate). *This is a new exception based on the reconciliation of this aging management program from the draft January 2005 GALL to the approved September 2005 GALL.*

NUREG-1801 states that the Fuel Oil Chemistry aging management program is focused on managing the conditions that cause general, pitting, and microbiologically-influenced corrosion (MIC) of the diesel fuel tank internal surfaces. This is accomplished in accordance with the plant's Technical Specifications on fuel oil purity, the sampling/analysis guidelines of the ASTM Standards, through the periodic draining of accumulated water and sediment from the tank bottom, and through tank internal inspections. Multilevel sampling, tank bottom sampling, draining, cleaning, and internal inspection of the Emergency Diesel Generator (EDG) Day Tanks are not routinely performed at Oyster Creek. The EDG Day Tanks do not have the capability of being sampled, however, these tanks are supplied directly from the EDG Fuel Storage Tank, which is routinely (weekly) sampled and analyzed. The EDG Day Tanks are small in size (130 gallons) and experience a high turnover rate of the fuel stored within as a result of routine engine operations. During Emergency Diesel Generator load testing, approximately 200 gallons of fuel oil will be consumed (approximately 1 hour of operation @ 200 gallons/hour). Depending on the day tank level (normal level is "above 1/4 full"), the day tank contents may turn over multiple times during load testing which is performed every 14 days. Stratification of fuel is not likely to occur in the EDG Day Tanks due to the high turnover rate. Additionally, the Emergency Diesel Generator Day Tanks are skid mounted on the Emergency Diesel Generator skid and are enclosed within the Emergency Diesel Generator enclosure, which is maintained at a constant temperature during cold periods through operation of the Emergency Diesel Generator keepwarm system. Maintaining a constant temperature during cold periods minimizes Emergency Diesel Generator Day Tank thermal cycling and reduces the potential for condensation formation within the Day Tanks. Therefore, the periodic draining of water and sediment from the bottom of the Day Tanks, and, the periodic internal inspections are not necessary.

Oyster Creek has not committed to ASTM D 4057-95 (2000) for manual sampling standards:

- Sampling of the Emergency Diesel Generator Fuel Storage Tank, although not directly comparable to any of the tank sampling methods described in ASTM D 4057-95 (2000), ensures that a multilevel sample and a bottom sample are obtained. The EDG Fuel Storage Tank is equipped with a sample station that includes two (2) sample recirculation pumps and sample collection points located internal to the tank at several tank elevations, thus making the Emergency Diesel Generator Fuel Storage Tank sample station effective for obtaining multilevel samples. Tank bottom samples are obtained through a sample line located ½" off of the bottom of the tank sump.

- Fire Pond Diesel Fuel Tank samples are obtained from the tank fuel oil outlet line located 4" off of the bottom of the tanks. The Fire Pond Diesel Fuel Tanks are each 2.1 cu meter (550 gallons) capacity. Spot sampling requirements in ASTM D 4057-95 (2000) for tanks less than or equal to 159 cu meter include a single sample from the middle (a distance of one-half of the depth of liquid below the liquid's surface). Although the actual sample location is lower in the tank than prescribed by the ASTM, the lower elevation is more likely to contain contaminants and water and sediment which tend to settle in the tank, thus making this an effective spot sampling location. Bottom samples from the Fire Pond Diesel Fuel Tanks are taken off of the tank drain located on the bottom of the tank.

Oyster Creek does not add corrosion inhibitors to fuel oil. The analysis for particulate contaminants using modified ASTM D 2276-00 Method A is sufficient for the detection of corrosion products at an early stage. Fuel contaminants and degradation products will normally settle to the tank bottom where they would be detected by routine analysis or by periodic draining of water and sediment from the storage tank bottoms.

<u>Enhancements to NUREG-1801, Element 1:</u>

The Oyster Creek Fuel Oil Chemistry program will be enhanced to include the following:

- Routine analysis for particulate contamination using modified ASTM D 2276-00 Method A on fuel oil samples from the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank.
- Analysis for particulate contamination using modified ASTM D 2276-00 Method A on new fuel oil.
- Analysis for water and sediment using ASTM D 2709-96 for Fire Pond Diesel Fuel Tank bottom samples.
- Analysis for bacteria to verify the effectiveness of biocide addition in the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank.

- Periodic draining, cleaning, and inspection of the Fire Pond Diesel Fuel Tanks and the Main Fuel Oil Tank (already performed for the Emergency Diesel Generator Fuel Storage Tank). Inspection activities will include the use of ultrasonic techniques for determining tank bottom thicknesses should there be any evidence of corrosion or pitting.

<u>Comparison and Evaluation Conclusion:</u>

This element is consistent with NUREG-1801, Element 1, Scope of Program with exceptions and enhancements as described above.

3.1 Preventive Actions

<u>NUREG-1801:</u>

a) *The quality of fuel oil is maintained by additions of biocides to minimize biological activity, stabilizers to prevent biological breakdown of the diesel fuel, and corrosion inhibitors to mitigate corrosion.*

b) *Periodic cleaning of a tank allows removal of sediments, and periodic draining of water collected at the bottom of a tank minimizes the amount of water and the length of contact time. Accordingly, these measures are effective in mitigating corrosion inside diesel fuel oil tanks.*

c) *Coatings, if used, prevent or mitigate corrosion by protecting the internal surfaces of the tank from contact with water and microbiological organisms.*

<u>Oyster Creek:</u>

a) The enhanced fuel oil chemistry activities provide for the addition of stabilizers to prevent the biological breakdown of the diesel fuel oil and biocides to minimize biological activity. Stability testing is performed and bacteria testing will be performed to verify the effectiveness of the stabilizers and biocides **(Reference: Procedure Number 327.1, 828.7, CY-OC-120-1107, and recurring task work order R2045450).**

b) The EDG Fuel Storage Tank, Fire Pond Diesel Fuel Tanks, and Main Fuel Oil Tank are periodically drained of accumulated water and sediment to reduce the amount of water and sediment and the length of contact time **(Reference: recurring task work orders R0801584, R0801586, R2044252, and R2045449).** The EDG Fuel Storage Tank is periodically drained, cleaned, and internally inspected which is effective in mitigating corrosion inside fuel storage tanks **(Reference: recurring task work order R2042556)**. The Fire Pond Diesel Fuel Tanks and the Main Fuel Oil Tank will be periodically drained, cleaned, and internally inspected **(Reference: recurring task work orders R2060569 and R2060570).**

c) The EDG Fuel Storage Tank and Main Fuel Oil Tank are internally coated to mitigate corrosion by protecting the internal surfaces of the tanks from contact with water and microbiological organisms. The EDG Day Tanks and Fire Pond Diesel Fuel Tanks are carbon steel and do not have coated interior surfaces.

<u>Exceptions to NUREG-1801, Element 2:</u>

Oyster Creek does not add corrosion inhibitors to fuel oil. The analysis for particulate contaminants using modified ASTM D 2276-00 Method A is sufficient for the detection of corrosion products at an early stage. Fuel contaminants and degradation products will normally settle to the tank bottom where they would be detected by routine analysis or by periodic draining of water and sediment from the storage tank bottoms.

The EDG day tanks are not periodically drained of accumulated water and sediment or periodically drained, cleaned, and internally inspected. The EDG Day Tanks do not have the capability of being sampled, however, these tanks are supplied directly from the EDG Fuel Storage Tank, which is routinely (weekly) sampled and analyzed. The EDG Day Tanks are small in size (130 gallons) and experience a high turnover rate of the fuel stored within as a result of routine engine operations. During Emergency Diesel Generator load testing, approximately 200 gallons of fuel oil will be consumed (approximately 1 hour of operation @ 200 gallons/hour). Depending on the day tank level (normal level is "above 1/4 full"), the day tank contents may turn over multiple times during load testing which is performed every 14 days. Stratification of fuel is not likely to occur in the EDG Day Tanks due to the high turnover rate. Additionally, the Emergency Diesel Generator Day Tanks are skid mounted on the Emergency Diesel Generator skid and are enclosed within the Emergency Diesel Generator enclosure, which is maintained at a constant temperature during cold periods through operation of the Emergency Diesel Generator keepwarm system. Maintaining a constant temperature during cold periods minimizes Emergency Diesel Generator Day Tank thermal cycling and reduces the potential for condensation formation within the Day Tanks. Therefore, the periodic draining of water and sediment from the bottom of the Day Tanks, and, the periodic internal inspections are not necessary.

Enhancements to NUREG-1801, Element 2:

The Oyster Creek Fuel Oil Chemistry program will be enhanced to include the following:

- Analysis for bacteria to verify the effectiveness of biocide addition in the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank.
- Periodic draining, cleaning, and inspection of the Fire Pond Diesel Fuel Tanks and the Main Fuel Oil Tank (already performed for the Emergency Diesel Generator Fuel Storage Tank). Inspection activities will include the use of ultrasonic techniques for determining tank bottom thicknesses should there be any evidence of corrosion or pitting.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 2, Preventive Actions, with exceptions and enhancements as described above.

3.2 Parameters Monitored or Inspected

NUREG-1801:

a) *The AMP monitors fuel oil quality and the levels of water and microbiological organisms in the fuel oil, which cause the loss of material of the tank internal surfaces.*

b) *The ASTM Standard D 4057 is used for guidance on oil sampling.*

c) *The ASTM Standards D 1796 and D 2709 are used for determination of water and sediment contamination in diesel fuel.*

d) *For determination of particulates,* modified *ASTM D 2276, Method A, is used. The modification consists of using a filter with a pore size of 3.0 μm, instead of 0.8 μm. These are the principal parameters relevant to tank structural integrity.*

Oyster Creek:

a) The enhanced fuel oil chemistry activities are preventive activities that provide assurance that contaminants, levels of water, and microbiological organisms are maintained at acceptable levels in fuel oil for systems and components within the scope of license renewal. The fuel oil tanks within the scope of license renewal are maintained by monitoring and controlling fuel oil contaminants in accordance with the guidelines of the American Society for Testing Materials (ASTM). Sampling and analysis is performed on both new diesel fuel oil and the fuel oil storage tanks **(Reference: Procedure Number 327.1, 828.7, CY-OC-120-1107, and CY-OC-130-7001).**

b) Fuel oil multilevel and tank bottom sampling activities meet the intent of ASTM D 4057-95 (2000) **(Reference: Procedure Number 828.7 and recurring task work orders R0801584 and R0801586).**

c) New fuel oil and stored fuel oil will be routinely sampled and analyzed for the presence of water and sediment in accordance with ASTM Standard D 2709-96. ASTM recommends the use of D 2709 for determination of water and sediment in grades D1 and D2 fuel. ASTM D 1796 is intended for testing higher viscosity fuels and is not applicable to the fuel oil used at Oyster Creek **(Reference: Procedure Number CY-OC-120-1107 and CY-OC-130-7001).**

d) New fuel oil and stored fuel oil will be routinely sampled and analyzed for particulate in accordance with modified ASTM Standard D 2276-00, Method A. The modification consists of using a filter with a pore size of 3.0 µm, instead of 0.8 µm **(Reference: Procedure Number CY-OC-120-1107).**

Exceptions to NUREG-1801, Element 3:

The EDG Day Tanks do not have the capability of being sampled, however, these tanks are supplied directly from the EDG Fuel Storage Tank, which is routinely (weekly) sampled and analyzed. The EDG Day Tanks are small in size (130 gallons) and experience a high turnover rate of the fuel stored within as a result of routine engine operations. During Emergency Diesel Generator load testing, approximately 200 gallons of fuel oil will be consumed (approximately 1 hour of operation @ 200 gallons/hour). Depending on the day tank level (normal level is "above 1/4 full"), the day tank contents may turn over multiple times during load testing which is performed every 14 days. Stratification of fuel is not likely to occur in the EDG Day Tanks due to the high turnover rate. Additionally, the Emergency Diesel Generator Day Tanks are skid mounted on the Emergency Diesel Generator skid and are enclosed within the Emergency Diesel Generator enclosure, which is maintained at a constant temperature during cold periods through operation of the Emergency Diesel Generator keepwarm system. Maintaining a constant temperature during cold periods minimizes Emergency Diesel Generator Day Tank thermal cycling and reduces the potential for condensation formation within the Day Tanks.

Oyster Creek has not committed to ASTM D 4057-95 (2000) for manual sampling standards:

- Sampling of the Emergency Diesel Generator Fuel Storage Tank, although not directly comparable to any of the tank sampling methods described in ASTM D 4057-95 (2000), ensures that a multilevel sample and a bottom sample are obtained. The EDG Fuel Storage Tank is equipped with a sample station that includes two (2) sample recirculation pumps and sample collection points located internal to the tank at several tank elevations, thus making the Emergency Diesel Generator Fuel Storage Tank sample station effective for obtaining multilevel samples. Tank bottom samples are obtained through a sample line located ½" off of the bottom of the tank sump.
- Fire Pond Diesel Fuel Tank samples are obtained from the tank fuel oil outlet line located 4" off of the bottom of the tanks. The Fire Pond Diesel Fuel Tanks are each 2.1 cu meter (550 gallons) capacity. Spot sampling requirements in ASTM D 4057-95 (2000) for tanks less than or equal to 159 cu meter include a single sample from the middle (a distance of one-half of the depth of liquid below the liquid's surface). Although the actual sample location is lower in the tank than prescribed by the ASTM, the lower elevation is more likely to contain contaminants and water and sediment which tend to settle in the tank, thus making this an effective spot sampling location. Bottom samples from the Fire Pond Diesel Fuel Tanks are taken off of the tank drain located on the bottom of the tank.

<u>Enhancements to NUREG-1801, Element 3:</u>

The Oyster Creek Fuel Oil Chemistry program will be enhanced to include the following:

- Routine analysis for particulate contamination using modified ASTM D 2276-00 Method A on fuel oil samples from the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank.

- Analysis for particulate contamination using modified ASTM D 2276-00 Method A on new fuel oil.
- Analysis for water and sediment using ASTM D 2709-96 for Fire Pond Diesel Fuel Tank bottom samples.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 3, Parameters Monitored or Inspected with exceptions and enhancements as described above.

3.3 Detection of Aging Effects

NUREG-1801:

a) *Degradation of the diesel fuel oil tank cannot occur without exposure of the tank internal surfaces to contaminants in the fuel oil, such as water and microbiological organisms. Compliance with diesel fuel oil standards in item 3, above, and periodic multilevel sampling provide assurance that fuel oil contaminants are below unacceptable levels.*

b) *Internal surfaces of tanks that are drained for cleaning are visually inspected to detect potential degradation.*

c) *However, corrosion may occur at locations in which contaminants may accumulate, such as a tank bottom, and an ultrasonic thickness measurement of the tank bottom surface ensures that significant degradation is not occurring.*

Oyster Creek:

a) Fuel oil sampling and analysis does not provide for detection of aging effects. The enhanced fuel oil chemistry activities are preventive in nature and provide assurance that contaminants are maintained below unacceptable limits. Fuel oil sampling is done on both new fuel and on stored fuel. Stored fuel sampling includes multilevel and tank bottom sampling. Fuel oil testing includes both "partial" and "complete" fuel oil analyses on both new and stored fuel oil. A partial fuel oil analysis (on-site lab) includes API gravity, water and sediment, and kinematic viscosity. A complete fuel oil analysis (approved off-site lab) includes particulate contamination, bacteria (except for fuel oil truck deliveries), API gravity, water and sediment, kinematic viscosity, sulfur content, flash point, cloud point, ash, distillation temperature, cetane index, carbon residue, and copper strip corrosion. Sampling and analysis is in accordance with the ASTM standards identified in element 3 above.

Fuel Oil sampling and analysis is performed as follow:

- New fuel oil - Water and sediment, API Gravity analysis, and Kinematic Viscosity is performed before the tanker unloads followed by a complete fuel oil analysis for every delivery **(Reference: Procedure Number 327.1, 828.7, CY-OC-120-1107, and CY-OC-130-7001).**
- EDG Fuel Storage Tank - a partial fuel oil analysis and a complete fuel oil analysis are performed on a weekly basis. A partial fuel oil analysis is performed following fuel oil transfer from the Main Fuel Oil Storage Tank. An oxidation stability (total insolubles) analysis is performed on a monthly basis **(Reference: Procedure Number 828.7, 636.4.003, 636.4.013, CY-OC-120-1107, and CY-OC-130-7001).**
- EDG Fuel Storage Tank (bottoms) - a water and sediment analysis is performed on a monthly basis **(Reference: Procedure Number 828.7, CY-OC-120-1107, and CY-OC-130-7001).**
- Fire Pond Diesel Fuel Tanks - a partial fuel oil analysis, a complete fuel oil analysis, and an oxidation stability (total insolubles) analysis are performed quarterly **(Reference: Procedure Number 828.7, CY-OC-120-1107, and CY-OC-130-7001).**
- Fire Pond Diesel Fuel Tanks (bottoms) - a water and sediment analysis will be performed quarterly **(Reference: Procedure Number CY-OC-130-7001 and recurring task work orders R0801584 and R0801586).**
- Main Fuel Oil Tank - a partial fuel oil analysis and a complete fuel oil analysis is performed on a monthly basis **(Reference: Procedure Number 828.7, CY-OC-120-1107, and CY-OC-130-7001).**
- Main Fuel Oil Tank (bottoms) - a water and sediment analysis is performed on a monthly basis **(Reference: Procedure Number 828.7, CY-OC-120-1107, and CY-OC-130-7001).**

b) The EDG Fuel Storage Tank is periodically drained, cleaned and internally inspected to detect potential degradation. The Fire Pond Diesel Fuel Tanks and the Main Fuel Oil Tank will be periodically drained, cleaned and internally inspected to detect potential degradation **(Reference: recurring task work orders R2042556, R2060569, and R2060570).**

c) Inspection activities will include the use of ultrasonic techniques for determining tank bottom thicknesses should there be any evidence of corrosion or pitting **(Reference: recurring task work orders R2042556, R2060569, and R2060570).**

<u>Exceptions to NUREG-1801, Element 4:</u>

Multilevel sampling, tank bottom sampling, draining, cleaning, and internal inspection of the Emergency Diesel Generator (EDG) Day Tanks are not routinely performed at Oyster Creek. The EDG Day Tanks do not have the capability of being sampled, however, these tanks are supplied directly from the EDG Fuel Storage Tank, which is routinely (weekly) sampled and analyzed. The EDG Day Tanks are small in size (130 gallons) and experience a high turnover rate of the fuel stored within as a result of routine engine operations. During Emergency Diesel Generator load testing, approximately 200 gallons of fuel oil will be consumed (approximately 1 hour of operation @ 200 gallons/hour). Depending on the day tank level (normal level is "above 1/4 full"), the day tank contents may turn over multiple times during load testing which is performed every 14 days. Stratification of fuel is not likely to occur in the EDG Day Tanks due to the high turnover rate. Additionally, the Emergency Diesel Generator Day Tanks are skid mounted on the Emergency Diesel Generator skid and are enclosed within the Emergency Diesel Generator enclosure, which is maintained at a constant temperature during cold periods through operation of the Emergency Diesel Generator keepwarm system. Maintaining a constant temperature during cold periods minimizes Emergency Diesel Generator Day Tank thermal cycling and reduces the potential for condensation formation within the Day Tanks. Therefore, the periodic draining of water and sediment from the bottom of the Day Tanks, and, the periodic internal inspections are not necessary.

Oyster Creek has not committed to ASTM D 4057-95 (2000) for manual sampling standards:

- Sampling of the Emergency Diesel Generator Fuel Storage Tank, although not directly comparable to any of the tank sampling methods described in ASTM D 4057-95 (2000), ensures that a multilevel sample and a bottom sample are obtained. The EDG Fuel Storage Tank is equipped with a sample station that includes two (2) sample recirculation pumps and sample collection points located internal to the tank at several tank elevations, thus making the Emergency Diesel Generator Fuel Storage Tank sample station effective for obtaining multilevel samples. Tank bottom samples are obtained through a sample line located ½" off of the bottom of the tank sump.

- Fire Pond Diesel Fuel Tank samples are obtained from the tank fuel oil outlet line located 4" off of the bottom of the tanks. The Fire Pond Diesel Fuel Tanks are each 2.1 cu meter (550 gallons) capacity. Spot sampling requirements in ASTM D 4057-95 (2000) for tanks less than or equal to 159 cu meter include a single sample from the middle (a distance of one-half of the depth of liquid below the liquid's surface). Although the actual sample location is lower in the tank than prescribed by the ASTM, the lower elevation is more likely to contain contaminants and water and sediment which tend to settle in the tank, thus making this an effective spot sampling location. Bottom samples from the Fire Pond Diesel Fuel Tanks are taken off of the tank drain located on the bottom of the tank.

Enhancements to NUREG-1801, Element 4:

The Oyster Creek Fuel Oil Chemistry program will be enhanced to include the following:

- Routine analysis for particulate contamination using modified ASTM D 2276-00 Method A on fuel oil samples from the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank.
- Analysis for particulate contamination using modified ASTM D 2276-00 Method A on new fuel oil.
- Analysis for water and sediment using ASTM D 2709-96 for Fire Pond Diesel Fuel Tank bottom samples.
- Periodic draining, cleaning, and inspection of the Fire Pond Diesel Fuel Tanks and the Main Fuel Oil Tank (already performed for the Emergency Diesel Generator Fuel Storage Tank). Inspection activities will include the use of ultrasonic techniques for determining tank bottom thicknesses should there be any evidence of corrosion or pitting.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 4, Detection of Aging Effects with exceptions and enhancements as described above.

3.4 Monitoring and Trending

NUREG-1801:

Water and biological activity or particulate contamination concentrations are monitored and trended in accordance with the plant's technical specifications or at least quarterly. Based on industry operating experience, quarterly sampling and analysis of fuel oil provides for timely detection of conditions conducive to corrosion of the internal surface of the diesel fuel oil tank before the potential loss of its intended function.

Oyster Creek:

The enhanced fuel oil chemistry activities provide for the monitoring and trending of water and biological activity or particulate contamination concentrations for timely detection of conditions conducive to corrosion of the internal surface of the diesel fuel storage tanks before the potential loss of their intended functions. Testing of the EDG Fuel Storage Tank includes particulate, water and sediment, and bacteria analysis weekly. Oxidation stability analysis is performed monthly on the EDG Fuel Storage Tank **(Reference: Procedure Number 828.7, CY-OC-120-1107, and CY-OC-130-7001).** EDG Fuel Storage Tank bottoms are analyzed for water and sediment monthly **(Reference: Procedure Number 828.7, CY-OC-120-1107, and CY-OC-130-7001).** The Fire Pond Diesel Fuel Tanks analysis includes particulate, water and sediment, bacteria, and oxidation stability on a quarterly basis **(Reference: Procedure Number 828.7, CY-OC-120-1107, and CY-OC-130-7001).** Fire Pond Diesel Fuel Tank bottoms are analyzed for water and sediment on a quarterly basis **(Reference: Procedure Number CY-OC-130-7001 and recurring task work orders R0801584 and R0801586).** The Main Fuel Oil Storage Tank analysis includes particulate, water and sediment, and bacteria analysis monthly **(Reference: Procedure Number 828.7, CY-OC-120-1107, and CY-OC-130-7001).** The Main Fuel Oil Tank bottoms are analyzed for water and sediment monthly **(Reference: Procedure Number 828.7, CY-OC-120-1107, and CY-OC-130-7001).** In the event the acceptance criteria for stored fuel oil are exceeded, an Issue Report will be initiated. This action enters the out-of-spec condition(s) into the corrective action program.

Exceptions to NUREG-1801, Element 5:

NUREG-1801 indicates that fuel oil tanks should be sampled for water and sediment, biological activity, and particulate contamination in accordance with the plants Technical Specifications or at least quarterly. Multilevel sampling and tank bottom sampling of the Emergency Diesel Generator (EDG) Day Tanks are not routinely performed at Oyster Creek. The EDG Day Tanks do not have the capability of being sampled, however, these tanks are supplied directly from the EDG Fuel Storage Tank, which is routinely (weekly) sampled and analyzed. The EDG Day Tanks are small in size (130 gallons) and experience a high turnover rate of the fuel stored within as a result of routine engine operations. During Emergency Diesel Generator load testing, approximately 200 gallons of fuel oil will be consumed (approximately 1 hour of operation @ 200 gallons/hour). Depending on the day tank level (normal level is "above 1/4 full"), the day tank contents may turn over multiple times during load testing which is performed every 14 days. Stratification of fuel is not likely to occur in the EDG Day Tanks due to the high turnover rate. Additionally, the Emergency Diesel Generator Day Tanks are skid mounted on the Emergency Diesel Generator skid and are enclosed within the Emergency Diesel Generator enclosure, which is maintained at a constant temperature during cold periods through operation of the Emergency Diesel Generator keepwarm system. Maintaining a constant temperature during cold periods minimizes Emergency Diesel Generator Day Tank thermal cycling and reduces the potential for condensation formation within the Day Tanks.

Enhancements to NUREG-1801, Element 5:

The Oyster Creek Fuel Oil Chemistry program will be enhanced to include the following:

- Routine analysis for particulate contamination using modified ASTM D 2276-00 Method A on fuel oil samples from the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank.
- Analysis for particulate contamination using modified ASTM D 2276-00 Method A on new fuel oil.
- Analysis for water and sediment using ASTM D 2709-96 for Fire Pond Diesel Fuel Tank bottom samples.

- Analysis for bacteria to verify the effectiveness of biocide addition in the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 5, Monitoring and Trending with exceptions and enhancements as described above.

3.5 Acceptance Criteria

NUREG-1801:

a) *The ASTM Standard D 4057 is used for guidance on oil sampling.*

b) *The ASTM Standards D 1796 and D 2709 are used for guidance on the determination of water and sediment contamination in diesel fuel.*

c) *ASTM D 6217 and Modified D 2276, Method A are used for guidance for determination of particulates. The modification to D 2276 consists of using a filter with a pore size of 3.0 μm, instead of 0.8 μm.*

Oyster Creek:

a) Fuel oil multilevel and tank bottom sampling activities meet the intent of ASTM D 4057-95 (2000) **(Reference: Procedure Number 828.7 and recurring task work orders R0801584 and R0801586).**

b) Fuel oil will be routinely sampled and analyzed for the presence of water and sediment in accordance with ASTM Standard D 2709-96. ASTM recommends the use of D 2709 for determination of water and sediment in grades D1 and D2 fuel. ASTM D 1796 is intended for testing higher viscosity fuels and is not applicable to the fuel oil used at Oyster Creek **(Reference: Procedure Number CY-OC-120-1107 and CY-OC-130-7001).**

c) Fuel oil will be routinely sampled and analyzed for particulate in accordance with modified ASTM Standard D 2276-00, Method A. The modification consists of using a filter with a pore size of 3.0 μm, instead of 0.8 μm **(Reference: Procedure Number CY-OC-120-1107).** The alternative methods of ASTM D 6217 will not be used.

Exceptions to NUREG-1801, Element 6:

Multilevel sampling and tank bottom sampling of the EDG Day Tanks are not routinely performed at Oyster Creek. The EDG Day Tanks do not have the capability of being sampled, however, these tanks are supplied directly from the EDG Fuel Storage Tank, which is routinely (weekly) sampled and analyzed. The EDG Day Tanks are small in size (130 gallons) and experience a high turnover rate of the fuel stored within as a result of routine engine operations. During Emergency Diesel Generator load testing, approximately 200 gallons of fuel oil will be consumed (approximately 1 hour of operation @ 200 gallons/hour). Depending on the day tank level (normal level is "above 1/4 full"), the day tank contents may turn over multiple times during load testing which is performed every 14 days. Stratification of fuel is not likely to occur in the EDG Day Tanks due to the high turnover rate. Additionally, the Emergency Diesel Generator Day Tanks are skid mounted on the Emergency Diesel Generator skid and are enclosed within the Emergency Diesel Generator enclosure, which is maintained at a constant temperature during cold periods through operation of the Emergency Diesel Generator keepwarm system. Maintaining a constant temperature during cold periods minimizes Emergency Diesel Generator Day Tank thermal cycling and reduces the potential for condensation formation within the Day Tanks.

Oyster Creek has not committed to ASTM D 4057-95 (2000) for manual sampling standards:

- Sampling of the Emergency Diesel Generator Fuel Storage Tank, although not directly comparable to any of the tank sampling methods described in ASTM D 4057-95 (2000), ensures that a multilevel sample and a bottom sample are obtained. The EDG Fuel Storage Tank is equipped with a sample station that includes two (2) sample recirculation pumps and sample collection points located internal to the tank at several tank elevations, thus making the Emergency Diesel Generator Fuel Storage Tank sample station effective for obtaining multilevel samples. Tank bottom samples are obtained through a sample line located ½" off of the bottom of the tank sump.
- Fire Pond Diesel Fuel Tank samples are obtained from the tank fuel oil outlet line located 4" off of the bottom of the tanks. The Fire Pond Diesel Fuel Tanks are each 2.1 cu meter (550 gallons) capacity. Spot sampling requirements in

ASTM D 4057-95 (2000) for tanks less than or equal to 159 cu meter include a single sample from the middle (a distance of one-half of the depth of liquid below the liquid's surface). Although the actual sample location is lower in the tank than prescribed by the ASTM, the lower elevation is more likely to contain contaminants and water and sediment which tend to settle in the tank, thus making this an effective spot sampling location. Bottom samples from the Fire Pond Diesel Fuel Tanks are taken off of the tank drain located on the bottom of the tank.

Enhancements to NUREG-1801, Element 6:

The Oyster Creek Fuel Oil Chemistry program will be enhanced to include the following:

- Routine analysis for particulate contamination using modified ASTM D 2276-00 Method A on fuel oil samples from the Emergency Diesel Generator Fuel Storage Tank, the Fire Pond Diesel Fuel Tanks, and the Main Fuel Oil Tank.
- Analysis for particulate contamination using modified ASTM D 2276-00 Method A on new fuel oil.
- Analysis for water and sediment using ASTM D 2709-96 for Fire Pond Diesel Fuel Tank bottom samples.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 6, Acceptance Criteria with exceptions and enhancements as described above.

3.6 Corrective Actions

NUREG-1801:

Specific corrective actions are implemented in accordance with the plant quality assurance (QA) program. For example, corrective actions are taken to prevent recurrence when the specified limits for fuel oil standards are exceeded or when water is drained during periodic surveillance. Also, when the presence of biological activity is confirmed, a biocide is added to fuel oil. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

Oyster Creek:

Evaluations are performed for test or inspection results that do not satisfy established criteria and an Issue Report is initiated to document the concern in accordance with plant administrative procedures. The 10 CFR Part 50, Appendix B corrective actions program ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude repetition. Stored fuel will be routinely tested for the presence of bacteria to determine the effectiveness of the biocide addition **(Reference: Procedure Number CY-OC-120-1107 and recurring task work order R2045450).**

Exceptions to NUREG-1801, Element 7:

None.

Enhancements to NUREG-1801, Element 7:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 7, Corrective Actions.

3.7 Confirmation Process

NUREG-1801:

Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process and administrative controls.

Oyster Creek:

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

Exceptions to NUREG-1801, Element 8:

None.

Enhancements to NUREG-1801, Element 8:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 8, Confirmation Process.

3.8 Administrative Controls

NUREG-1801:

See Item 8, above.

Oyster Creek:

See Item 8, above.

Exceptions to NUREG-1801, Element 9:

None.

Enhancements to NUREG-1801, Element 9

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 9, Administrative Controls.

3.9 Operating Experience

NUREG-1801:

The operating experience at some plants has included identification of water in the fuel, particulate contamination, and biological fouling. However, no instances of fuel oil system component failures attributed to contamination have been identified.

Oyster Creek:

Operating experience, both internal and external, is used in two ways at Oyster Creek to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Oyster Creek. The first way in which operating experience is used is through the Oyster Creek Operating

Experience process. The Operating Experience process screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The second way is through the process for managing programs. This process requires the review of program related operating experience by the program owner.

Both of these processes review operating experience from both external and internal (also referred to as in-house) sources. External operating experience may include such things as INPO documents (e.g., SOERs, SERs, SENs, etc.), NRC documents (e.g., GLs, LERs, INs, etc.), Westinghouse documents (e.g., TBs, etc.), General Electric documents (e.g., RCSILs, SILs, TILs, etc.), and other documents (e.g., 10CFR Part 21 Reports, NERs, etc.). Internal operating experience may include such things as event investigations, trending reports, and lessons learned from in-house events as captured in program notebooks, self-assessments, and in the 10 CFR Part 50, Appendix B corrective action process.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that the loss of material in fuel oil systems is being adequately managed by fuel oil chemistry activities and inspections. The following examples of operating experience provide objective evidence that the Fuel Oil Chemistry aging management program is effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1. The Emergency Diesel Generator (EDG) Fuel Oil Tank was internally inspected in November 2004. This "out-of-service" inspection was performed by an API Certified Inspector (reference CAP No. O2004-3745). The Oyster Creek Site Coatings Coordinator conducted an independent inspection of the internal tank coating (reference CAP No. O2004-3550). The following summarizes the findings associated with the tank floor inspections:
    - The floor and shell metal thickness was acceptable at an average of .248 - .260 inches (with a nominal design thickness of .25 inches). As such, the tank meets the API standard and there are no tank integrity concerns.
    - The inspector concluded that the remaining floor coating thickness was less than industry standards and should be replaced. Although coatings are not required by API standards, internal coating extends the life of the tank and should be repaired as needed to ensure the maximum

service life of the tank is attained. According to the coating vendor, Thortex, the coating does not degrade by thinning. The failure mechanism for the coating is pinholes or defects in the coating. The inspector only noted defects in the coating at the sample tube brackets. The Site Coatings Coordinator also noted these minor deficiencies and they were repaired prior to returning the tank to service. There were no defects found in the bulk of the coating. It was concluded that the coating was most likely applied thin upon initial installation and that there was no need to recoat the tank. The tank internal coating will be re-evaluated during the next regularly scheduled tank inspection (2014).

This example provides objective evidence that fuel oil chemistry control, and the installation of protective coatings, have been effective in controlling the amount of contaminants within the fuel oil, and, in mitigating corrosion by protecting the internal surfaces of the tank from potential contact with water and microbiological organisms.

2. Oyster Creek experienced high concentrations of water and sediment in Main Fuel Oil Tank bottom samples (reference CAP O2003-1865). No fuel oil system failures were attributed to this event, and, the all levels sample was within specifications indicating that the identified deficiency was limited to the sump area of the tank. Corrective actions from this event included the creation of a new preventive maintenance task (PM) to periodically drain accumulated water and sediment from the tank sump. This example provides objective evidence that fuel oil chemistry activities have detected levels of contaminants in stored fuel in a timely manner so that corrective actions could be initiated before blockage of fuel oil system supply lines or corrosion of fuel oil tanks and fuel supply lines occurs.

3. Oyster Creek experienced an increasing trend in the concentration of water and sediment in EDG fuel oil tank bottom and multilevel samples (reference CAP O2003-2076). All sample results were within specification allowables, however, the condition was entered into the corrective action process for trending, analysis, and for establishing corrective actions. Corrective actions involved using a feed and bleed process to replace the oil in the EDG fuel oil tank. This example provides objective evidence that fuel oil chemistry activities identify and correct adverse trends prior to exceeding unacceptable chemistry limits.

The operating experience of the Fuel Oil Chemistry aging management program did not show any adverse trend in performance. Problems identified would not cause significant impact to the safe operation of the plants, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Fuel Oil Chemistry aging management program will effectively maintain fuel oil contaminants at acceptable levels.

3.10 Conclusion

The Oyster Creek Fuel Oil Chemistry aging management program is credited for managing the aging effects, systems, and components listed in Table 5.2 exposed to a fuel oil environment. The Oyster Creek Fuel Oil Chemistry program's elements have been evaluated against NUREG-1801 in Section 3.0. Program exceptions have been identified in Section 2.3. Program enhancements have been identified in Section 2.4. The implementing documents and commitment numbers for this aging management program are listed in Table 5.1. The relevant operating experience has been reviewed and a demonstration of program effectiveness is provided in Section 3.10.

Based on the above, the enhanced Oyster Creek Fuel Oil Chemistry aging management program provides reasonable assurance that fuel oil contaminants and aging effects are adequately managed so that the intended functions of components within the scope of license renewal will be maintained during the period of extended operation.

4.0 REFERENCES

4.1 Generic to Aging Management Programs

4.1.1 10 CFR 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*

4.1.2 10 CFR 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*

4.1.3 NUREG-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants*, Revision 1, dated September 2005

4.1.4 NUREG-1801, *Generic Aging Lessons Learned (GALL)*

Report, Revision 1, dated September 2005

4.2 Industry Standards

4.2.1 NUREG-1433, *Standard Technical Specifications General Electric Plants*, Revision 3, June 2004

4.2.2 Regulatory Guide 1.137, *Fuel-Oil Systems for Standby Diesel Generators,* Rev. 1 dated October 1979

4.2.3 ANSI N195-1976, *Fuel Oil Systems for Standby Diesel Generators*

4.2.4 ASTM D 4057-95 (2000), *Standard Practice for Manual Sampling of Petroleum and Petroleum Products*

4.2.5 ASTM D 2276-00, *Standard Test Method for Particulate Contamination in Aviation Fuel by Line Sampling*

4.2.6 ASTM D 6217-98, *Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration*

4.2.7 ASTM D 2709-96, *Standard Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge*

4.2.8 ASTM D 1796-97, *Standard Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)*

4.3 Oyster Creek Program References

4.3.1 Specification SP-1302-38-010, *Specification for Oyster Creek Generating Station Diesel Fuel Oil No. 2*, Revision 8

4.3.2 Procedure Number 327.1, *Fuel Oil Receipt and Handling Procedure*

4.3.3 Procedure Number 828.7, *Secondary Systems Analysis: Plant Oil*

4.3.4 Procedure CY-OC-120-1107, *Fuel Oil System Sample and Analysis Schedule*

4.3.5 Procedure CY-OC-130-7001, *Water and Sediment*

4.3.6 Procedure Number 636.4.003, *Diesel Generator #1 Load*

Test

4.3.7 Procedure Number 636.4.013, *Diesel Generator #2 Load Test*

4.3.8 Recurring Task Work Order R0801584, *Fire Diesel Engines Quarterly Inspection*

4.3.9 Recurring Task Work Order R0801586, *Fire Diesel Engine Quarterly Inspection*

4.3.10 Recurring Task Work Order R2044252, *PM Task for T-39-2 Bottom Drain (EDG FO Tank)*

4.3.11 Recurring Task Work Order R2045449, *Drain the Bottom of the Main Fuel Oil Tank*

4.3.12 Recurring Task Work Order R2042556, *Open, Clean, and Inspect T-39-2 (EDG FO Tank)*

4.3.13 Recurring Task Work Order Rxxxxxxx (NEW), *Open, Clean, and Inspect the Main Fuel Oil Tank*

4.3.14 Recurring Task Work Order R2060569, *Perform Internal Inspection of T-9-103* (Fire Pond FO Tank "A")

4.3.15 Recurring Task Work Order R2060570, *Perform Internal Inspection of T-9-104* (Fire Pond FO Tank "B")

4.3.16 Recurring Task Work Order R2045450, *Add Biocide to the Main Fuel Oil Tank*

5.0 TABLES

5.1 Aging Management Program Implementing Documents

Procedure Number	Procedure Title	Commitment No.	Status
327.1	Fuel Oil Receipt and Handling Procedure	00330592.22.01	ACC/ASG
828.7	Secondary Systems Analysis: Plant Oil Corrosion	00330592.22.02	ACC/ASG
CY-OC-120-1107	Fuel Oil System Sample and Analysis Schedule	00330592.22.15	ACC/ASG
CY-OC-130-7001	Water and Sediment	00330592.22.03	ACC/ASG

636.4.003	Diesel Generator #1 Load Test	00330592.22.13	ACC/ASG
636.4.013	Diesel Generator #2 Load Test	00330592.22.14	ACC/ASG
R0801584	Fire Diesel Engines Quarterly Inspection (Fire Diesel Engine #1)	00330592.22.07	ACC/ASG
R0801586	Fire Diesel Engines Quarterly Inspection (Fire Diesel Engine #2)	00330592.22.08	ACC/ASG
R2044252	PM Task for T-39-2 (EDG Fuel Storage Tank) Bottom Draining	00330592.22.05	ACC/ASG
R2045449	Drain the Bottom of the Main Fuel Oil Tank T-36-1	00330592.22.06	ACC/ASG
R2042556	Open, Clean and Inspect T-39-2 (EDG Fuel Storage Tank)	00330592.22.09	ACC/ASG
R2060569	Open, Clean, and Inspect Fire Pond Diesel Fuel Oil Tank 1-1 (Fire Diesel Engine # 1)	00330592.22.11	ACC/ASG
R2060570	Open, Clean, and Inspect Fire Pond Diesel Fuel Oil Tank 1-2 (Fire Diesel Engine # 2)	00330592.22.12	ACC/ASG
Rxxxxxxx	Open, Clean, and Inspect the Main Fuel Oil Tank T-36-1	00330592.22.10	ACC/ASG
R2045450	Add Biocide to the Main Fuel Oil Tank T-36-1	00330592.22.04	ACC/ASG
SP-1302-38-010	Specification for Oyster Creek Generating Station Diesel Fuel Oil No. 2	00330592.22.16	ACC/ASG

5.2 Aging Management Review Results

SSC Name	Structure and/or Component	Material	Environment	Aging Effect
Emergency Diesel Generator and Auxiliary System	Strainer Body	Aluminum	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Stainless Steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Pump Casing (Fuel Oil)	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Piping and fittings	Stainless Steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Brass	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Aluminum	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Strainer Body	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Tanks (Fuel Oil Tank)	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Flexible Hose	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Strainer	Stainless Steel	Fuel Oil (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Tanks (Fuel Day Tank)	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Filter Housing (Fuel Oil)	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Fire Protection System	Valve Body	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material

Fire Protection System	Piping and fittings	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Fire Protection System	Valve Body	Bronze	Fuel Oil (Internal)	Loss of Material
Fire Protection System	Tanks (Fuel Oil)	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Main Fuel Oil Storage & Transfer System	Piping and fittings	Stainless Steel	Fuel Oil (Internal)	Loss of Material
Main Fuel Oil Storage & Transfer System	Sight Glasses	Brass	Fuel Oil (Internal)	Loss of Material
Main Fuel Oil Storage & Transfer System	Flexible Hose	Stainless Steel	Fuel Oil (Internal)	Loss of Material
Main Fuel Oil Storage & Transfer System	Strainer Body	Cast Iron	Fuel Oil (Internal)	Loss of Material
Main Fuel Oil Storage & Transfer System	Pump Casing	Cast Iron	Fuel Oil (Internal)	Loss of Material
Main Fuel Oil Storage & Transfer System	Valve Body	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Main Fuel Oil Storage & Transfer System	Piping and fittings	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Main Fuel Oil Storage & Transfer System	Valve Body	Stainless Steel	Fuel Oil (Internal)	Loss of Material
Main Fuel Oil Storage & Transfer System	Flow Meter	Cast Iron	Fuel Oil (Internal)	Loss of Material

Notes:
1. The Main Fuel Oil Tank does not perform an Intended Function and is not in the scope of License Renewal. However, Main Fuel Oil Tank Fuel Oil Chemistry program activities will be credited aging management activities for in-scope fuel oil piping, piping components, piping elements, and tanks.

6.0 ATTACHMENTS

6.1 LRA Appendix A

6.2 LRA Appendix B

PROGRAM BASIS DOCUMENT

PBD-AMP-B.1.8

Revision 0

BWR PENETRATIONS

GALL PROGRAM XI.M8 – BWR PENETRATIONS

Prepared By: M. J. May

Reviewed By: *G. J. Beck*

Program Owner Review: *G. F. Harttraft*

Technical Lead Approval: *D. B. Warfel*

Revision History:

Revision	*Prepared by:*	*Reviewed by:*	*Program Owner:*	*Approved by:*
0	*M. J. May*	*G. J. Beck*	*G. F. Harttraft*	*D. B. Warfel*
Date				

Summary of Revisions:

Rev. Number	Reason for the Revision(s)
0	Initial Issue

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1.0 PURPOSE

1.1 Purpose

The purpose of this Program Basis Document is to document the evaluation of those activities of the Oyster Creek BWR Penetrations aging management program that are credited for managing cracking due to stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSCC) as part of Oyster Creek License Renewal to meet the requirements of the License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

This includes the following:

- The identification of the scope of the program;
- The evaluation of program elements against NUREG-1801;
- The review of Operating Experience to demonstrate program effectiveness;
- The identification of required program enhancements; and
- The identification of Oyster Creek documents required to implement the program.

1.2 Methodology

The nuclear power plant License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," describes the License Renewal process and provides requirements for the contents of License Renewal Applications. 10 CFR 54.21(a)(3) states:

"For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the Current Licensing Basis (CLB) for the period of extended operation."

The NRC and the industry identified 10 program elements that are useful in describing an aging management program and then demonstrating its effectiveness. These program elements are described in Appendix A.1, Section A.1.2.3 of the Standard Review Plan. NUREG-1801 uses these program elements in Section XI to describe acceptable aging management programs.

The purpose of this Program Basis Document is to identify and describe the basis for the BWR Penetrations aging management program and associated activities credited for managing the effects of cracking due to stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSCC). This Program Basis Document also provides a comparison of the credited Oyster Creek program with the elements of the corresponding NUREG-1801 Chapter XI program XI.M8, BWR Penetrations. Project Level Instruction PLI-8 "Program Basis Documents" prescribes the methodology for evaluating Aging Management Programs. An evaluation of the Oyster Creek aging management program criteria or activities to those of the NUREG-1801 program elements is performed and a conclusion is reached concerning consistency for each individual program element. A demonstration of overall program effectiveness is made after all program elements are evaluated. Required program enhancements are documented. An overall determination is made as to consistency with the program description in NUREG-1801.

2.0 PROGRAM DESCRIPTION

2.1 Program Description

NUREG-1801:

The program includes:

a) inspection and flaw evaluation in conformance with the guidelines of staff-approved boiling water reactor vessel and internals project BWRVIP-49 and BWRVIP-27 documents, and

b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-29 (Electric Power Research Institute [EPRI] TR-103515) to ensure the long-term integrity and safe operation of boiling water reactor (BWR) vessel internal components.

c) BWRVIP-49 provides guidelines for instrument penetrations, and BWRVIP-27 addresses the standby liquid control (SLC) system nozzle or housing.

Oyster Creek:

a) The BWR Penetration aging management program activities at Oyster Creek are in conformance with and incorporate the inspection and flaw evaluation recommendations of BWRVIP-27-A, "BWR Standby Liquid Control System/Core Plate ΔP Inspection and Flaw Evaluation Guidelines," and BWRVIP-49-A "Instrument Penetration Inspection and Flaw Evaluation Guidelines,"

b) The plant water chemistry procedures monitor and control water chemistry are consistent with the recommendations of the EPRI water chemistry guidelines, BWRVIP-130, "BWR Vessel and Internals Project BWR Water Chemistry Guidelines". (See aging management program B.1.2 (Water Chemistry).

c) BWRVIP-49-A provides guidelines for instrument penetrations, and BWRVIP-27-A addresses the Standby Liquid Control (SLC) system nozzle or housing.

Note: "-A" is used to denote NRC acceptance of the BWRVIP document.

2.2 Overall NUREG-1801 Consistency

The Oyster Creek BWR Penetrations aging management program is consistent with the ten elements of aging management program XI.M8, "BWR Penetrations," specified in NUREG-1801 with the exceptions discussed in Section 2.3 below.

2.3 Summary of Exceptions to NUREG-1801

NUREG-1801 indicates that water chemistry control is in accordance with BWRVIP-29 for water chemistry in BWRs. BWRVIP-29 references the 1996 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines." The Oyster Creek water chemistry program is based on BWRVIP-130, which is the 2004 revision of "BWR Water Chemistry Guidelines". For justification of exceptions to the water chemistry program see the Water Chemistry aging management program, PBD-AMP-B.1.2.

Additionally, NUREG-1801 program XI.M9 references ASME Section XI, Table IWB 2500-1 (2001 edition, including the 2002 and 2003 Addenda). Oyster Creek ISI program is based on the 1995 (including 1996 Addenda) version of ASME Section XI. For justification of exceptions to the ISI program see the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program, PBD-AMP-B.1.1.

2.4 Summary of Enhancements to NUREG-1801

None. The existing Oyster Creek BWR Penetrations aging management program is found to be adequate to support the extended period of operation with no enhancements.

3.0 EVALUATIONS AND TECHNICAL BASIS

Note

This section is organized by quoting the relevant NUREG-1801 Chapter XI program element (September 2005 version) followed by the related Oyster Creek program attributes and a conclusion of the comparison. Where applicable, the NUREG-1801 program element was separated into logical sub-elements and addressed accordingly.

Implementing procedure references are included in ( ) for information purposes. This information from the source procedure has been either directly extracted from the procedure or summarized for inclusion into this PB.

3.0 Scope of Program

NUREG-1801:

The program is focused on managing the effects of cracking due to stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSCC). The program contains preventive measures to mitigate SCC or IGSCC, inservice inspection (ISI) to monitor the effects of cracking on the intended function of the components, and repair and/or replacement as needed to maintain the ability to perform the intended function.

a) *The inspection and evaluation guidelines of BWRVIP-49 and BWRVIP-27 contain generic guidelines intended to present appropriate inspection recommendations to assure safety function integrity. The guidelines of BWRVIP-49 provide information on the type of instrument penetration, evaluate their susceptibility and consequences of failure, and define the inspection strategy to assure safe operation. The guidelines of BWRVIP-27 are applicable to plants in which the SLC system injects sodium pentaborate into the bottom head region of the vessel (in most plants, as a pipe within a pipe of the core plate*

ΔP monitoring system). The BWRVIP-27 guidelines address the region where the ΔP and SLC nozzle or housing penetrates the vessel bottom head and include the safe ends welded to the nozzle or housing.

b) *Guidelines for repair design criteria are provided in BWRVIP-57 for instrumentation penetrations, and BWRVIP-53 for SLC line.*

Oyster Creek:

The Oyster Creek station program mitigates the effects of cracking due to stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSCC) through the station water chemistry program. **(Reference: OC-5 paragraph 1.3, CY-AB-120-100, paragraph 1.1).** Inservice inspection (ISI) activities for BWR penetrations are performed through the station Reactor Internals Program to monitor for the effects of cracking on the vessel penetrations to ensure the pressure boundary function is maintained. The program also includes guidelines for repair or replacement of penetrations as needed to maintain the ability to perform their intended function.

a) The inspection and flaw evaluation guidelines of BWRVIP-27-A and BWRVIP-49-A contain the guidelines intended to present appropriate inspection recommendations to assure safety function integrity as described above. **(Reference: OC-5, paragraph 1.7).**The station Reactor Internals Program plan specifies inspections of the instrument penetrations and the standby liquid control nozzle be performed in accordance with the recommendations and inspection strategies of BWRVIP–27-A and BWRVIP-49-A, respectively to ensure safety function integrity. **(Reference: OC-5, inspection plan 7.7, 7.15)**

b) Repair and replacement activities, if needed, are performed in accordance with the recommendations of the appropriate BWRVIP repair/replacement guidelines, including the general design and acceptance provided in BWRVIP-53 for Standby Liquid Control penetrations and those in BWRVIP-57 for BWR vessel penetrations. **(Reference: ER-AA-331-1001, paragraph 3.1.2)**

The Oyster Creek BWR Penetrations program manages the aging effect of cracking due to stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSSC) for the systems, components, and environments listed in Table 5.2. The implementing documents for this aging management program are listed in Table 5.1.

Exceptions to NUREG-1801, Element 1:

None.

Enhancements to NUREG-1801, Element 1:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 1, Scope of Program.

3.1 Preventive Actions

NUREG-1801:

Maintaining high water purity reduces susceptibility to SCC or IGSCC. Reactor coolant water chemistry is monitored and maintained in accordance with the guidelines in BWRVIP-29 (EPRI TR-103515). The program description and the evaluation and technical basis of monitoring and maintaining reactor water chemistry are presented in Chapter XI.M2, "Water Chemistry."

Oyster Creek:

Oyster Creek programs mitigate the potential for SCC and IGSCC by maintaining high reactor water purity through the water chemistry program. The station water chemistry program implements the requirements of the EPRI water chemistry guideline, BWRVIP-130. As is described in the Water Chemistry program, PBD-AMP-B.1.2, BWRVIP-130 replaced BWRVIP-29 as the BWR water chemistry standard. This exception is discussed below. The program description and the evaluation and technical basis of monitoring and maintaining reactor water chemistry are presented in PBD-AMP-B.1.2 **(Reference: OC-5, paragraph 1.3; ER-AB-331, paragraph 4.1.14).**

Exceptions to NUREG-1801, Element 2:

NUREG-1801 indicates that water chemistry control is in accordance with BWRVIP-29 for water chemistry in BWRs. BWRVIP-29 references the 1996 revision of EPRI TR-103515, "BWR Water Chemistry Guidelines." The Oyster Creek water chemistry programs are based on BWRVIP-130, which is the 2004 revision of "BWR Water Chemistry Guidelines" For justification of exceptions to the water chemistry program see the Water Chemistry aging management program, PBD-AMP-B.1.2.

Enhancements to NUREG-1801, Element 2:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 2, Preventive Actions with the exception discussed above.

3.2 Parameters Monitored or Inspected

NUREG-1801:

a) *The program monitors the effects of SCC/IGSCC on the intended function of the component by detection and sizing of cracks by ISI in accordance with the guidelines of approved BWRVIP-49 or BWRVIP-27 and the requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, Table IWB 2500-1 (2001 edition[1] including the 2002 and 2003 Addenda).*

b) *An applicant may use the guidelines of BWRVIP-62 for inspection relief for vessel internal components with hydrogen water chemistry, provided that such relief is submitted under the provisions of 10 CFR 50.55a and approved by the staff.*

Oyster Creek:

a) Oyster Creek Reactor Internals Program Plan monitors the effects of SCC and IGSCC by the detection and sizing of cracks using the inservice inspections (ISIS) that are performed in accordance with the recommendations of BWRVIP-27-A and BWRVIP-49-A, as well as the requirements of Section XI, Table 2500-1 of the ASME Code. **(Reference: OC-5, inspection plans 7.7, 7.15)**

As specified in BWRVIP-27-A the SLBC penetration is inspected in accordance with the requirements ASME Section XI, IWB Table 2500-1. During each refueling outage a VT-2 inspection of the penetration is performed during the RCPB leak test. **(Reference: OC-5, inspection plan 7.7)**

[1] An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code.

The Oyster Creek penetrations have a stainless steel safe end extension welded to an Alloy 600 housing. This configuration contains a dissimilar metal weld, and based on the line size, ASME Section XI requires a surface examination in addition to the VT-2. Also, due to the potential for boron to leak through any flaws, a volumetric examination of the housing-to-safe end extension weld is performed. The reinspection strategy for the liquid poison structure consists of performing the VT-2 and surface exam per the ASME Section XI program. UT examinations must be repeated once per 10-year interval in conjunction with continued VT-2 leakage inspections each outage. **[(Reference: OC-5, inspection plan 7.7)**

As specified in BWRVIP-49-A the instrumentation penetrations are inspected in accordance with the requirements ASME Section XI, IWB-2500, Table 2500-1. During each refueling outage a VT-2 inspection of the penetration weld is performed during the RCPB leak test each refueling outage. **(Reference: OC-5, inspection plan 7.15)**

NUREG-1801 specifies the 2001 ASME Section XI B&PV Code, 2002 and 2003 Addenda for Subsections IWB, IWC, and IWD. The current Oyster Creek ISI Program Plan for the fourth ten-year inspection interval effective from October 15, 2002 through October 14, 2012, approved per 10CFR50.55a, is based on the 1995 ASME Section XI B&PV Code, 1996 addenda. The next 120-month inspection interval for Oyster Creek will incorporate the requirements specified in the version of the ASME Code incorporated into 10 CFR 50.55a 12 months before the start of the inspection interval. (See the program description PBD-AMP-B.1.1- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program).
(Reference: OC-1, paragraph 1.1)

b) While Oyster Creek employs Hydrogen Water Chemistry (HWC) as a mitigation strategy, no inspection relief requests based on the guidance in BWRVIP-62 have been made or are planned.

<u>Exceptions to NUREG-1801, Element 3:</u>

NUREG-1801 program XI.M8 references ASME Section XI, Table IWB 2500-1 (2001 edition, including the 2002 and 2003 Addenda). Oyster Creek ISI program is based on the 1995 (including 1996 Addenda) version of ASME Section XI. For justification of exceptions to the ISI program see the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program, B.1.1.

Enhancements to NUREG-1801, Element 3:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 3, Parameters Monitored or Inspected with the exception described above.

3.3 Detection of Aging Effects

NUREG-1801:

a) *The evaluation guidelines of BWRVIP-49 and BWRVIP-27 recommend that the inspection requirements currently in ASME Section XI continue to be followed. The extent and schedule of the inspection and test techniques prescribed by the ASME Section XI program are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of the component. Inspection can reveal cracking and leakage of coolant.*

b) *The nondestructive examination (NDE) techniques appropriate for inspection of BWR vessel internals including the uncertainties inherent in delivering and executing NDE techniques in a BWR, are included in BWRVIP-03.*

c) *Instrument penetrations and SLC system nozzles or housings are inspected in accordance with the requirements of ASME Section XI, Subsection IWB. Components are examined and tested as specified in Table IWB-2500-1, examination categories B-E for pressure-retaining partial penetration welds in vessel penetrations, B-D for full penetration nozzle-to-vessel welds, B-F for pressure-retaining dissimilar metal nozzle-to-safe end welds, or B-J for similar metal nozzle-to-safe end welds. In addition, these components are part of examination category B-P for pressure-retaining boundary. Further details for examination are described in Chapter XI.M1, "ASME Section XI, Inservice Inspection, Subsections IWB, IWC, and IWD," of this report.*

Oyster Creek:

a) Oyster Creek Reactor Internals Program Plan inspections are performed consistent with the recommendations of BWRVIP-27-A and BWRVIP-49-A, as well as the requirements of Section XI of the ASME Code, IBW Table 2500-1, as a category B-F component. The examination extent and schedule prescribed in ASME Section XI are utilized to ensure structural integrity is maintained and aging affects of the SBLC and instrument penetrations are discovered and managed before the loss of intended function. **(Reference: OC-5, inspection plans 7.7 & 7.15, OC-1 Table 2.2-7).**

b) The non-destructive examination techniques recommendations used in following BWRVIP-27-A and BWRVIP-49-A at Oyster Creek are included in BWRVIP-03. The requirement for applicable NDE examination techniques to comply with BWRVIP-03 is established in Oyster Creek governing procedures for reactor internals inspections. **(Reference: ER-AA-331, paragraph 4.1.7)**

c) The SLBC and instrument penetrations are inspected in accordance with the requirements ASME Section XI, Table IWB-2500-1, as a category B-F component. During each refueling outage a VT-2 inspection of the penetration weld is performed during the RCPB leak test. These components also qualified as category B-P in IWB Table 2500-1. During each refueling outage a VT-2 inspection of these penetrations is performed during the RCPB leak test . **(Reference: OC-5, inspection programs 7.7 & 7.15; OC-1, Table 2.2.-7)**

Additionally, the Oyster Creek SBLC and instrument penetrations have a stainless steel safe end extension welded to an Alloy 600 housing. This configuration contains a dissimilar metal weld, and based on the line size, ASME Section XI requires a surface examination in addition to the VT-2. Also, due to the potential for boron to leak through any flaws, a volumetric examination of the housing-to-safe end extension weld is performed. The reinspection strategy for the liquid poison structure consists of performing the VT-2 and surface exam per the ASME Section XI program. UT examinations are repeated once per 10-year interval in conjunction with continued VT-2 leakage inspections each outage. **(Reference: OC-5, inspection plans 7.7 & 7.15)**

Exceptions to NUREG-1801, Element 4:

None.

Enhancements to NUREG-1801, Element 4:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 4, Detection of Aging Effects.

3.4 Monitoring and Trending

NUREG-1801:

a) *Inspections scheduled in accordance with IWB-2400 and approved BWRVIP-49 or BWRVIP-27 provide timely detection of cracks.*

b) *The scope of examination and reinspection must be expanded beyond the baseline inspection if flaws are detected.*

Oyster Creek:

a) The inspections to be performed at each refuel outage are determined by review of BWRVIP–27-A, BWRVIP-49-A, and ASME Section XI, IWB-2400 as well as past operating experience to provide for timely detection of cracks. The reinspection strategy for the liquid poison structure consists of performing the VT-2 and surface exam per the ASME Section XI program. UT examinations are repeated once per 10-year interval in conjunction with continued VT-2 leakage inspections each outage. As specified in BWRVIP-49-A the instrumentation penetrations are inspected in accordance with the requirements ASME Section XI, Table IWB-2500-1. During each refueling outage a VT-2 inspection of the penetration weld is performed during the RCPB leak test. **(Reference: OC-1, Table 2.2-24; OC-5, inspection plan 7.7 & 7.15)**

b) If flaws are detected the scope of examination and reinspection is expanded according the requirements of ASME Section XI. The initial expansion of examinations shall comply with the requirements of IWB-2430(a) or alternatives approved by the NRC. If the examinations reveal additional indications exceeding the standards of IWB-3000, then a second expansion of scope is required during the outage. This second expansion shall comply with the requirements of IWB-2430(b) or alternatives approved by the NRC.
(Reference: ER-AA-330-002, paragraph 4.12 & 4.13)

Exceptions to NUREG-1801, Element 5:

None.

Enhancements to NUREG-1801, Element 5:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 5, Monitoring and Trending.

3.5 Acceptance Criteria

NUREG-1801:

a) *Any indication detected is evaluated in accordance with ASME Section XI or other acceptable flaw evaluation criteria, such as the staff-approved BWRVIP-49 or BWRVIP-27 guidelines.*

b) *Applicable and approved BWRVIP-14, BWRVIP-59, and BWRVIP-60 documents provide guidelines for evaluation of crack growth in stainless steels (SSs), nickel alloys, and low-alloy steels, respectively.*

Oyster Creek:

a) Evaluation of indications is conducted in accordance with ASME XI, consistent with BWRVIP–27-A and BWRVIP–49-A . For the SBLC penetration, evaluation guidelines are provided in ASME Section XI for the volumetric and surface examinations. IWB-3514 provides crack length and depth acceptance standards. As described in BWRVIP-49-A, evaluation guidelines for the penetration, safe end or extension do not apply, as cracking is not detected until there is a leak in need of correction. Section IWB-3522 describes the possible paths that must be followed to correct the condition. If the crack exceeds the requirements of this standard, the flaw may be further evaluated by analysis per IWB-3600, or a repair can be made per IWB-4000. **(Reference: OC-5, inspection plan 7.7; ER-AA-330-002, paragraphs 4.13 & 4.15)**

b) Flaw evaluations for the SBLC and instrumentation penetrations, if needed, would include the guidance of BWRVIP14, BWRVIP-59, and BWRVIP-60 as applicable. **(Reference: ER-AB-331-1001, paragraph 3.1.3; and OC-5,**

paragraph 1.6).

Exceptions to NUREG-1801, Element 6:

None.

Enhancements to NUREG-1801, Element 6:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 6, Acceptance Criteria.

3.6 Corrective Actions

NUREG-1801:

a) *Repair and replacement procedures in staff-approved BWRVIP-57 and BWRVIP-53 are equivalent to those required in the ASME Section XI. Guidelines for repair design criteria are provided in BWRVIP-57 for instrumentation penetrations and BWRVIP-53 for standby liquid control line.*

b) *As discussed in the appendix to this report, the staff finds that licensee implementation of the guidelines in BWRVIP-49, as modified, will provide an acceptable level of quality for inspection and flaw evaluation of the safety-related components addressed in accordance with 10 CFR Part 50, Appendix B, corrective actions.*

Oyster Creek:

a) Repair and replacement are not described in BWRVIP-27-A, BWRVIP-49-A but in BWRVIP-53-A and BWRVIP-57-A. The repair and replacement procedures in staff-approved BWRVIP-57 and BWRVIP-53 are equivalent to those required in the ASME Section XI. Guidelines for repair design criteria are provided in BWRVIP-57 for instrumentation penetrations and BWRVIP-53 for standby liquid control line. Repairs for the SBLC or instrumentation penetrations have not been required at Oyster Creek. However, if required, repairs and replacement for the instrument and SBLC penetrations also follow the requirements of the above guidelines. **(References: OC-5, paragraph 1.5 & 1.7; ER-AA-331-1001, paragraph 3.1.2)**

b) Inspection and flaw evaluations of the SBLC and instrument penetrations are implemented in accordance with the requirements of BWRVIP-27-A and BWRVIP-49-A respectively. This provides an acceptable level of quality for the inspections and flaw evaluations of the instrument and SBLC penetrations. Evaluations are performed for test or inspection results that do not satisfy established criteria and an issue report (IR) is initiated within the corrective action program to document the concern in accordance with plant administrative procedures. The 10 *CFR Part 50, Appendix B* corrective action program ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence. **(References: OC-5, paragraph 1.5; ER-AA-330-002, paragraph 4.12)**

Exceptions to NUREG-1801, Element 7:

None.

Enhancements to NUREG-1801, Element 7:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 7, Corrective Actions.

3.7 Confirmation Process

NUREG-1801:

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. As discussed in the appendix to this report, the staff finds that licensee implementation of the guidelines in BWRVIP-49, as modified, will provide an acceptable level of quality for inspection and flaw evaluation of the safety-related components addressed in accordance with the 10 CFR Part 50, Appendix B, confirmation process and administrative controls.

Oyster Creek:

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

Inspection and flaw evaluations of the SBLC and instrument penetrations implement the requirements of BWRVIP-27-A and BWRVIP-49-A respectively. Evaluations are performed for test or inspection results that do not satisfy established criteria and a condition report is initiated to document the concern in accordance with plant administrative procedures. The 10 *CFR Part 50, Appendix B* corrective action program ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence.

<u>Exceptions to NUREG-1801, Element 8:</u>

None.

<u>Enhancements to NUREG-1801, Element 8:</u>

None.

<u>Comparison and Evaluation Conclusion:</u>

This element is consistent with NUREG-1801, Element 8, Confirmation Process.

3.8 Administrative Controls

<u>NUREG-1801:</u>

See Item 8, above.

<u>Oyster Creek:</u>

See Item 8, above.

<u>Exceptions to NUREG-1801, Element 9:</u>

None.

<u>Enhancements to NUREG-1801, Element 9</u>

None.

<u>Comparison and Evaluation Conclusion:</u>

This element is consistent with NUREG-1801, Element 9, Administrative Controls.

3.9 Operating Experience

NUREG-1801:

Cracking due to SCC or IGSCC has occurred in BWR components made of austenitic stainless steels and nickel alloys. The program guidelines are based on an evaluation of available information, including BWR inspection data and information about the elements that cause IGSCC, to determine which locations may be susceptible to cracking. Implementation of the program provides reasonable assurance that cracking will be adequately managed so the intended functions of the instrument penetrations and SLC system nozzles or housings will be maintained consistent with the current licensing basis CLB) for the period of extended operation.

Oyster Creek:

Review of industry operating experience has confirmed that cracking due to SCC or IGSCC has occurred in BWR components made of austenitic stainless steel and nickel alloys. (GL88-01, BWRVIP-49-A, BWRVIP-27-A). BWRVIP-27-A and BWRVIP-49-A have been developed to evaluate materials, environments, and mechanisms that can lead to a loss of intended function of the standby liquid control (SBLC) and vessel instrument penetrations. These evaluations determined these penetrations have the potential to develop cracking due the effects of SCC and IGSCC. BWRVIP-29-A and BWRVIP-49-A provide guidelines for performing inspections and flaw evaluations to manage the effects of cracking. Implementation of the recommendations from these BWRVIP guidelines provides reasonable assurance that cracking will be adequately managed so that the intended functions of the SLC and instrument penetrations will be maintained consistent with the current licensing basis for the period of extended operation.

A review of Oyster Creek operating experience shows that cracking in these penetrations has not occurred. This operating experience at Oyster Creek provides evidence that the BWR Penetration program in conjunction with the Water Chemistry program is effective in managing cracking so that the intended function of the vessel SBLC and instrument penetrations will be maintained consistent with the current licensing basis for the period of extended operation.

Operating experience, both internal and external, is used in two ways at Oyster Creek to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Oyster Creek. The first way in which operating experience is used is through the Oyster Creek Operating Experience process. The Operating Experience process screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The second way is through the process for managing programs. This process requires the review of program related operating experience by the program owner.

Both of these processes review operating experience from both external and internal (also referred to as in-house) sources. External operating experience may include such things as INPO documents (e.g., SOERs, SERs, SENs, etc.), NRC documents (e.g., GLs, LERs, INs, etc.), Westinghouse documents (e.g., TBs, etc.), General Electric documents (e.g., RICSILs, SILs, TILs, etc.), and other documents (e.g., 10CFR Part 21 Reports, NERs, etc.). Internal operating experience may include such things as event investigations, trending reports, and lessons learned from in-house events as captured in program notebooks, self-assessments, and in the 10 CFR Part 50, Appendix B corrective action process.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that demonstrates that cracking due to SCC and IGGSCC is being adequately managed for the SBLC and vessel penetrations. The following examples of operating experience provide objective evidence that the BWR Penetrations aging management program is effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation.

The inspection requirements for reactor vessel penetration inspections are implemented through the station Reactor Internals Program Plan, which incorporate the requirements of Section XI of the ASME Code as well as those from BWRVIP-27-A and BWRVIP-49-A for the Standby Liquid Control and vessel instrument penetration. A visual (VT-2) Inspection of the standby Liquid Control and instrument penetrations is performed in accordance with the ASME Section XI ISI program each refueling outage. To date Oyster Creek has not found indication of leakage from these penetrations.

With the issuance of BWRVIP-27-A, a dye penetrant test (PT) is required every other outage for the SBLC nozzle and safe end. The N12 nozzle was PT examined during the 2002 (19R) outage in accordance with NRC and INPO recommendations. No indications of cracking were found. Ultrasonic testing (UT) of the Liquid Poison Nozzle N12 and safe end is scheduled for the 2006 (R21) outage.

The Oyster Creek inspection and testing methodologies have detected cracking aging effects in other vessel and internals components. The following examples provide evidence of timely detection and effective corrective action.

<u>Top Guide</u>
Cracking of the Top Guide was first detected in 1994 (MNCR 94-0165). Subsequent inspections in 1996, 2000 and 2004 have tracked cracking growth (MNCR 96-0087, MNCR 96-0131, CAP-O2000-1612, CAP-O2004-3747). Flaw evaluations have been performed to ensure the top guide is acceptable for continued operation and to schedule future inspections. Monitoring of the Top Guide cracking remains a critical Reactor Internals issue. This example provides objective evidence that the Reactor Internals Program is effective in detecting cracking and that corrective actions are taken to manage cracking before a loss of intended function occurs.

1) <u>Shroud repairs:</u>
In response to industry experience (e.g. SIL 572, IEN 93-79, IEN 94-42) inspection of the shroud was conducted in 1994 (R15) and found significant cracking in the core shroud circumferential weld H4. The inspection was conducted in accordance with the recommendations of the BWRVIP-76. During the same outage a shroud repair system was installed addressing all susceptible shroud circumferential welds. The repair consisted of 10 tie rods anchored to the top and bottom of the Shroud. Subsequent inspections were conducted in 1996 (R16) on the vertical welds. Some crack indications in V-9 were found and were dispositioned as acceptable (MNCR 96-0084). In 1998 (R17) additional vertical welds were inspected using both enhanced visual and UT methodologies. Again minor indications were dispositioned as acceptable (MNCR CAP O1998-1460). Inspections of vertical welds in 2000 (R18) did not find additional crack indications.

2) In the 2002 outage (R19) the inspection recommendations of BWRVIP-76 were used to establish inspection schedule for the core shroud. Since all accessible welds had been inspected by the end of 2002 in accordance with BWRVIP-76, a ten-year inspection program was established. No welds inspections

were required in 2002. The V-9 vertical weld will be reinspected in 2006 (R21).

The shroud repair and inspection program provides objective evidence that aging management program for the Reactor Internals and BWR penetrations will detect cracking and take corrective action prior to the loss of intended function. This example also demonstrates industry operating experience is considered when establishing acceptance criteria and other effective elements of the aging management programs that manage the reactor vessel and internals.

There is sufficient confidence that the implementation of the BWR Penetrations Aging Management Program through the Reactor Internals Program will effectively detect and manage the effects of cracking from SCC and IGSCC. Appropriate guidance for reevaluation, repair or replacement is provided for locations where the calculations indicate an area will reach minimum allowable thickness before the next inspection. Periodic self-assessments of the Reactor Internals program are performed to identify the areas that need improvement to maintain the quality performance of the program.

3.10 Conclusion

The Oyster Creek BWR Penetrations program is credited for managing cracking due to stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSCC) for the components and environments listed in Table 5.2. The Oyster Creek BWR Penetrations program's elements have been evaluated against NUREG-1801 in Section 3.0. Program exceptions have been identified in Section 2.3. Program enhancements have been identified in Section 2.4. The implementing documents for this aging management program are listed in Table 5.1. The relevant operating experience has been reviewed and a demonstration of program effectiveness is provided in Section 3.10.

Based on the above, the continued implementation of the Oyster Creek BWR Penetrations aging management program provides reasonable assurance that cracking due to stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSCC) will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained during the period of extended operation.

The BWR Penetrations aging management program provides reasonable assurance that the effects of cracking are adequately managed so that the intended functions of components within the scope of license renewal are maintained during the period of extended operation.

4.0 REFERENCES

4.1 Generic to Aging Management Programs

4.1.1 10 CFR 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*

4.1.2 10 CFR 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*

4.1.3 NUREG-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants*, Revision 1, dated September 2005

4.1.4 NUREG-1801, *Generic Aging Lessons Learned (GALL) Report*, Revision 1, dated September 2005

4.2 Industry Standards

4.2.1 BWRVIP-27-A, *BWR Standby Liquid Control System/Core Plate ΔP Inspection and Flaw Evaluation Guideline*

4.2.2 BWRVIP-49-A, *BWR Instrument Penetration Inspection and Flaw Evaluation Guideline*

4.2.3 BWRVIP-130, *BWR Vessel and Internals Project BWR Water Chemistry Guidelines*

4.2.4 BWRVIP-53-A, *BWR Vessel and Internals Project Standby Liquid Control Line Repair Design Criteria*

4.2.5 BWRVIP-57-A, *BWR Vessel and Internals Project Instrument Penetration Repair Design Criteria*

4.3 Oyster Creek Program References

4.3.1 Technical Data Report, TDR 1211, *Oyster Creek Reactor Internals Technical Basis Document*, Revision 2, November 2003

4.1.2 *Oyster Creek Reactor Internals Program*, OC-5, September 2005

5.0 TABLES

5.1 Aging Management Program Implementing Documents

Procedure Number	Procedure Title	Commitment No.	Status
OC-1	Oyster Creek Generating Station ISI Program Plan	00330592.08.06	ACC/ASG
OC-5	Reactor Internals Program Plan	00330592.08.03	ACC/ASG
ER-AB-331	BWR RX Internals Management Program Activities	00330592.08.01	ACC/ASG
ER-AA-331-1001	Reactor Internals Program	00330592.08.02	ACC/ASG
ER-AA-330-002	In-service Inspection of Section XI Welds and Components	00330592.08.04	ACC/ASG
ER-AA-330-009	ASME Section XI Repair/Replacement Program	00330592.08.05	ACC/ASG
CY-AB-120-100	Reactor Water Chemistry	00330592.08.07	ACC/ASG

5.2 Aging Management Review Results

SSC Name	Structure and/or Component	Material	Environment	Aging Effect
Reactor Pressure Vessel	Penetrations (Instrumentation including safe ends)	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Penetrations (Standby Liquid Control)	Nickel Alloy	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Penetrations (Instrumentation including safe ends)	Nickel Alloy	Treated Water (Internal)	Cracking Initiation and Growth

6.0 ATTACHMENTS

6.1 LRA Appendix A

6.2 LRA Appendix B

PROGRAM BASIS DOCUMENT

PBD-AMP-B.1.19

Revision 0

FIRE PROTECTION

GALL PROGRAM XI.M26 – FIRE PROTECTION

Prepared By:

Reviewed By:

Program Owner Review:

Technical Lead Approval:

Revision History:

Revision	*Prepared by:*	*Reviewed by:*	*Program Owner:*	*Approved by:*
0	*S. C. Getz*	*K. Muggleston*	*T. P. Trettel*	*F. W. Polaski*
Date				

Summary of Revisions:

Rev. Number	Reason for the Revision(s)
0	Initial Issue

TABLE OF CONTENTS

1.0 PURPOSE AND METHODOLOGY

1.1 Purpose

The purpose of this Program Basis Document is to document and evaluate those activities of the Oyster Creek Fire Protection aging management program that are credited for managing the loss of material, cracking, and change in material properties in fire barrier penetrations seals, fire wraps, fire barrier walls, ceilings and floors, fire doors and dampers, and piping and components in the diesel-driven fire pumps, and halon and CO2 fire suppression systems as part of Oyster Creek License Renewal to meet the requirements of the License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

This includes the following:

- The identification of the scope of the program;
- The evaluation of program elements against NUREG-1801;
- The review of Operating Experience to demonstrate program effectiveness;
- The identification of required program enhancements;
- The identification of Oyster Creek documents required to implement the program.

1.2 Methodology

The nuclear power plant License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," describes the License Renewal process and provides requirements for the contents of License Renewal Applications. 10 CFR 54.21(a)(3) states:

"For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the Current Licensing Basis (CLB) for the period of extended operation."

The NRC and the industry identified 10 program elements that are useful in describing an aging management program and then demonstrating its effectiveness. These program elements are described in Appendix A.1, Section A.1.2.3 of the Standard Review Plan. NUREG-1801 uses these program elements in Section XI to describe acceptable aging management programs.

The Program Basis Document provides a comparison of the credited Oyster Creek program with the elements of the corresponding NUREG-1801 Chapter XI program XI.M26, Fire Protection. Project Level Instruction PLI-8 "Program Basis Documents" prescribes the methodology for evaluating Aging Management Programs. An evaluation of Oyster Creek's aging management program criteria or activities to those of the NUREG-1801 program elements is performed and a conclusion is reached concerning consistency for each individual program element. A demonstration of overall program effectiveness is made after all program elements are evaluated. Required program enhancements are documented. An overall determination is made as to consistency with the program description in NUREG-1801.

2.0 PROGRAM DESCRIPTION

2.1 Program Description

<u>NUREG-1801:</u>

(a) For operating plants, the fire protection aging management program (AMP) includes a fire barrier inspection program and a diesel-driven fire pump inspection program. The fire barrier inspection program requires periodic visual inspection of fire barrier penetration seals, fire barrier walls, ceilings, and floors, and periodic visual inspection and functional tests of fire rated doors to ensure that their operability is maintained. The diesel-driven fire pump inspection program requires that the pump be periodically tested to ensure that the fuel supply line can perform the intended function.

(b) The AMP also includes periodic inspection and testing of the halon/carbon dioxide (CO_2) fire suppression system.

<u>Oyster Creek:</u>

This AMP is for the following non-water based fire protection system equipment:

- Fire barrier penetration seals and fire wraps (cable tray/conduit fire wrap envelope system)
- Fire barrier walls, ceilings, and floors
- Fire doors and dampers
- Diesel driven fire pumps (Fuel Oil Chemistry is evaluated in

XI.M30, "Fuel Oil Chemistry")

- Halon/carbon dioxide fire suppression systems

The Oyster Creek Fire Protection aging management program includes provisions for post fire safe shutdown by identifying key program elements and organizational positions, and the responsibilities assigned to those positions. The Oyster Creek Fire Protection aging management program defines and establishes goals, functions, controls, responsibilities, and authority of the Plant Fire Protection Organization and interfacing departments for implementation of the fire protection program. **(Reference: CC-AA-211 Section 1.1; 101.2 Section 1.1)**

a) This AMP is a Condition Monitoring program that utilizes fire barrier visual inspections to identify aging effects prior to loss of intended function. These inspections examine for signs of degradation such as damage, holes, cracks, loss of material, etc. The program also includes periodic surveillance tests of the diesel driven fire pumps fuel oil supply line.

b) For fire barrier penetration seals and fire wraps, the Oyster Creek Fire Protection aging management program for periodic visual inspection is implemented by station procedures that provide acceptance criteria and lists of individual barriers.

c) For fire barrier walls, ceilings and floors in structures within the scope of license renewal, enhancements to the Oyster Creek Fire Protection aging management program provide for visual inspection for the aging effects of cracking, spalling and loss of material.

d) For fire doors and dampers, the Oyster Creek Fire Protection aging management program directs periodic inspection and functional testing of fire doors in the scope of license renewal. This program manages aging of fire doors through periodic visual inspections, operability checks, and functional tests ensuring fire door operability is maintained. The program directs periodic visual inspections, preventive maintenance, and functional tests of fire rated doors performed under preventive maintenance tasks at specified frequencies to ensure that aging effects do not adversely affect operability.

e) Enhancements to the requirements for inspection of fire doors in the scope of license renewal include specific direction for verification of door surface integrity and for clearances.

f) The Oyster Creek Fire Protection aging management program for periodic visual inspection of fire dampers is implemented by station procedures that provide acceptance criteria and list individual fire dampers.

g) For diesel driven fire pumps, the Oyster Creek Fire Protection aging management program inspection activities manage loss of materials aging effects by the performance of periodic surveillance tests of the diesel driven fire pumps fuel oil systems. The tests demonstrate that the fuel oil systems can deliver sufficient fuel to the engines for continued operation.

h) Enhancements to the inspections will provide specific guidance for examining the fire pump diesel fuel supply systems for external surface corrosion during pump tests.

i) For the Halon and low-pressure carbon dioxide fire suppression systems, the Oyster Creek Fire Protection aging management program provides for managing the effects of aging of the external piping and component surfaces. The program also provides for periodic system operability testing. While performing the operability testing, visual aging degradation inspections are performed. Existing operability testing requirements are implemented through station procedures at an established frequency.

j) Enhancements to the halon and low-pressure carbon dioxide fire suppression system inspection procedures include adding specific inspection steps for detecting piping and component external surface degradation.

2.2 Overall NUREG-1801 Consistency

The Oyster Creek Fire Protection program is an existing program that is consistent with NUREG-1801 aging management program XI.M26, Fire Protection with the exception and enhancements identified in paragraphs 2.3 and 2.4 below.

2.3 Summary of Exceptions to NUREG-1801

NUREG-1801 recommends visual inspection and functional testing of the halon and CO2 fire suppression systems at least once every six months. Procedurally, the Oyster Creek halon and low-pressure carbon dioxide fire suppression systems currently undergo in-depth operational testing and inspections every 18 months. Additionally, the halon fire suppression system undergoes an inspection of the system charge (storage tank weight/level and pressure) every 6 months, and the low-pressure carbon dioxide fire suppression system undergoes a weekly tank check and monthly valve position alignment verification. These test frequencies are considered sufficient to ensure system availability and operability based on the station's operating history that shows no aging related events that have adversely affected the systems' operation. These test procedures will be enhanced to include visual inspections of the component external surfaces. Test and inspection frequency adequacy will be evaluated as part of the corrective action process based on actual test and inspection results.

2.4 Summary of Enhancements to NUREG-1801

The Oyster Creek Fire Protection aging management program is found to be adequate to support the extended period of operation with the following enhancements:

The program will provide additional inspection guidance to identify degradation of fire barrier walls, ceilings, and floors such as spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates.

The program will be enhanced to require that surface integrity and clearances of fire doors in the scope of license renewal be routinely inspected every two years. The program currently requires these doors be intact and verified functional, with fire doors identified as secondary containment receiving routine clearance checks. Other fire doors in the scope of license renewal currently receive clearance checks if they have been damaged or undergone maintenance such that the clearances may have been physically altered. The enhancement of requiring routine surface integrity and clearance checks for all fire doors in the scope of license renewal will provide assurance that degradation of fire doors prior to loss of intended function will be detected.

The program will provide specific guidance for examining external surfaces of the fire pump diesel fuel supply systems for external surface corrosion during pump tests.

The program will provide for inspection for corrosion and mechanical damage on external surfaces of piping and components for the Oyster Creek halon and low-pressure carbon dioxide fire suppression systems.

Enhancements will be implemented prior to the period of extended operation.

3.0 EVALUATIONS AND TECHNICAL BASIS

Note

This section is organized by quoting the relevant NUREG-1801 Chapter XI program element (September 2005 version) followed by the related Oyster Creek program attributes and a conclusion of the comparison. Where applicable, the NUREG-1801 program element was separated into logical sub-elements and addressed accordingly.

Implementing procedure references are included in **( )** for information purposes. This information from the source procedure has been either directly extracted from the procedure or summarized for inclusion into this PBD.

3.0 Scope of Program

NUREG-1801:

a) *For operating plants, the AMP manages the aging effects on the intended function of the penetration seals, fire barrier walls, ceilings, and floors, and all fire rated doors (automatic or manual) that perform a fire barrier function.*

b) *It also manages the aging effects on the intended function of the fuel supply line.*

c) *The AMP also includes management of the aging effects on the intended function of the halon/CO_2 fire suppression system.*

Oyster Creek:

a) This AMP addresses the aging effects on the intended functions of the non-water based fire protection system through required periodic inspection, surveillance, and maintenance activities. Included in the program are:
   - fire barrier penetration seals and fire wraps
   - fire barrier walls, ceilings, and floors in specified structures
   - fire doors and dampers
   - diesel driven fire pumps
   - Halon/carbon dioxide fire suppression systems

b) Fire Barrier Penetration Seals and Fire Wraps

c) The Oyster Creek Fire Protection aging management program for periodic visual inspection of fire barrier penetration seals and fire wraps is implemented by station procedures. The program's penetration inspection procedure provides inspection instructions and acceptance criteria for fire area/zone barrier penetration seals. The program's fire wrap inspection procedure provides inspection instructions and acceptance criteria to verify the ability of envelope system fire barriers. **(Reference: 645.6.017 Section 6.2; Reference: 645.6.028 Sections 6.0, 7.0, 8.0)**

d) Fire Barrier Walls, Ceilings, and Floors

e) The Oyster Creek Fire Protection aging management program manages the aging effects on the intended function of fire barrier walls, ceilings, and floors that perform a fire barrier function. The program directs inspection of walls, ceilings, and floors that perform a fire barrier function in the scope of license renewal. **(Reference: 645.6.017 Section 6.5)**

f) Fire Doors and Dampers

g) The Oyster Creek Fire Protection aging management program manages the aging effects of all fire dampers and automatic and manual fire doors in the scope of license renewal. The doors in the scope of license renewal are the Category I fire doors and the secondary containment doors that are also considered backup or alternate fire doors. Activities controlled by site procedures list all Category 1 fire doors and direct visual inspections and required functional tests to ensure fire barrier integrity. Recurring task work orders direct inspection of the secondary containment doors that are also alternate fire barrier doors. **(Reference: 101.2 Attachment 101.2-3 Section 5.0, Attachment 101.2-4 Table 6; R0802114, R0802166, R0802129, 645.6.026 Section 1.1)**

h) Diesel Driven Fire Pumps

i) The Oyster Creek Fire Protection aging management program inspection activities manage loss of materials aging effects by the performance of periodic surveillance tests of the diesel driven fire pumps fuel oil systems. The tests demonstrate that the fuel oil systems can deliver sufficient fuel to the engines for continued operation.

j) The program provides instructions for full functional tests of the fire pumps and associated diesel engine driver. **(Reference: 645.6.012 Section 1.0)**

k) Halon/Carbon Dioxide Fire Suppression Systems

l) The Fire Protection AMP will be used for managing the effects of station environment external surface degradation of the halon and low-pressure carbon dioxide fire suppression system piping and components.

m) Periodic system operability tests and enhanced visual inspections provide for managing external surface loss of material and confirming the functionality of the station halon and low-pressure carbon dioxide fire suppression systems. **(Reference: 645.6.013 Section 1.0; 645.6.016 Section 1.0)**

The Oyster Creek Fire Protection aging management program manages the aging effects of loss of material, cracking, and change in material properties for the systems, components, and environments listed in Table 5.2. The implementing documents for this aging management program are listed in Table 5.1 and are described throughout the individual program element discussions. The commitment numbers under which these implementing documents are being revised are contained within the listings in Table 5.1.

<u>Exceptions to NUREG-1801, Element 1:</u>

None.

<u>Enhancements to NUREG-1801, Element 1:</u>

None.

<u>Comparison and Evaluation Conclusion:</u>

This element is consistent with NUREG-1801, Element 1, Scope of Program.

3.1 Preventive Actions

<u>NUREG-1801:</u>

a) *For operating plants, the fire hazard analysis assesses the fire potential and fire hazard in all plant areas.*
b) *It also specifies measures for fire prevention, fire detection, fire suppression, and fire containment and alternative shutdown capability for each fire area containing structures, systems, and components important to safety.*

<u>Oyster Creek:</u>

a) The Oyster Creek fire hazards analysis is 990-1746, "Oyster Creek Fire Hazards Analysis Report." The fire hazards analysis assesses the fire potential and fire hazard in all plant areas.
b) The Oyster Creek Fire Hazards Analysis Report specifies

measures for fire prevention, fire detection, fire suppression, and fire containment and alternative shutdown capability for each fire area containing structures, systems, and components important to safety. The Oyster Creek Fire Protection aging management program does not prevent or mitigate degradation due to aging effects but is a condition monitoring program that utilizes inspections and operational checks to identify aging effects prior to loss of intended function.

Exceptions to NUREG-1801, Element 2:

None.

Enhancements to NUREG-1801, Element 2:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 2, Preventive Actions.

3.2 Parameters Monitored or Inspected

NUREG-1801:

(a) Visual inspection of approximately 10% of each type of penetration seal is performed during walkdowns carried out at least once every refueling outage.

(b) These inspections examine any sign of degradation such as cracking, seal separation from walls and components, separation of layers of material, seals rupture and puncture of seals which are directly caused by increased hardness, and shrinkage of seal material due to weathering.

(c) Visual inspection of the fire barrier walls, ceilings, and floors examines any sign of degradation such as cracking, spalling, and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates.

(d) Fire-rated doors are visually inspected on a plant specific interval to verify the integrity of door surfaces and for clearances.

(e) The plant specific inspection intervals are to be determined by engineering evaluation to detect degradation of the fire doors prior to the loss of intended function.

(f) The diesel-driven fire pump is under observation during performance tests such as flow and discharge tests, sequential starting capability tests, and controller function tests for detection of any degradation of the fuel supply line.

(g) The periodic visual inspection and function test is performed at least once every six months to examine the signs of degradation of the halon/CO2 fire suppression system. Material conditions that may affect the performance of the system, such as corrosion, mechanical damage, or damage to dampers, are observed during these tests.

Oyster Creek:

a) The Oyster Creek Fire Protection aging management program requires performance of visual inspections of at least 10% of each type of penetration seal at least once per refuel cycle. **(101.2 Attachment 101.2-3 Section 5.B.1)**

b) These inspections examine for signs of degradation. Acceptance criteria ensure that aging effects will be identified prior to loss of intended function. **(645.6.017 Section 6.0)**

c) The program directs penetration seal inspection of:

d) Grouted penetration seals to verify that grout material is in place with no missing pieces or voids beyond the face of the barrier, that the grout material has not shrunk away from the penetration opening or penetrating objects, and to verify no cracks exist creating through openings in the wall;

e) Foam penetration seals for Appendix R requirements to verify no damage or missing pieces of RTV foam exist from the face of the seal, or that the RTV foam has not shrunk away from the penetration opening or penetrating objects creating gaps wider than ¼" wide and 1" deep;

f) Foam penetration seals for Non-Appendix R requirements to verify no damage or missing pieces of RTV foam exist from the face of the seal, or sides of the seal when extended beyond the barrier creating a void 2" or greater in depth, or that the RTV foam has not shrunk away from the penetration opening or penetrating objects creating gaps wider than ¼" wide and 1" deep; and

g) Concrete or metal floor plugs and metal hatch covers to verify the plug is in place within the opening to be protected, and to verify the hatch cover is closed, covering the opening to be protected.

h) The program directs fire wrap inspection of:

i) Thermo-Lag covered supports and structures to verify that no visible damage to the surface, gaps, cracks, or missing pieces exist, and that there is no water damage or wet conditions; and

j) Mecatiss firewrap to verify that the material is intact without visible damage to surface material or mat material or deterioration of caulking material, that the material is free from wet conditions or water damage, and that the outer Silco cloth barrier is free of grease, paint, or excessive dirt. **(Reference: 645.6.028 Section 7.0)**

k) Fire barrier walls, ceilings and floors are monitored using specific inspection parameters in accordance with industry codes, standards, and guidelines that ensure aging degradation is detected and corrected prior to loss of intended functions. Enhanced inspections of fire barrier walls, ceilings, and floors look for signs of degradation including but not limited to cracking, spalling, and loss of material caused by freeze-thaw, aggressive chemical attack, reaction with aggregates, and corrosion of embedded steel. The Oyster Creek Fire Protection aging management program directs inspection of walls, ceilings, and floors that perform a fire barrier function in the scope of license renewal.

l) The program will be enhanced to provide additional inspection guidance to identify degradation of fire barrier walls, ceilings, and floors such as spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates. **(Reference: 645.6.017)**

m) The Oyster Creek Fire Protection aging management program describes fire door functionality in order to verify the operability of automatic hold-open, release, closing mechanisms, and latches. These inspections of fire doors in the scope of license renewal are performed at least once per six months, or whenever a fire door has been repaired or had maintenance performed on it prior to being declared functional.

n) The program directs that doors shall be verified to be intact. The program will be enhanced to direct visual inspection of the fire doors for integrity of door surfaces, and clearance checks every two years.

o) The enhancement of requiring routine fire door surface integrity and clearance checks for all fire doors in the scope of license renewal every two years will provide assurance that fire door degradation prior to loss of intended function will be detected.

p) This inspection interval ensures timely identification and correction of degraded door conditions prior to loss of intended function. The inspection interval will be evaluated by engineering as part of the corrective action process based on inspection results.

Locked-closed doors not used for vital area access or primary/secondary containment requirements are verified closed at least once per 7 days. Doors with automatic hold-open and release mechanisms are verified free from obstructions at least once per 24 hours, and undergo a functional test at least once per 18 months. Each unlocked fire door without electrical supervision is verified closed at least once per 24 hours. **(Reference: 101.2 Attachment 101.2-3 Section 5.B.2)**

The program directs visual inspection of fire dampers by station procedures that provide acceptance criteria and list the individual fire dampers to be inspected at the appropriate frequency. The program lists the required fire damper inspection frequency of at least once per 24 months, and directs visual inspection and cleaning procedures, with subsequent test procedures to be performed if the visual examination results in a determination that the damper may be malfunctioning. Dampers are to be visually inspected to verify that the damper is not obstructed in any way that could prevent proper operation, including that the damper is free of debris and rust, is not damaged and appears structurally sound, and that links appear intact and properly oriented. Exposed portions of dampers, channels and springs are to be wiped down as much as possible. If malfunction is suspected, damper operation testing is directed by removing the link and allowing the damper to close unassisted. Thorough cleaning is directed followed by a second unassisted closing test. **(Reference: 101.2 Attachment 101.2-3 Section 5.B.1; 645.6.026 Section 6.0)**

q) Operational tests of the Oyster Creek diesel driven fire pumps are performed to record flow and discharge, starting capability, and controller function. Enhancements to the program will require a visual inspection for detecting any degradation of the fuel supply line during engine operation.

r) The Oyster Creek Fire Protection aging management program directs halon fire suppression system surveillance that verifies storage tank weight, level, and pressure once every six months. Actuation of the system (automatic and manual, including dampers) and flow is verified every 18 months. The program directs performance of functional operability testing and flow verification, including operation of associated ventilation dampers, and manual and automatic actuation. Procedural inspection enhancements will include inspection for signs of corrosion and mechanical damage. The frequency of the inspection is sufficient to ensure system availability and operability, considering station operating experience that indicates no occurrence of aging related degradation having adversely affected the system's operation. **(Reference: 645.6.013 Section 1.0; 645.6.014 Section 1.0; 101.2 Attachment 101.2-3 Section 6.B)**

The program directs low-pressure carbon dioxide fire suppression system surveillance that verifies the CO2 tank charge at least once per week. Valve alignment is verified every month. System operability (including dampers) and flow is verified every 18 months. The program directs performance of functional testing and flow verification, including operation of associated ventilation dampers, and automatic actuation. Procedural inspection enhancements will include inspection for signs of corrosion and mechanical damage. The frequency of the inspection is sufficient to ensure system availability and operability, considering station operating experience that indicates no occurrence of aging related degradation having adversely affected the system's operation. **(Reference: 645.6.016 Section 1.0, 6.17; 645.6.015 Section 1.0; 101.2 Attachment 101.2-3 Section 7.B)**

<u>Exceptions to NUREG-1801, Element 3:</u>

NUREG-1801 recommends visual inspection and functional testing of the halon and CO2 fire suppression systems at least once every six months. Procedurally, the Oyster Creek halon and low-pressure carbon dioxide fire suppression systems currently undergo operational testing and inspections every 18 months. Additionally, the halon fire suppression system undergoes an inspection of the system charge (storage tank weight/level and pressure) every 6 months, and the low-pressure carbon dioxide fire suppression system undergoes a weekly tank check and monthly valve position alignment verification. These test frequencies are considered sufficient to ensure system availability and operability based on the station's operating history that shows no aging related events that have adversely affected the systems' operation. These test procedures will be enhanced to include visual inspections of the component external surfaces. Test and inspection frequency adequacy will be evaluated as part of the corrective action process based on actual test and inspection results.

Enhancements to NUREG-1801, Element 3:

The program will be enhanced to provide additional inspection guidance to identify degradation of fire barrier walls, ceilings, and floors such as spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates.

The program will be enhanced to require that surface integrity and clearances of fire doors in the scope of license renewal be routinely inspected every two years. The program currently requires these doors be intact and verified functional, with fire doors identified as secondary containment receiving routine clearance checks. Other fire doors in the scope of license renewal currently receive clearance checks if they have been damaged or undergone maintenance such that the clearances may have been physically altered. The enhancement of requiring routine surface integrity and clearance checks for all fire doors in the scope of license renewal will provide assurance that degradation of fire doors prior to loss of intended function will be detected.

The program will be enhanced to provide specific guidance for examining external surfaces of the fire pump diesel fuel supply systems for corrosion during pump tests.

The program will be enhanced to provide for inspection for corrosion and mechanical damage on external surfaces of piping and components for the Oyster Creek halon and low-pressure carbon dioxide fire suppression systems.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 3, Parameters Monitored or Inspected with the exception and enhancements as described above.

3.3 Detection of Aging Effects

NUREG-1801:

a) Visual inspection of penetration seals detects cracking, seal separation from walls and components, and rupture and puncture of seals.

b) Visual inspection by fire protection qualified inspectors of approximately 10% of each type of seal in walkdowns is performed at least once every refueling cycle. If any sign of degradation is detected within that sample, the scope of the inspection is expanded to include additional seals.

c) Visual inspection by fire protection qualified inspectors of the fire barrier walls, ceilings, and floors, performed in walkdowns at least once every refueling outage ensures timely detection of concrete cracking, spalling, and loss of material.

d) Visual inspection by fire protection qualified inspectors detects any sign of degradation of the fire door such as wear and missing parts. Periodic visual inspection and function tests detect degradation of the fire doors before there is a loss of intended function.

e) Periodic tests performed at least once every refueling outage, such as flow and discharge tests, sequential starting capability tests, and controller function tests performed on diesel-driven fire pump ensure fuel supply line performance. The performance tests detect degradation of the fuel supply lines before the loss of the component intended function.

f) Visual inspection of the halon/CO2 fire suppression system detects any sign of added degradation, such as corrosion, mechanical damage, or damage to dampers. The periodic function test and inspection performed at least once every six months detects degradation of the halon/CO2 fire suppression system before the loss of the component intended function.

Oyster Creek:

a) The Oyster Creek Fire Protection aging management program directs visual inspection of penetration seals to detect cracking, and seal separation from walls and components. Rupture and puncture of seals is detected by inspecting for damage or missing pieces of seals. **(Reference: 645.6.017 Section 6.0)**

b) The program directs visual inspection of at least 10% of each type of penetration seal to be performed at least once per refuel cycle. Any sign of degradation detected in the sample will result in an expanded sample to ensure timely detection of degradation of the penetration seal before loss of component function. The program directs fire wraps to be visually inspected at least once per 24 months. Personnel performing inspections will be qualified and trained to perform the inspection activities. **(Reference: 101.2 Attachment 101.2-3 Section 5.B.1)**

c) The program specifies visual examinations of the fire barrier walls, ceilings, and floors at a frequency of at least once per 24 months (the Oyster Creek refueling cycle). This frequency ensures timely detection and correction of cracking, spalling, and loss of material for concrete components prior to loss of intended function. Personnel performing inspections will be qualified and trained to perform the inspection activities. **(Reference: 101.2 Section 5.0; CC-AA-211 Section 3.0)**

d) The program will be enhanced to provide additional inspection guidance to detect degradation of fire barrier walls, ceilings, and floors such as inspections for spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates.

e) The program will direct that fire doors in the scope of license renewal are to be visually inspected by designated qualified personnel for signs of degradation such as wear, missing parts, holes, and clearances. Functional/operational condition tests of fire doors are also conducted. Frequency of these inspections and tests ensures degradation is detected prior to loss of intended function. Enhancements to the program direct visual inspection of the fire door for integrity of door surfaces, and clearance checks every two years. This inspection frequency ensures timely identification and correction of degraded door conditions prior to loss of intended function.

f) The program directs visual inspection of fire dampers to be implemented by station procedures that provide acceptance criteria and list individual fire dampers at the appropriate frequency. The program lists the required fire damper inspection frequency of at least once per 24 months, and directs visual inspection and cleaning procedures, with subsequent test procedures to be performed if the visual examination results in a determination that the damper may be malfunctioning. Dampers are to be visually inspected to verify that the damper is not obstructed in any way that could prevent proper operation, including that the damper is free of debris and rust, is not damaged and appears structurally sound, and that links appear intact and properly oriented. Exposed portions of dampers, channels and springs are to be wiped down as much as possible. If malfunction is suspected, damper operation testing is directed by removing the link and allowing the damper to close unassisted. Thorough cleaning is directed followed by a second unassisted closing test. **(Reference: 101.2 Attachment 101.2-3 Section 5.B.1; 645.6.026 Section 6.0)**

g) The program includes operational tests of the Oyster Creek diesel driven fire pumps to record flow and discharge, starting capability, and controller function, to be performed every 18 months. These performance tests detect degradation of the fuel supply lines before the loss of the component intended function. The program will be enhanced to require a visual inspection for detecting any degradation of external surfaces of the fuel supply line during engine operation. **(Reference: 645.6.012 Section 1.0)**

h) The program directs periodic halon and low-pressure carbon dioxide fire suppression system inspections, including inspections for operation of the dampers. **(Reference 645.6.013 Section 6.3; 645.6.016 Sections 6.11, 7.1)** The program will be enhanced to include visual inspections of the piping and components for external surface corrosion degradation and mechanical damage. The station inspection frequencies will provide detection of external surface degradation prior to loss of intended functions. The frequency of the inspections is sufficient to ensure system availability and operability, considering station operating experience that indicates no occurrence of aging related degradation having adversely affected the system's operation.

i) The halon fire suppression system surveillance includes verification of storage tank weight, level, and pressure once every six months. The low-pressure carbon dioxide fire suppression system surveillance includes verification of the CO_2 tank charge once per week.

j) Detection of aging effects procedural commitments will include enhanced inspection steps for signs of corrosion and mechanical damage in surveillance procedures for the halon and low-pressure carbon dioxide system functional tests.

<u>Exceptions to NUREG-1801, Element 4:</u>

NUREG-1801 recommends visual inspection and functional testing of the halon and CO_2 fire suppression systems at least once every six months. Procedurally, the Oyster Creek halon and low-pressure carbon dioxide fire suppression systems currently undergo in-depth operational testing and inspections every 18 months. Additionally, the halon fire suppression system undergoes an inspection of the system charge (storage tank weight/level and pressure) every 6 months, and the low-pressure carbon dioxide fire suppression system undergoes a weekly tank check and monthly valve position alignment verification. These test frequencies are considered sufficient to ensure system availability and operability based on the station's operating history that shows no aging related events that have adversely affected the systems' operation. These test procedures will be enhanced to include visual inspections of the component external surfaces. Test and inspection frequency adequacy will be evaluated as part of the corrective action process based on actual test and inspection results.

Enhancements to NUREG-1801, Element 4:

The program will be enhanced to provide additional inspection guidance to identify degradation of fire barrier walls, ceilings, and floors such as spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates.

The program will be enhanced to require that surface integrity and clearances of fire doors in the scope of license renewal be routinely inspected every two years. The program currently requires these doors be intact and verified functional, with fire doors identified as secondary containment receiving routine clearance checks. Other fire doors in the scope of license renewal currently receive clearance checks if they have been damaged or undergone maintenance such that the clearances may have been physically altered. The enhancement of requiring routine surface integrity and clearance checks for all fire doors in the scope of license renewal will provide assurance that degradation of fire doors prior to loss of intended function will be detected.

The program will be enhanced to provide specific guidance for examining external surfaces of the fire pump diesel fuel supply systems for corrosion during pump tests.

The program will be enhanced to provide for inspection for corrosion and mechanical damage on external surfaces of piping and components for the Oyster Creek halon and low-pressure carbon dioxide fire suppression systems.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 4, Detection of Aging Effects, with the exception and enhancements described above.

3.4 Monitoring and Trending

NUREG-1801:

a) *The aging effects of weathering on fire barrier penetration seals are detectable by visual inspection and, based on operating experience, visual inspections are performed at least once every refueling outage to detect any sign of degradation of fire barrier penetration seals prior to loss of the intended function.*

b) *Concrete cracking, spalling, and loss of material are detectable by visual inspection and, based on operating experience, visual inspection performed at least once every refueling outage detects any sign of degradation of the fire barrier walls, ceilings, and floors before there is a loss of the intended function.*

c) *Based on operating experience, degraded integrity or clearances in the fire door are detectable by visual inspection performed on a plant specific frequency. The visual inspections detect degradation of the fire doors prior to loss of the intended function.*

d) *The performance of the fire pump is monitored during the periodic test to detect any degradation in the fuel supply lines. Periodic testing provides data (e.g., pressure) for trending necessary.*

e) *The performance of the halon/CO2 fire suppression system is monitored during the periodic test to detect any degradation in the system. These periodic tests provide data necessary for trending.*

Oyster Creek:

a) The Oyster Creek Fire Protection aging management program directs inspection of at least 10% of each type of penetration seal to be performed at least once per 24 months (the Oyster Creek refueling cycle). Visual inspection of each fire wrap is performed at least once per 24 months. These inspections will identify aging related effects prior to loss of intended function. **(Reference: 101.2 Attachment 101.2-3 Section 5.B.1;**

645.6.017 Section 6.0; 645.6.028 Section 7.0)

b) The program directs visual inspections of concrete fire barrier walls, ceilings, and floors, and will be enhanced to include inspection for the aging effects of cracking, spalling, and loss of material. Inspection frequency of at least once per 24 months ensures timely identification and correction of degraded conditions for concrete components prior to loss of intended function.

c) Based on Oyster Creek operating experience, degraded integrity or clearances in fire doors are detectable by visual inspection performed on specific frequencies. The Oyster Creek Fire Protection aging management program describes fire door functionality in order to verify the operability of automatic hold-open, release, closing mechanisms, and latches. Inspections are performed once per six months or whenever a fire door has been repaired or had maintenance performed on it prior to being declared functional. Locked-closed doors not used for vital area access or primary/secondary containment requirements are verified closed at least once per 7 days. Doors with automatic hold-open and release mechanisms are verified free from obstructions at least once per 24 hours, and undergo a functional test at least once per 18 months. Each unlocked fire door without electrical supervision is verified closed at least once per 24 hours. **(Reference: 101.2 Attachment 101.2-3 Section 5.B.2)**

d) Enhancements to the program direct visual inspection of the fire doors for integrity of door surfaces, and clearance checks every two years. The visual inspections provide for detection of degradation of the fire doors prior to loss of intended function.

e) The program directs implementation of visual inspection of fire dampers by station procedures that list the individual fire dampers, provide acceptance criteria, and specify the required fire damper inspection frequency of at least once per 24 months. The procedure describing the inspection activities directs visual inspection and cleaning procedures, with subsequent test procedures to be performed if the visual examination results in a determination that the damper may be malfunctioning. **(Reference: 101.2 Attachment 101.2-3 Section 5.B.1; 645.6.026 Section 6.0)**

f) The program directs performance of operational tests of the Oyster Creek diesel driven fire pumps to record flow and discharge pressure, starting capability, and controller function.

These performance tests detect degradation of the fuel supply lines before the loss of the component intended function, and provide data for trending. **(Reference: 645.6.012 Section 1.0)** The program will be enhanced to provide specific guidance for examining the fire pump diesel fuel supply systems for external surface corrosion during pump tests.

g) The program directs periodic functional tests to detect degradation prior to loss of intended functions. Inspection and testing results will be trended by the Fire Protection System Engineer. **(Reference: CC-AA-211 Section 3.1.5; 645.6.013 Section 1.0; 645.6.016 Section 1.0)** The program will be enhanced to provide for inspection for corrosion and mechanical damage on external surfaces of piping and components for the halon and low-pressure carbon dioxide fire suppression systems.

<u>Exceptions to NUREG-1801, Element 5:</u>

None.

<u>Enhancements to NUREG-1801, Element 5:</u>

The program will be enhanced to provide additional inspection guidance to identify degradation of fire barrier walls, ceilings, and floors such as spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates.

The program will be enhanced to require that surface integrity and clearances of fire doors in the scope of license renewal be routinely inspected every two years. The program currently requires these doors be intact and verified functional, with fire doors identified as secondary containment receiving routine clearance checks. Other fire doors in the scope of license renewal currently receive clearance checks if they have been damaged or undergone maintenance such that the clearances may have been physically altered. The enhancement of requiring routine surface integrity and clearance checks for all fire doors in the scope of license renewal will provide assurance that degradation of fire doors prior to loss of intended function will be detected.

The program will be enhanced to provide specific guidance for examining external surfaces of the fire pump diesel fuel supply systems for corrosion during pump tests.

The program will be enhanced to provide for inspection for corrosion and mechanical damage on external surfaces of piping and components for the halon and low-pressure carbon dioxide fire suppression systems.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 5, Monitoring and Trending, with the enhancements described above.

3.5 Acceptance Criteria

NUREG-1801:

a) *Inspection results are acceptable if there are no visual indications (outside those allowed by approved penetration seal configurations) of cracking, separation of seals from walls and components, separation of layers of material, or ruptures or punctures of seals; no visual indications of concrete cracking, spalling and loss of material of fire barrier walls, ceilings, and floors; no visual indications of missing parts, holes, and wear and no deficiencies in the functional tests of fire doors.*

b) *No corrosion is acceptable in the fuel supply line for the diesel-driven fire pump.*

c) *Also, any signs of corrosion and mechanical damage of the halon/CO2 fire suppression system are not acceptable.*

Oyster Creek:

a) Visual indications (outside those allowed by approved penetration seal configurations) of cracking, separation of seals from walls and components, separation of layers of material, or ruptures or punctures of penetration seals are addressed by the Oyster Creek Fire Protection aging management program through detailed inspection acceptance criteria that are based on the type of penetration seal, and which will identify aging related effects prior to loss of intended function. **(Reference: 645.6.017 Section 6.2)**

b) Grouted penetration seals: grout material is in place with no missing pieces or voids beyond the face of the barrier, the grout material has not shrunk away from the penetration opening or penetrating objects, and no cracks exist creating through openings in the wall;

c) Foam penetration seals for Appendix R requirements: no damage or missing pieces of RTV foam exist from the face of the seal, the RTV foam has not shrunk away from the penetration opening or penetrating objects creating gaps wider than ¼" wide and 1" deep;

Foam penetration seals for Non-Appendix R requirements: no damage or missing pieces of RTV foam exist from the face of the seal or sides of the seal when extended beyond the barrier creating a void 2" or greater in depth, the RTV foam has not shrunk away from the penetration opening or penetrating objects creating gaps wider than ¼" wide and 1" deep; and

Concrete or metal floor plugs and metal hatch covers: the plug is in place within the opening to be protected, and the hatch cover is closed, covering the opening to be protected.

Thermo-Lag covered supports and structures: no visible damage to the surface, gaps, cracks, or missing pieces exist, and no water damage or wet conditions; Mecatiss firewrap: the material is intact without visible damage to surface material or mat material or deterioration of caulking material, the material is free from wet conditions or water damage, and the outer Silco cloth barrier is free of grease, paint, or excessive dirt. **(Reference: 645.6.028 Sections 6.0, 7.0, 8.0)**

Enhanced inspections of fire barrier walls, ceilings, and floors will look for signs of degradation including but not limited to cracking, spalling, and loss of material caused by freeze-thaw, aggressive chemical attack, reaction with aggregates, and corrosion of embedded steel.

Enhanced inspections of fire doors for Oyster Creek will look for missing parts, holes, wear, or other degradation that would impact the intended function of the fire doors. Fire door functional tests are acceptable when no deficiencies are observed.

The program directs implementation of visual inspection of fire dampers by station procedures that list the individual fire dampers, provide acceptance criteria, and specify the required fire damper inspection frequency of at least once per 24 months. The procedure describing the inspection activities directs visual inspection and cleaning procedures, with subsequent test procedures to be performed if the visual examination results in a determination that the damper may be malfunctioning. Dampers are to be visually inspected to verify that the damper is not obstructed in any way that could prevent proper operation, including that the damper is free of debris and rust, is not damaged and appears structurally sound, and that links appear intact and properly oriented. The acceptance criteria ensure that function of the dampers is not lost. **(Reference: 101.2 Attachment 101.2-3 Section 5.B.1; 645.6.026 Section 6.0)**

d) Oyster Creek performs monthly operational tests of the diesel driven fire pumps. These test procedures include requirements for engine operating rpm range. System functional tests of the diesel driven fire pumps are also performed. Every 18 months, the system functional test procedure requires that engine and pump performance (capacity and head) meet predetermined acceptance criteria. **(Reference: 645.6.012 Section 1.0)**

e) The procedure will be enhanced to require a visual inspection for detecting any degradation of the fuel supply line during engine operation. Signs of corrosion or mechanical damage will be evaluated to determine impact on the system and component function, with corrective actions taken as appropriate.

f) The program will be enhanced to include acceptance criteria for the periodic external surface degradation inspections of the halon and low-pressure carbon dioxide fire suppression systems, to be noted in the inspection and test procedures. Signs of corrosion or mechanical damage will be evaluated to determine impact on the system and component function, with corrective actions taken as appropriate.

<u>Exceptions to NUREG-1801, Element 6:</u>

None.

<u>Enhancements to NUREG-1801, Element 6:</u>

The program will be enhanced to provide additional inspection guidance to identify degradation of fire barrier walls, ceilings, and floors such as spalling and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates.

The program will be enhanced to require that surface integrity and clearances of fire doors in the scope of license renewal be routinely inspected every two years. The program currently requires these doors be intact and verified functional, with fire doors identified as secondary containment receiving routine clearance checks. Other fire doors in the scope of license renewal currently receive clearance checks if they have been damaged or undergone maintenance such that the clearances may have been physically altered. The enhancement of requiring routine surface integrity and clearance checks for all fire doors in the scope of license renewal will provide assurance that degradation of fire doors prior to loss of intended function will be detected.

The program will be enhanced to provide specific guidance for examining external surfaces of the fire pump diesel fuel supply systems for corrosion during pump tests.

The program will be enhanced to provide for inspection for corrosion and mechanical damage on external surfaces of piping and components for the Oyster Creek halon and low-pressure carbon dioxide fire suppression systems.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 6, Acceptance Criteria, with the enhancements described above.

3.6 Corrective Actions

NUREG-1801:

For fire protection structures and components identified within scope that are subject to an AMR for license renewal, the applicant's 10 CFR Part 50, Appendix B, program is used for corrective actions, confirmation process, and administrative controls for aging management during the period of extended operation. This commitment is documented in the final safety analysis report (FSAR) supplement in accordance with 10 CFR 54.21(d). As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions, confirmation process, and administrative controls.

Oyster Creek:

Evaluations are performed for test or inspection results that do not satisfy established criteria and a condition report is initiated to document the concern in accordance with plant administrative procedures. The corrective actions program ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence. Conditions found to be unacceptable, including conditions that may impede the operation of fire protection equipment and systems, are identified and corrected in accordance with the corrective actions program (CAP). The inspection and test procedure reporting requirements require that Issue Reports be generated in accordance with the corrective actions program.

The corporate corrective actions program meets the requirements of 10 CFR Part 50, Appendix B such that new Fire Protection commitments are not required. The corrective actions program includes general and specific corrective action steps as specified in the various annotated procedures to ensure that any conditions adverse to system operability are promptly corrected.

Exceptions to NUREG-1801, Element 7:

None.

Enhancements to NUREG-1801, Element 7:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 7, Corrective Actions.

3.7 Confirmation Process

NUREG-1801:

See Item 7, above.

Oyster Creek:

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

Exceptions to NUREG-1801, Element 8:

None.

Enhancements to NUREG-1801, Element 8:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 8, Confirmation Process.

3.8 Administrative Controls

NUREG-1801:

See Item 7, above.

Oyster Creek:

See Item 8, above.

Exceptions to NUREG-1801, Element 9:

None.

Enhancements to NUREG-1801, Element 9

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 9, Administrative Controls.

3.9 Operating Experience

NUREG-1801:

Silicone foam fire barrier penetration seals have experienced splits, shrinkage, voids, lack of fill, and other failure modes (IN 88-56, IN 94-28, and IN 97-70). Degradation of electrical racing way fire barrier such as small holes, cracking, and unfilled seals are found on routine walkdown (IN 91-47 and GL 92-08). Fire doors have experienced wear of the hinges and handles.

Oyster Creek:

Operating experience, both internal and external, is used in two ways at Oyster Creek to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Oyster Creek. The first way in which operating experience is used is through the Oyster Creek Operating Experience process. The Operating Experience process screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The second way is through the process for managing programs. This process requires the review of program related operating experience by the program owner.

Both of these processes review operating experience from both external and internal (also referred to as in-house) sources. External operating experience may include such things as INPO documents (e.g., SOERs, SERs, SENs, etc.), NRC documents (e.g., GLs, LERs, INs, etc.), General Electric documents (e.g., RCSILs, SILs, TILs, etc.), and other documents (e.g., 10CFR Part 21 Reports, NERs, etc.). Internal operating experience may include such things as event investigations, trending reports, and lessons learned from in-house events as captured in program notebooks, self-assessments, and in the 10 CFR Part 50, Appendix B corrective action process.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that loss of material, cracking, and change in material properties in fire barrier penetrations seals, fire wraps, fire barrier walls, ceilings and floors, fire doors and dampers, and piping and components in the diesel-driven fire pump fuel supply system, and halon and CO2 fire suppression systems are being adequately managed. The following examples of operating experience provide objective evidence that the Fire Protection program is effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

Fire Barrier Penetration Seals and Fire Wraps

A review of industry and Oyster Creek operating experience with silicone foam fire barrier penetration seals indicates that station experience is consistent with that of the industry (shrinkage, gaps, etc.).

A lower cable spreading room penetration was determined to have a missing cover on a conduit box and foam was pulled away from a flex conduit. The seal was repaired, and corrective actions were issued to instruct technicians to look for conditions where conduit covers and foam separation might occur, and to restore conduits to proper configuration when maintenance activities could disturb them. This example provides objective evidence that industry operating experience is considered when establishing inspection criteria, and that foam shrinkage will be detected during walkdown examinations. It also demonstrates that the corrective action process provides a means to ensure that lessons learned from operating experiences are used to prevent occurrences of such events to improve plant safety and reliability. (O2000-0398)

A penetration seal in the A/B battery room was found to have shrinkage around the edge of the foam and to have paint applied to the foam surface. The seal was repaired, and a corrective action was issued to instruct personnel not to apply coatings to fire barrier materials. This example provides objective evidence that industry operating experience is considered when establishing inspection criteria, and that foam shrinkage will be detected during walkdown examinations. It also provides evidence that the corrective action process provides a means to ensure that lessons learned from operating experiences are used to prevent occurrences. (O2000-0390)

Fire Barrier Walls, Ceilings, and Floors

The fire protection program demonstrated effective aging management by the detection of minor cracks and holes in various structures. These types of degradation were evaluated and dispositioned in accordance with the above attributes discussion.

A small hole in a concrete block wall was discovered during a scheduled penetration seal walkdown. The hole was approximately 1 inch in diameter and several inches deep, but did not penetrate the wall. As this wall is a 1-hour fire barrier, compensatory measures were employed until repair could be made. This example provides objective evidence that walkdowns are effective in identifying minor degradation in concrete fire barriers. (O2002-1356)

Two joints between concrete block and poured concrete walls were identified as leaking air from the lower cable spreading room. Engineering performed an evaluation and determined that the structural and fire barrier integrity of the walls were not impaired, and was not a result of wall degradation. The issue was determined to be cosmetic, and was repaired. This example provides objective evidence that an apparent fire barrier discrepancy was identified during a walkdown and in accordance with the corrective action process was referred to engineering for evaluation to determine cause and disposition. (O2002-0065)

The effective use of the Corrective Action Program has provided significant quantitative and qualitative data on performance, extent of degradation, and effects of operating and environmental conditions ensuring timely identification and correction of degraded conditions.

Fire Doors and Dampers

A review of Corrective Action Program (CAP) documents for Oyster Creek fire doors indicates that they have been effective in identifying degradations and taking corrective action as necessary. Examples of discrepancies included mis-adjusted gaps, missing fasteners, and non-latching.

A fire door was declared inoperable due to improper latching. A firewatch was posted and repair was scheduled and performed. (O2000-0358) A door was determined to not close consistently. An hourly firewatch was established and repair was scheduled and performed. (O2001-1872) These examples provide objective evidence that fire barrier deficiencies are identified during walkdowns and, in accordance with the corrective action process, were repaired to maintain the fire barrier intended function.

A self-assessment performed on Oyster Creek fire doors in 2001 identified ten fire door discrepancies that were evaluated and corrected. A result of this self-assessment was that a maintenance procedure was identified for development for improved installation and maintenance of fire doors, and revisions to existing inspection tasks were made as appropriate. This example provides objective evidence that program deficiencies are entered into the corrective action process and that the program is updated as necessary to ensure that it remains effective in identifying conditions for evaluation and repair in order to maintain intended functions. (O2001-0601)

In 2001, an incidence of fire door assembly loss of material due to corrosion was identified. The door was repaired, and additional guidance for inspections of fire doors for corrosion and damage was included in the surveillance document. This example provides objective evidence that deficiencies in the Fire Protection surveillance program are entered into the 10 CFR Part 50, Appendix B Corrective Action process, and demonstrates that the program is updated as necessary to ensure that the program effectively identifies conditions for evaluation and repair, thereby maintaining intended functions. (O2001-0341)

The Oyster Creek programs for periodic visual inspection of fire dampers are implemented by station procedures that provide acceptance criteria and lists individual fire dampers at the appropriate frequency. The program is effective as found through review of operating experience.

During a halon circuitry test, three fire dampers did not operate as stated in the surveillance procedure. An evaluation determined that degradation was not responsible; the dampers were designed to remain in-place and operated correctly. The evaluation determined that the procedure was incorrectly written, and corrective actions were issued to update personnel training and correct the procedure. This example provides objective evidence that deficiencies in the fire protection program are entered into the 10 CFR Part 50, Appendix B Corrective Action process, and that updates are performed as necessary to ensure that the program maintains intended functions. (O2001-0247)

Diesel Driven Fire Pumps

The overall effectiveness of the fire protection activities is supported by the operating experience Oyster Creek has had with the diesel driven fire pump fuel oil system. Minor system events have been detected and corrected in a timely manner. A repeat air entrapment issue has occurred following maintenance, with the corrective action of revision to all Fire Diesel PMs to provide specific venting and priming direction, providing objective evidence that the corrective action process provides a means to ensure that lessons learned from operating experiences are used to prevent occurrences. (O2004-1739)

Review of Oyster Creek operating experience has shown no reports of loss of function of the diesel driven fire pumps as a result of corrosion or degradation of the fuel oil system.

Halon/Carbon Dioxide Fire Suppression Systems

Review of Oyster Creek operating experience has shown no loss of material on the external surfaces of components in the halon and low-pressure carbon dioxide systems that have adversely affected system operation.

Enhancements to the surveillance test procedures include specific corrosion inspection steps that align with NUREG-1801 terminology. The Fire Protection AMP aging management activities with enhancements will be effective in managing aging degradation for the period of extended operation by providing timely detection of aging effects and implementing appropriate corrective actions prior to loss of system or component intended functions.

The operating experience of Fire Protection program did not show any adverse trends in performance. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of the Fire Protection program will effectively maintain the integrity of fire barriers, the diesel-driven fire pump fuel system, and the halon and CO2 fire suppression systems. Periodic self-assessments of the Fire Protection program are performed to identify the areas that need improvement to maintain the quality performance of the program.

3.10 Conclusion

The Oyster Creek Fire Protection aging management program is credited for managing the aging effects of loss of material, cracking, and change in material properties for the systems, components, and environments listed in Table 5.2. The Oyster Creek Fire Protection program's elements have been evaluated against NUREG-1801 in Section 3.0. Program exceptions have been identified in Section 2.3. Program enhancements have been identified in Section 2.4. The implementing documents for this aging management program are listed in Table 5.1. The relevant operating experience has been reviewed and a demonstration of program effectiveness is provided in Section 3.10.

Based on the above, the continued implementation of the Oyster Creek Fire Protection aging management program provides reasonable assurance that the aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained during the period of extended operation.

4.0 REFERENCES

4.1 Generic to Aging Management Programs

4.1.1 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants

4.1.2 10 CFR 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants

4.1.3 NUREG-1800, Standard Review Plan for Review of License *Renewal Applications for Nuclear Power Plants,* Revision 1, dated September 2005

4.1.4 NUREG-1801, *Generic Aging Lessons Learned (GALL) Report*, Revision 1 dated September 2005

4.2 Industry Standards

None

4.3 Oyster Creek Program References

4.3.1 990-1746, "Oyster Creek Fire Hazards Analysis Report"

5.0 TABLES

5.1 Aging Management Program Implementing Documents

Procedure Number	Procedure Title	Commitment No.	Status
CC-AA-211	Fire Protection Program	00330592.20.01	ACC/ASG
101.2	Oyster Creek Site Fire Protection Program	00330592.19.25	ACC/ASG
645.6.017	Fire Barrier Penetration Surveillance	00330592.19.06	ACC/ASG
LIB R0803907	Fire Barrier Penetration Surveillance	00330592.19.21	ACC/ASG
LIB R0803906	Fire Barrier Penetration Surveillance	00330592.19.10	ACC/ASG
645.6.026	Fire Damper Inspection	00330592.19.02	ACC/ASG
LIB R0803916	Fire Damper Inspection	00330592.19.17	ACC/ASG
645.6.028	Thermo-Lag and Mecatiss Envelope System Fire Barriers	00330592.19.03	ACC/ASG
645.6.012	Fire Pump Functional Test	00330592.19.03	ACC/ASG
645.6.013	Fire Suppression System Halon Functional Test	00330592.19.01	ACC/ASG

LIB R0803902	Fire Suppression System Halon Functional Test	00330592.19.22	ACC/ASG
645.6.016	Fire Suppression System Low-Pressure CO2 System Functional Test	00330592.19.12	ACC/ASG
LIB R0803905	Fire Suppression System Low-Pressure CO2 System Functional Test	00330592.19.14	ACC/ASG
FPE-OC-00814-005	Fire Door Evaluation	00330592.19.15	ACC/ASG
LIB R0802114	Fire Door Evaluation	00330592.19.13	ACC/ASG
LIB R0802166	Fire Door Evaluation	00330592.19.07	ACC/ASG
LIB R0802129	Fire Door Evaluation	00330592.19.11	ACC/ASG
LIB R2033244	Fire Door Evaluation	00330592.19.19	ACC/ASG
LIB R0801047	Fire Door Evaluation	00330592.19.09	ACC/ASG
LIB R0803908	1C Switchgear Inspection Points	00330592.19.20	ACC/ASG
LIB R0803909	1D Switchgear Inspection Points	00330592.19.04	ACC/ASG
LIB R0800978	Fire Barrier Stairwells and Walls - Visual	00330592.19.08	ACC/ASG
LIB R0801040	Marinite/M-Board Fire Barrier	00330592.19.16	ACC/ASG
LIB R0800980	Inspection of Environmental Qualification Penetrations	00330592.19.18	ACC/ASG
645.6.014	Fire Suppression System Halon Cylinder Check	00330592.19.26	ACC/ASG
645.6.015	Low Pressure CO2 System Valve Position Verification	00330592.19.27	ACC/ASG

5.2 Aging Management Review Results

SSC Name	Structure and/or Component	Material	Environment	Aging Effect
Fire Protection System	Fire Barrier Penetration Seals	Elastomer	Indoor Air	Change in Material Properties
Fire Protection System	Fire Barrier Penetration Seals	Grout	Indoor Air	Cracking
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Indoor Air	Loss of Material
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Indoor Air	Cracking
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Outdoor Air	Loss of Material
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Outdoor Air	Cracking
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Outdoor Air	Change in Material Properties
Fire Protection System	Fire Doors	Carbon and low alloy steel	Outdoor Air	Loss of Material
Fire Protection System	Fire Doors	Carbon and low alloy steel	Indoor Air	Loss of Material
Fire Protection System	Fire Rated Enclosures	Thermo-Lag	Indoor Air (External)	Loss of Material
Fire Protection System	Fire Rated Enclosures	Pyrocrete	Indoor Air (External)	Cracking
Fire Protection System	Fire Rated Enclosures	Pyrocrete	Indoor Air (External)	Loss of Material
Fire Protection System	Fire Rated Enclosures	Thermo-Lag	Indoor Air (External)	Cracking
Fire Protection System	Fire Rated Enclosures	Alumina Silica	Indoor Air	Change in Material Properties
Fire Protection System	Fire Rated Enclosures	Alumina Silica	Indoor Air	Cracking
Fire Protection System	Fire Rated Enclosures	Elastomer	Indoor Air	Change in Material Properties
Fire Protection System	Fire Rated Enclosures	Mecatiss	Indoor Air	Change in Material Properties
Fire Protection System	Gas Bottles (CO2, Halon Storage Cylinders)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Fire Protection System	Odorizer	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Fire Protection System	Odorizer	Carbon and low alloy steel	Indoor Air (Internal)	Loss of Material
Fire Protection System	Piping and fittings	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Fire Protection System	Piping and fittings	Carbon and low alloy steel	Indoor Air (Internal)	Loss of Material
Fire Protection System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

Fire Protection System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Fire Protection System	Spray Nozzle (CO2, Halon)	Carbon and low alloy steel	Indoor Air (Internal)	Loss of Material
Fire Protection System	Spray Nozzle (CO2, Halon)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Fire Protection System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Fire Protection System	Valve Body	Carbon and low alloy steel	Fuel Oil (Internal)	Loss of Material
Fire Protection System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

6.0 ATTACHMENTS

6.1 LRA Appendix A

6.2 LRA Appendix B

PROGRAM BASIS DOCUMENT

PBD-AMP-B.1.17

Revision 0

COMPRESSED AIR MONITORING

GALL PROGRAM XI.M24 – COMPRESSED AIR MONITORING

Prepared By: ______________________

Reviewed By: ______________________

Program Owner Review: ______________________

Technical Lead Approval: ______________________

Revision History:

Revision	*Prepared by:*	*Reviewed by:*	*Program Owner:*	*Approved by:*
0	*Charles Micklo*	*George Beck*	*Tim Trettel*	*Fred Polaski*
Date				

Summary of Revisions:

Rev. Number	Reason for the Revision(s)
0	Initial Issue

TABLE OF CONTENTS

1.0 PURPOSE AND METHODOLOGY

1.1 Purpose

The purpose of this Program Basis Document is to document and evaluate those activities of the Oyster Creek Compressed Air Monitoring aging management program that ensure dewpoint, particulates, and suspended hydrocarbons are kept within the specified limits to preclude aging effects as part of Oyster Creek License Renewal to meet the requirements of the License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

This includes the following:

- The identification of the scope of the program;
- The evaluation of program elements against NUREG-1801;
- The review of Operating Experience to demonstrate program effectiveness;
- The identification of required program enhancements;
- The identification of Oyster Creek documents required to implement the program.

1.2 Methodology

The nuclear power plant License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," describes the License Renewal process and provides requirements for the contents of License Renewal Applications. 10 CFR 54.21(a)(3) states:

"For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the Current Licensing Basis (CLB) for the period of extended operation."

The NRC and the industry identified 10 program elements that are useful in describing an aging management program and then demonstrating its effectiveness. These program elements are described in Appendix A.1, Section A.1.2.3 of the Standard Review Plan. NUREG-1801 uses these program elements in Section XI to describe acceptable aging management programs.

The Program Basis Document also provides a comparison of the credited Oyster Creek program with the elements of the corresponding NUREG-1801 Chapter XI program XI.M24, Compressed Air Monitoring. Project Level Instruction PLI-8 "Program Basis Documents" prescribes the methodology for evaluating Aging Management Programs. An evaluation of Oyster Creek's aging management program criteria or activities to those of the NUREG-1801 program elements is performed and a conclusion is reached concerning consistency for each individual program element. A demonstration of overall program effectiveness is made after all program elements are evaluated. Required program enhancements are documented. An overall determination is made as to consistency with the program description in NUREG-1801.

2.0 PROGRAM DESCRIPTION

2.1 Program Description

NUREG-1801:

a) *The program consists of inspection, monitoring, and testing of the entire system. This includes (a) frequent leak testing of valves, piping, and other system components, especially those made of carbon steel and stainless steel; and (b) preventive monitoring that checks air quality at various locations in the system to ensure that oil, water, rust, dirt, and other contaminants are kept within the specified limits.*

b) *The aging management program (AMP) provides for timely corrective actions to ensure that the system is operating within specified limits.*

c) *The AMP is based on results of the plant owner's response to Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-14, augmented by previous NRC Information Notices (IN) 81-38, IN 87-28, and IN 87-28 S1, and by the Institute of Nuclear Power Operations Significant Operating Experience Report (INPO SOER) 88-01. The NRC GL 88-14, issued after several years of study of problems and failures of instrument air systems, recommends each holder of an operating license to perform an extensive design and operations review and verification of its instrument air system. The GL 88-14 also recommends the licensees to describe their program for maintaining proper instrument air quality. The AMP also incorporates provisions conforming to the guidance of the Electric Power Research Institute (EPRI) NP-7079, issued in 1990, to assist utilities in identifying and correcting system* *problems in the instrument air system and to enable them to maintain required industry safety standards. Subsequent to these initial actions by all plant licensees to implement an improved AMP, some utilities decided to replace their instrument air system with newer models and types of components. The EPRI then issued TR-108147, which addresses maintenance of the latest compressors and other instrument air system components currently in use at those plants. The American Society of Mechanical Engineers operations and maintenance standards and guides (ASME OM-S/G-1998, Part 17) provides additional guidance to the maintenance of the instrument air system by offering recommended test methods, test intervals, parameters to be measured and evaluated, acceptance criteria, corrective actions, and records requirements.*

Oyster Creek:

a) Compressed Air Monitoring aging management activities ensure that dew point, particulates, and suspended hydrocarbons are kept within the specified limits for the portions of the instrument air system within the scope of license renewal. These activities consist of air quality monitoring, pressure decay testing, and visual inspections.

b) Program air quality and valve accumulator leak test procedures provide quantitative acceptance criteria. Evaluations are performed for test or inspection results that do not satisfy established criteria. A condition report is initiated to document the concern in accordance with plant administrative procedures. The corrective actions program ensures that the conditions adverse to quality are promptly addressed.

c) The Oyster Creek Compressed Air Monitoring AMP is based on GPU's response to NRC Generic Letter 88-14, "Instrument Air Supply Problems" which was based on IN 81-38, IN 87-28 and IN 87-28 S1 and utilizes guidance and standards provided by INPO SOER 88-01, EPRI TR-108147 (revised guide to EPRI NP-7079) and ASME OM-S/G-1998, Part 17. EPRI TR-108147 is relevant to Oyster Creek as recently replaced compressors provide instrument air dried by a new train of dryers.

2.2 Overall NUREG-1801 Consistency

The Oyster Creek Compressed Air Monitoring program is an existing program that is consistent with NUREG-1801 aging management program XI.M24, Compressed Air Monitoring.

2.3 Summary of Exceptions to NUREG-1801

None. The existing Oyster Creek Compressed Air Monitoring aging management program is found to be adequate to support the extended period of operation with no exceptions.

2.4 Summary of Enhancements to NUREG-1801

None. The existing Oyster Creek Compressed Air Monitoring aging management program is found to be adequate to support the extended period of operation with no enhancements.

3.0 EVALUATIONS AND TECHNICAL BASIS

Note

This section is organized by quoting the relevant NUREG-1801 Chapter XI program element (September 2005 version) followed by the related Oyster Creek program attributes and a conclusion of the comparison. Where applicable, the NUREG-1801 program element was separated into logical sub-elements and addressed accordingly.

Implementing procedures and references are included in **( )** for information purposes. This information from the source procedure and references have been either directly extracted from the procedure and references or summarized for inclusion into this PBD.

3.0 Scope of Program

NUREG-1801:

a) *The program manages the effects of corrosion and the presence of unacceptable levels of contaminants on the intended function of the compressed air system.*

b) *The AMP includes frequent leak testing of valves, piping, and other system components, especially those made of carbon steel and stainless steel, and*

c) *a preventive maintenance program to check air quality at several locations in the system.*

Oyster Creek:

a) Air quality testing performed yearly provides a verification that the dew point, particulates, and suspended hydrocarbons are within acceptable limits for the instrument air system by analyzing air samples to standard ISA-S7.0.01-1996

(Reference: 4.3.4, paragraph 5). This test, which is implemented by a recurring task work order, is performed yearly **(Reference: Table 5.1, document 1, task frequency field activity 1, steps 1.1, 7.1).** Maintaining air quality within acceptable limits prevents corrosion and the presence of contaminants, which could interfere with the intended function of system components.

b) Pressure decay tests at intervals performed primarily during refueling outages **(Reference: 4.4.11, section 3.10.3)** and implemented by recurring task work orders **(Reference(s): Table 5.1, documents 2-28, task frequency field)** provide a verification of the leak tightness of the accumulators, piping, and valves for the air supplies to safety-related air operated valves. Component materials of construction include carbon steel, stainless steel, aluminum, copper, brass and zinc. **(Reference: Table 5.2)**

c) Air quality samples obtained from several locations in buildings supplied with instrument air provide confirmation of the air quality used by safety related equipment. **(Reference(s): 4.3.3, recommendation 4; Table 5.1, document 1, activity 1, step 6)**

The scope of components included in the Compressed Air Monitoring aging management activities includes piping, valves and accumulators for air operated safety-related valves, and the containment isolation valves of the instrument air system. Air operated valves with accumulator backup were identified in the response to GL 88-14 **(Reference: 4.4.1, item 3)** and are listed in plant design bases documents **(References: 4.4.11, section 3.10.3, 4.4.3)** and test implementing documents listed in Table 5.1. The service and instrument air system compressors, receivers, filters, and dryers are not within the scope of license renewal.

The Oyster Creek Compressed Air Monitoring aging management program ensures by air quality monitoring and by confirmatory leak tests that air quality is kept within specified limits to preclude aging effects in the instrument air system components listed in Table 5.2. The implementing documents for this aging management program are listed in Table 5.1 and are described throughout the individual program element discussions.

<u>Exceptions to NUREG-1801, Element 1:</u>

None.

Enhancements to NUREG-1801, Element 1:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 1, Scope of Program.

3.1 Preventive Actions

NUREG-1801:

a) *The system air quality is monitored and maintained in accordance with the plant owner's testing and inspection plans, which are designed to ensure that the system and components meet specified operability requirements.*

b) *These requirements are prepared from consideration of manufacturer's recommendations for individual components and guidelines based on ASME OM-S/G-1998, Part 17; ISA-S7.0.01-1996; EPRI NP-7079; and EPRI TR-108147.*

c) *The preventive maintenance program addresses various aspects of the inoperability of air-operated components due to corrosion and the presence of oil, water, rust, and other contaminants.*

Oyster Creek:

a) Air quality at Oyster Creek is monitored and maintained by a preventative maintenance and surveillance test program based on GL 88-14 **(Reference 4.2.1)** and Oyster Creek technical specifications.

b) The existing GL 88-14 Oyster Creek test program was compared to the guidelines in ASME OM-S/G-1998, Part 17 and EPRI TR-108147 for this aging management program review. Air quality testing is performed to in accordance with ISA-S7.0.01-1996, Quality Standard for Instrument Air **(Reference: 4.3.4)**, as endorsed by ASME OM-S/G-1998, Part 17 **(Reference: 4.3.1, paragraph 5.2.3)** and EPRI TR-108147 **(Reference: 4.3.2, paragraph 4.4)** which is relevant to plants with new instrument air components. Air quality testing is performed at multiple plant locations at Oyster Creek consistent with SOER #88-1 recommendation 4 **(Reference: 4.3.3)**. Yearly samples taken from several locations in buildings that are supplied by the Instrument Air system provide a representative sample of instrument air quality **(Reference: Table 5.1, document 1, task frequency field; activity 1, step 6).** Air quality testing is supported by continuous dew point monitoring. Leak testing and accompanying valve stroke tests are performed as recommended in section 8.9 of EPRI TR-108147 **(Reference: 4.3.2).** Valve leak and stroke tests of accumulator equipped primary containment isolation valves are performed every refueling outage as recommended in section 5.3 of ASME OM-S/G-1998, Part 17 **(Reference: 4.3.1).** The remaining accumulator equipped valves within the scope of license renewal are tested at intervalsof every two refueling outages **(Reference 4.4.11, section 3.10.3).** These tests are implemented by recurring task work orders **(Reference: Table 5.1, document 2, task frequency field, documents 3-28, step numbers vary by document).** The industry recommendations implemented at Oyster Creek have resulted in improved air quality as demonstrated by the plant history discussed in the Operating Experience, section 3.10.

c) As part of the response to GL 88-14 **(Reference: 4.2.1),** the Oyster Creek Instrument Air System was evaluated against the requirements of ANSI Standard IAS-S7.3, and was determined to meet or exceed these requirements **(Reference: 4.4.1, Item 1).** The acceptance criteria for air quality contained in ISA-S7.0.01-1996 and currently utilized by the Oyster Creek Compressed Air Monitoring AMP **(Reference: Table 5.1, document 1, activity 1, step 7.1)** will continue to preclude corrosive conditions that can affect component operability. Leak and valve stroke tests demonstrate operability of instrument supplied components.

Exceptions to NUREG-1801, Element 2:

None.

Enhancements to NUREG-1801, Element 2:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 2, Preventive Actions.

3.2 Parameters Monitored or Inspected

NUREG-1801:

a) *Inservice inspection (ISI) and testing is performed to verify proper air quality and confirm that maintenance practices, emergency procedures, and training are adequate to ensure that the intended function of the air system is maintained.*

Oyster Creek:

a) Periodic air quality tests verify that dew point, particulates, and hydrocarbons are within acceptable limits for the pneumatic equipment connected to the air system **(Reference: Table 5.1, document 1, activity 1, steps 1.1, 7.1)**. Pressure decay and valve stroke tests of the pneumatic systems of MSIVs, safety related valves and containment isolation valves including the piping, accumulators, and check valves, are performed to ensure that sufficient air will be available for the valves to perform their intended function. **(Reference Table 5.1, document 2, activity 1, step 8.B, documents 3-28, step numbers vary by document)**. Post maintenance testing is also performed on equipment on which work has been performed.

These periodic tests in conjunction with post maintenance testing provide confirmation that the functioning of the air system within the scope of license renewal will be maintained consistent with its intended function **(Reference: 4.4.1, items 2 & 3 response).**

Exceptions to NUREG-1801, Element 3:

None.

Enhancements to NUREG-1801, Element 3:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 3, Parameters Monitored or Inspected.

3.3 Detection of Aging Effects

NUREG-1801:

a) *Guidelines in EPRI NP-7079, EPRI TR-108147, and ASME OM-S/G-1998, Part 17, ensure timely detection of degradation of the compressed air system function.*

b) *Degradation of the piping and any components would become evident by observation of excessive corrosion, by the discovery of unacceptable leakage rates, and by failure of the system or any item of components to meet specified performance limits.*

Oyster Creek:

a) Oyster Creek performs yearly air quality monitoring at several locations **(Reference: Table 5.1, document 1, activity 1, step 6)** utilizing standard ISA-S7.0.01-1996 as recommended in ASME OM-S/G-1998, Part 17 **(Reference: 4.3.1, paragraph 5.2.3)** and specified in EPRI TR-108147, the revised guide to EPRI NP-7079 which is relevant to Oyster Creeks new instrument air compressors and dryers **(Reference: 4.3.2, paragraph 4.4)**. The yearly air quality testing is supplemented by continuous dew point monitoring. Pressure decay tests of accumulator provided valves including the piping, accumulators, and check valves, are performed to ensure that sufficient air will be available for the valve to perform its intended function **(Reference: Table 5.1, document 2, activity 1, steps 1.A.3, 7.A, documents 3-28, step numbers vary by document)**. These tests are consistent with EPRI TR-108147 **(Reference: 4.3.2, paragraph 8.9)** and ASME OM-S/G-1998, Part 17 **(Reference: 4.3.1, paragraph 5.3)** recommendations for distribution systems.

b) Program air quality and valve accumulator leak test procedures provide quantitative acceptance criteria. Evaluations are performed for test or inspection results that do not satisfy established criteria.

   Oyster Creek performs testing and inspection of the air systems within the scope of license renewal. Pressure decay tests and subsequent functional stroke tests require inspections for leakage if acceptance criteria is not met **(Reference: Table 5.1, document 2, activity 1, steps 7.A.10, 8.B.1; documents 3-28, step numbers vary by document)**.

Exceptions to NUREG-1801, Element 4:

None.

Enhancements to NUREG-1801, Element 4:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 4, Detection of Aging Effects.

3.4 Monitoring and Trending

NUREG-1801:

a) *Effects of corrosion and the presence of contaminants are monitored by visual inspection and periodic system and component tests, including leak rate tests on the system and on individual items of components. These tests verify proper operation by comparing measured values of performance with specified performance limits.*

b) *Test data are analyzed and compared to data from previous tests to provide for timely detection of aging effects.*

Oyster Creek:

a) The effects of corrosion and the presence of contaminants are monitored by the performance of air quality tests. Periodic tests monitor the air for dew point, particulates, and hydrocarbons at several locations in the system. Air quality is evaluated to the standards in ISA-S7.0.01-1996 **(Reference: 4.3.4)** by recurring task work order **(Reference: Table 5.1, document 1, activity 1, steps 1.1, 7.1)**. Leak rate tests and stroke tests on the accumulator supplied air operated valves demonstrate proper operation of instrument air supplied components based on calculated and operational parameters **(Reference(s): 4.4.3)**. Visual inspections for leakage are performed if leak rate tests do not pass established pressure drop criteria **(Reference: Table 5.1, document 2, activity 1, step 7.A.10, documents 3-28, step numbers vary by document)**.

b) Test results are compared with established acceptance criteria. Evaluations and corrective maintenance are performed for test or inspection results that do not satisfy established criteria as discussed in section 3.7. **(Reference: Table 5.1, document 1, activity 1, step 7.1, document 2, activity 1, steps 8-10, documents 3-28, step numbers vary by document)**

Exceptions to NUREG-1801, Element 5:

None.

Enhancements to NUREG-1801, Element 5:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 5, Monitoring and Trending.

3.5 Acceptance Criteria

NUREG-1801:

a) *Acceptance criteria are established for the system and for individual components that contain specific limits or acceptance ranges based on design basis conditions and/or components vendor specifications.*

b) *The testing results are analyzed to verify that the design and performance of the system is in accordance with its intended function.*

Oyster Creek:

a) Instrument air quality acceptance criteria for dew point, particulates, and hydrocarbons are in accordance with ISA-S7.0.01-1996 **(Reference: 4.3.4)** as implemented by recurring task work order **(Reference: Table 5.1, document 1, activity 1, steps 1.1, 7.1)**. Oyster Creek pneumatic systems pressure decay tests **(Reference: Table 5.1, document 2, activity 1, steps 8–10, documents 3-28, step numbers vary by document)** provide quantitative acceptance criteria for air pressure loss. The acceptance criteria reflect the valve design and operating requirements **(Reference(s): Ref 4.4.3)**.

b) Acceptance criteria, established and based on system design and intended functions are included in testing procedures **(Reference: Table 5.1, document 1, activity 1, step 7.1, document 2, activity 1, steps 8-10, documents 3-28, step numbers vary by document)**. If test results exceed acceptance criteria, the test data is reviewed. Results that meet acceptance criteria confirm operation and performance criteria.

Exceptions to NUREG-1801, Element 6:

None.

Enhancements to NUREG-1801, Element 6:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 6, Acceptance Criteria.

3.6 Corrective Actions

NUREG-1801:

Corrective actions are taken if any parameters are out of acceptable ranges, such as moisture content in the system air. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

Oyster Creek:

Air quality test procedures provide quantitative acceptance criteria for moisture, particulates, and hydrocarbons. Valve accumulator tests provide quantitative acceptance criteria for allowable pressure loss. Evaluations are performed for test or inspection results that do not satisfy established criteria. A condition report is initiated to document the concern in accordance with plant administrative procedures. The corrective actions program ensures that the conditions adverse to quality are promptly addressed. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude repetition in accordance with 10 CFR Part 50, Appendix B Corrective Action Program.

Exceptions to NUREG-1801, Element 7:

None.

Enhancements to NUREG-1801, Element 7:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 7, Corrective Actions.

3.7 Confirmation Process

NUREG-1801:

The site corrective actions program, quality assurance (QA) procedures, site review and approval process, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process and administrative controls.

Oyster Creek:

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

Exceptions to NUREG-1801, Element 8:

None.

Enhancements to NUREG-1801, Element 8:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 8, Confirmation Process.

3.8 Administrative Controls

NUREG-1801:

See Item 8, above.

Oyster Creek:

See Item 8, above.

Exceptions to NUREG-1801, Element 9:

None.

Enhancements to NUREG-1801, Element 9

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 9, Administrative Controls.

3.9 Operating Experience

NUREG-1801:

Potentially significant safety-related problems pertaining to air systems have been documented in NRC IN 81-38, IN 87-28, IN 87-28 S1 and license event report (LER) 50-237/94-005-3. Some of the systems that have been significantly degraded or have failed due to the problems in the air system include the decay heat removal, auxiliary feedwater, main steam isolation, containment isolation, and fuel pool seal system. As a result of NRC GL 88-14 and consideration of INPO SOER 88-01, EPRI NP-7079, and EPRI TR-108147, performance of air systems has improved significantly.

Oyster Creek:

The Compressed Air Monitoring aging management program incorporates air quality monitoring activities identified in NRC IN 81-38, IN 87-28, IN 87-28 S1 and SOER 88-01 **(Reference(s): 4.2.2, 4.2.3, 4.2.4, 4.3.3)** and industry operating experience and air monitoring and operability testing guidance provided in EPRI TR-108147 (revised guide to EPRI NP-7079) and ASME OM-S/G-1998, Part 17 **(Reference(s): 4.3.2, 4.3.1)**. EPRI TR-108147 is relevant to Oyster Creek as recently replaced compressors provide instrument air dried by a new train of dryers. The program utilizes the new industry air quality standard, ISA-S7.0.01-1996 **(Reference: 4.3.4),** consistent with NUREG 1801.

Operating experience, both internal and external, is used in two ways at Oyster Creek to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Oyster Creek. The first way in which operating experience is used is through the Oyster Creek Operating Experience process. The Operating Experience process screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The second way is through the process for managing programs. This process requires the review of program related operating experience by the program owner.

Both of these processes review operating experience from both external and internal (also referred to as in-house) sources. External operating experience may include such things as INPO documents (e.g., SOERs, SERs, SENs, etc.), NRC documents (e.g., GLs, LERs, INs, etc.), General Electric documents (e.g., RCSILs, SILs, TILs, etc.), and other documents (e.g., 10CFR Part 21 Reports, NERs, etc.). Internal operating experience may include such things as event investigations, trending reports, and lessons learned from in-house events as captured in program notebooks, self-assessments, and in the 10 CFR Part 50, Appendix B corrective action process.

Demonstration that Oyster Creek Compressed Air Monitoring aging management program will continue to effectively manage the instrument air quality to preclude aging effects is achieved through objective evidence. The following examples of operating experience provide objective evidence that the existing GL 88-14 activities which are maintained by the Oyster Creek Compressed Air Monitoring aging management program have been effective in managing air quality. This demonstrates that the Oyster Creek Compressed Air Monitoring program will continue to be effective in ensuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

1) Dryer performance in the past five years prior to Oyster Creek LRA submittal had resulted in periods of elevated dew points **(Reference(s) 4.4.4, 4.4.5, 4.4.8)**. Dew points, however, typically remained at least 18°F below system operating temperatures consistent with ISA-S7.0.01-1996, Quality Standard for Instrument Air **(Reference: 4.3.4)**.

2) In 2004, both sets of instrument air dryer trains failed to switch columns **(Reference: 4.4.6)**. Two days after this occurrence, an instrument air dryer train again failed to switch columns **(Reference: 4.4.9)**. These events were caused by insufficient draining of compressor condensate thus allowing large moisture carryover to the dryers. This was confirmed by identification of moisture in the third air dryer pre-filter, from partially clogged air receiver and pre-filter drains and by reduced function of compressor inter and after coolers during high humidity days. Also, the moisture carryover into the dryers caused eventual desiccant fracture. Loss of both dryers for an extended period of time and dessicant fracture could impact operation of

instrument air components. An OPEX review found no industry operating experience applicable to this issue.

Corrective actions including desiccant change to activated alumina and an increase of the blowdown time of the compressor moisture separators. Use of activated alumina desiccant improves dryer performance because the desiccant can function even with water impingement. Evaluation of drain piping modification or addition of a cycling refrigerated air dryer upstream of the receivers is in progress.

Prior to this event the one train of instrument air dryers was replaced in 2003. The lead and lag air compressors were replaced in 2001. Replacement of the second train of instrument air dryers is being considered.

These issues, which are documented and addressed as part of the corrective action process, did not result in a prolonged or extensive decrease in air quality nor result in the failure of components utilizing instrument air **(Reference: 4.4.15).**

3) Oyster Creek has experienced superficial external corrosion on safety related components of the instrument air system and equipment failures of air operated valves due to instrument air leaks **(Reference(s) 4.4.4, 4.4.7)**. These failures were of individual components, not common mode and not caused by internal corrosion of the instrument air system.

4) Oyster Creek has had an air leak on an air scram header caused by a material installation not meeting specifications **(Reference(s): 4.4.8, 4.4.10)**. This occurrence, which is similar to that identified by LER 50-237/94-005-3 **(Reference: 4.2.5)**, was a procurement deficiency during a modification. All deficient material was subsequently replaced. The deficiency at Oyster Creek was not the result of instrument air related aging mechanism nor involved piping within the scope of license renewal.

The operating experience of the Oyster Creek GL 88-14 activities did not show any adverse trend in performance. Problems are promptly identified and corrective actions are taken to correct the situation and prevent recurrence to preclude significant impact to the safe operation of the plant. There is sufficient confidence that the implementation of the Compressed Air Monitoring program will continue to effectively maintain air quality. Periodic self-assessments of the Compressed Air Monitoring program are performed to identify the areas that need improvement to maintain the quality performance of the program. One improvement as the result of self assessment was the upgrade to ISA-S7.0.01-1996.

3.10 Conclusion

The Oyster Compressed Air Monitoring aging management program ensures that the compressed air environment meets the requirements of dry gas such that the aging effects are precluded for the components listed in Table 5.2. The Oyster Creek Compressed Air Monitoring program's elements have been evaluated against NUREG-1801 in Section 3.0. Program exceptions have been identified in Section 2.3. Program enhancements have been identified in Section 2.4. The implementing documents for this aging management program are listed in Table 5.1. The relevant operating experience has been reviewed and a demonstration of program effectiveness is provided in Section 3.10.

Based on the above, the continued implementation of the Oyster Creek Compressed Air Monitoring aging management program provides reasonable assurance that aging effects are precluded so that the intended functions of the instrument air components within the scope of license renewal are maintained during the period of extended operation.

4.0 REFERENCES

4.1 Generic to Aging Management Programs

4.1.1 10 CFR 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*

4.1.2 10 CFR 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*

4.1.3 NUREG-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,* Revision 1, dated September 2005

4.1.4 NUREG-1801, *Generic Aging Lessons Learned (GALL) Report*, Revision 1, dated September 2005

4.2 NRC Documents

4.2.1 NRC Generic Letter 88-14, *Instrument Air Supply Problems*

Affecting Safety-Related Components, U.S. Nuclear Regulatory Commission, August 8, 1988

4.2.2 NRC Information Notice 81-38, *Potentially Significant Components Failures Resulting from Contamination of Air-Operated Systems*, U.S. Nuclear Regulatory Commission, December 17, 1981

4.2.3 NRC Information Notice 87-28, *Air Systems Problems at U.S. Light Water Reactors,* U.S. Nuclear Regulatory Commission, June 27, 1987

4.2.4 NRC Information Notice 87-28 S1, *Air Systems Problems at U.S. Light Water Reactors,* U.S. Nuclear Regulatory Commission, December 28, 1987

4.2.5 LER 50-237/94-005-3, *Manual Reactor Scram due to Loss of*
Instrument Air Resulting from Air Receiver Pipe Failure Caused by Improper Installation of Threaded Pipe during Initial Construction, U.S. Nuclear Regulatory Commission, April 23, 1997.

4.3 Industry Standards

4.3.1 ASME OM-S/G-1998, Part 17, *Performance Testing of Instrument Air Systems Information Notice Light-Water Reactor Power Plants*, 1ISA-S7.0.1-1996, "Quality Standard for Instrument Air," American Society of Mechanical Engineers, New York, NY, 1998

4.3.2 EPRI/NMAC TR-108147, *Compressor and Instrument Air System Maintenance Guide: Revision to NP-7079*, Electric Power Research Institute, Palo Alto, CA., March 1998

4.3.3 INPO SOER 88-01, *Instrument Air System Failures*, May 18, 1988

4.3.4 ANSI/ISA-S7.0.01-1996, *Quality Standard for Instrument Air*

4.4 Oyster Creek Program References

4.4.1 Letter E. E. Fitzpatrick to NRC dated February 21, 1989, Response to GL 88-14.

4.4.2 Letter J.J. Barton to NRC dated March 9, 1992, Status of Actions, Generic Letter 88-14

4.4.3 Calculation C-1302-852-5360-008, Accumulator Leakage Criteria

4.4.4 Instrument Air CAP summary, 2000 thru 2004.

4.4.5 CAPs O1998-1059, O2001-1047, O2004-1859, O2004-2031, Dew Point Issues

4.4.6 CAP O2004-0647, Failure of Instrument Air dryers

4.4.7 CAPs O2003-1518, SGTS accumulator corrosion, O2004-1477, SGTS AOV air line crack

4.4.8 CAP O2003-2490, Air leak in scram header

4.4.9 CAP O2004-0661, Air dryer failure

4.4.10 828.0.0043, *Service, Instrument and Breathing Air Operator Training*

4.4.11 SDBD-0C-852, Rev 3, *Plant Compressed Air System Design Basis Document*

4.4.12 AMP-081, Compressed Air Monitoring, document requests, 9/23/05

4.4.13 AMP-113, Compressed Air Monitoring, implementing documentation for element 5, 10/5/05 (Provided to K Sullivan 10/7/05)

4.4.14 AMP-130, Compressed Air Monitoring, implementing documentation per ten element, 10/5/05 (1. Deferred to AMP-113 (10/6/05) & 2. PBD-AMP-B.1.17, rev 0))

4.4.15 Email from J Tabone to C Micklo, 11/22/05, Instrument Air Quality

5.0 TABLES

5.1 Aging Management Program Implementing Documents

	Document Number	Document Title	AR No.	Status

1.	R0800446	Instrument Air System Dew Point and Particulate	00330592.17.01	ACC/ASG
2.	R0800738	Instrument Air Leak Test, MSIV V-1-7	00330592.17.02	ACC/ASG
3.	R0800741	Instrument Air Leak Test, MSIV V-1-8	00330592.17.03	ACC/ASG
4.	R0800744	Instrument Air Leak Test, MSIV V-1-9	00330592.17.04	ACC/ASG
5.	R0800747	Instrument Air Leak Test, MSIV V-1-10	00330592.17.05	ACC/ASG
6.	R0800716	ISOL COND VLV V-11-34	00330592.17.06	ACC/ASG
7.	R0800719	ISOL COND VLV V-11-36	00330592.17.07	ACC/ASG
8.	R0803679	PERFORM NRC GL 88-14 AIR OPERATOR/AC, V-23-13/14, V-23-15/16	00330592.17.08	ACC/ASG
9.	R0800733	V-26-16 INST. AIR; TORUS-TO-RB VACUUM BREAKER	00330592.17.09	ACC/ASG
10.	R0800735	V-26-18 INST. AIR; TORUS-TO-RB VACUUM BREAKER	00330592.17.10	ACC/ASG
11.	R0800722	CONTAINMENT ISOLATION VALVE-INSTRUMENT AIR SYSTEM, V-27-1	00330592.17.11	ACC/ASG
12.	R0800724	V-27-2 CTMT ISOL VALVE INST AIR INSP	00330592.17.12	ACC/ASG
13.	R0800727	V-27-3 CTMT ISOL VALVE INST AIR INSP	00330592.17.13	ACC/ASG
14.	R0800730	V-27-4 CTMT ISOL VALVE INST AIR INSP	00330592.17.14	ACC/ASG
15.	R0800750	Containment Isolation Valve-Instrument Air System, V-28-1/2	00330592.17.15	ACC/ASG
16.	R0800753	Containment Isolation Valve Instrument Air Inspection, V-28-3/4	00330592.17.16	ACC/ASG
17.	R0800756	CTMT ISO VALVE-INST AIR SYS INSP V-28-5 & V-28-6, V-28-5/6	00330592.17.17	ACC/ASG
18.	R0800759	V-28-7 & -8 CTMT ISOL VALVE-INST AIR SYS INSP	00330592.17.18	ACC/ASG
19.	R0800762	V-28-9 & -10 CTMT ISOL VALVE-INST AIR SYS INSP	00330592.17.19	ACC/ASG
20.	R0800765	Instrument Air Leak Test, V-28-11/12	00330592.17.20	ACC/ASG
21.	R0800779	Instrument Air Leak Test, V-28-13/14	00330592.17.21	ACC/ASG
22.	R0800782	Instrument Air Leak Test, V-28-15/16	00330592.17.22	ACC/ASG
23.	R0800771	Instrument Air Leak Test, V-28-21/22	00330592.17.23	ACC/ASG
24.	R0800811	Instrument Air Leak Test, V-28-23/26	00330592.17.24	ACC/ASG
25.	R0800768	Instrument Air Leak Test, V-28-27/30	00330592.17.25	ACC/ASG
26.	R0800785	Instrument Air Leak Test, V-28-36/37	00330592.17.26	ACC/ASG
27.	R0800788	Instrument Air Leak Test, V-28-38/39	00330592.17.27	ACC/ASG
28.	R0800791	Instrument Air Leak Test, V-28-42/43	00330592.17.28	ACC/ASG

5.2 Aging Management Review Results

SSC Name	Structure and/or Component	Material	Environment	Aging Effect
Instrument (Control) Air System	Accumulator	Carbon and low alloy steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Filter Housing	Zinc	Dry Gas (Internal)	None
Instrument (Control) Air System	Filter Housing	Zinc	Dry Gas (Internal)	None
Instrument (Control) Air System	Filter Housing	Stainless Steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Flexible Hose	Stainless Steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Flow Element	Stainless Steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Piping and fittings	Copper	Dry Gas (Internal)	None
Instrument (Control) Air System	Piping and fittings	Brass	Dry Gas (Internal)	None
Instrument (Control) Air System	Piping and fittings	Stainless Steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Piping and fittings	Carbon and low alloy steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Piping and fittings	Carbon and low alloy steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Piping and fittings	Brass	Dry Gas (Internal)	None
Instrument (Control) Air System	Piping and fittings	Stainless Steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Piping and fittings	Copper	Dry Gas (Internal)	None
Instrument (Control) Air System	Valve Body	Brass	Dry Gas (Internal)	None
Instrument (Control) Air System	Valve Body	Carbon and low alloy steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Valve Body	Aluminum	Dry Gas (Internal)	None
Instrument (Control) Air System	Valve Body	Bronze	Dry Gas (Internal)	None
Instrument (Control) Air System	Valve Body	Brass	Dry Gas (Internal)	None
Instrument (Control) Air System	Valve Body	Carbon and low alloy steel	Dry Gas (Internal)	None
Instrument (Control) Air System	Valve Body	Stainless Steel	Dry Gas (Internal)	None

Note 1 The environment of dried gas –dry air (air treated to reduce dew point well below system operating temperature) was used for the Instrument Air system. The Compressed Air Monitoring program is applied to the Instrument Air system components to confirm the internal environment remains sufficiently dry to preclude aging effects.

6.0 ATTACHMENTS

6.1 LRA Appendix A

6.2 LRA Appendix B

PROGRAM BASIS DOCUMENT

PBD-AMP-B.1.25

Revision 0

SELECTIVE LEACHING OF MATERIALS

GALL PROGRAM XI.M33 - SELECTIVE LEACHING OF MATERIALS

Prepared By: ______________________

Reviewed By: ______________________

Program Owner Review: ______________________

Technical Lead Approval: ______________________

Revision History:

Revision	*Prepared by:*	*Reviewed by:*	*Program Owner:*	*Approved by:*
0	*Charles Micklo*	*Stuart Getz*	*John Camire*	*Fred Polaski*
Date				

Summary of Revisions:

Rev. Number	Reason for the Revision(s)
0	Initial Issue

TABLE OF CONTENTS

1.0 PURPOSE AND METHODOLOGY

1.1 Purpose

The purpose of this Program Basis Document is to document and evaluate those activities of the Oyster Creek Selective Leaching of Materials aging management program that are credited for managing the loss of material due to selective leaching as part of Oyster Creek License Renewal to meet the requirements of the License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

This includes the following:

- The identification of the scope of the program;
- The evaluation of program elements against NUREG-1801;
- The review of Operating Experience to demonstrate program effectiveness; and
- The identification of required program enhancements;
- The identification of Oyster Creek documents required to implement the program.

1.2 Methodology

The nuclear power plant License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," describes the License Renewal process and provides requirements for the contents of License Renewal Applications. 10 CFR 54.21(a)(3) states:

"For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the Current Licensing Basis (CLB) for the period of extended operation."

The NRC and the industry identified 10 program elements that are useful in describing an aging management program and then demonstrating its effectiveness. These program elements are described in Appendix A.1, Section A.1.2.3 of the Standard Review Plan. NUREG-1801 uses these program elements in Section XI to describe acceptable aging management programs.

The Program Basis Document also provides a comparison of the credited Oyster Creek program with the elements of the corresponding NUREG-1801 Chapter XI program XI.M33, Selective Leaching of Materials. Project Level Instruction PLI-8 "Program Basis Documents" prescribes the methodology for evaluating Aging Management Programs. An evaluation of Oyster Creek's aging management program criteria or activities to those of the NUREG-1801 program elements is performed and a conclusion is reached concerning consistency for each individual program element. A demonstration of overall program effectiveness is made after all program elements are evaluated. Required program enhancements are documented. An overall determination is made as to consistency with the program description in NUREG-1801.

2.0 PROGRAM DESCRIPTION

2.1 Program Description

<u>NUREG-1801:</u>

a) *The program for selective leaching of materials ensures the integrity of the components made of cast iron, bronze, brass, and other alloys exposed to a raw water, brackish water, treated water, or groundwater environment that may lead to selective leaching of one of the metal components.*

b) *The aging management program (AMP) includes a one-time visual inspection and hardness measurement of selected components that may be susceptible to selective leaching to determine whether loss of materials due to selective leaching is occurring, and whether the process will affect the ability of the components to perform their intended function for the period of extended operation.*

<u>Oyster Creek:</u>

a) The Selective Leaching of Materials aging management program ensures the integrity of the components that may be susceptible to selective leaching at Oyster Creek. Components of the susceptible materials are comprised of cast iron and copper alloys exposed to raw water, treated water, closed cooling water and groundwater environments. The aging management program (AMP) includes a one-time visual inspection and hardness measurement of selected components to determine whether loss of materials by the preferential removal of one of the alloying elements from a material in an aqueous environment is occurring. The Selective Leaching of Materials program will develop a new procedure to perform visual inspections and hardness tests on components susceptible to selective leaching.

b) Visual inspections are performed as part of the one-time inspection program. Overall dimensional changes may not result when selective leaching occurs; however, the remaining material may be brittle and possess little strength. As such, the program will develop a new procedure to perform visual inspections supplemented with hardness tests and other appropriate examination methods as may be required to confirm or rule out selective leaching, and to evaluate the remaining component wall thickness when selective leaching is identified. If selective leaching is found, the program inspection procedure will require an evaluation as to the effect it will have on the ability of the affected components to perform their intended function for the period of extended operation and the need for additional inspections.

The Selective Leaching of Materials aging management program is a new program. The program will be implemented prior to the period of extended operation.

2.2 Overall NUREG-1801 Consistency

The Oyster Creek Selective Leaching of Materials is a new program that is consistent with NUREG-1801 aging management program XI.M33.

2.3 Summary of Exceptions to NUREG-1801

None. The new Oyster Creek Selective Leaching of Materials aging management program is found to be adequate to support the extended period of operation with no exceptions.

2.4 Summary of Enhancements to NUREG-1801

None. The new Oyster Creek Selective Leaching of Materials aging management program is found to be adequate to support the extended period of operation with no enhancements.

3.0 EVALUATIONS AND TECHNICAL BASIS

Note

This section is organized by quoting the relevant NUREG-1801 Chapter XI program element (September 2005 version) followed by the related Oyster Creek program attributes and a conclusion of the comparison. Where applicable, the NUREG-1801 program element was separated into logical sub-elements and addressed accordingly.

References are included in **( )** for information purposes. This information from the source reference has been either directly extracted from the reference or summarized for inclusion into this PBD.

3.0 Scope of Program

NUREG-1801:

a) *This AMP determines the acceptability of the components that may be susceptible to selective leaching and assesses their ability to perform the intended function during the period of extended operation.*

b) *These components include piping, valve bodies and bonnets, pump casings, and heat exchanger components.*

c) *The materials of construction for these components may include cast iron, brass, bronze, or aluminum-bronze.*

d) *These components may be exposed to a raw water, treated water, or groundwater environment.*

e) *The AMP includes a one-time visual inspection and hardness measurement of a selected set of sample components to determine whether loss of material due to selective leaching is not occurring for the period of extended operation.*

f) *The selective leaching process involves the preferential removal of one of the alloying elements from the material, which leads to the enrichment of the remaining alloying elements. Dezincification (loss of zinc from brass) and graphitization (removal of iron from cast iron) are examples of such a process. Susceptible materials, high temperatures, stagnant-flow conditions, and corrosive environment such as acidic solutions, for example, for brasses with high zinc content, and dissolved oxygen, are conducive to selective leaching.*

Oyster Creek:

a) The scope of this program includes the Oyster Creek components that may be susceptible to selective leaching and, if selective leaching is found, assesses their ability to perform their intended function during the period of extended operation.

b) These components include piping and fittings, valve bodies, pump casings, strainer bodies, heat exchanger sub-assemblies and fire protection components that include fire hydrants, tanks and sprinkler heads as listed in Table 5.2.

c) The materials of construction for these components include cast iron, brass, bronzes and copper alloys as listed in Table 5.2.

d) These components are exposed to raw water (salt and fresh), treated water, closed cooling water - treated water subject to the closed cooling water chemistry program **(Reference: 4.1.4, Table IX.D)**, and groundwater environments as listed in Table 5.2. Remaining copper alloy components and cast iron components within the scope of License Renewal at Oyster Creek are not within environments that make them susceptible to selective leaching. Fuel and lube oil are monitored for leaching conducive water content and thus are not leaching environments. (*Oil and fuel oil are not good electrolytes. Intrusion of moisture into these systems is required for selective leaching to be a concern.* ***(Reference 4.2.1, App C, par 3.1.8)****)*

e) The AMP includes a one-time visual inspection and hardness measurement of a selected set of sample components to determine whether loss of material due to selective leaching is not occurring for the period of extended operation. Laboratory examinations may be performed if visual inspections and hardness tests are unfeasible or inconclusive. The program will include these requirements in a new inspection procedure.

f) The selective leaching process involves the preferential removal of one of the alloying elements from the material, which leads to the enrichment of the remaining alloying elements **(Reference(s) 4.2.1, App's A, B, C & E; 4.2.2, pg 25)**. Dezincification (loss of zinc from brass) and graphitization (removal of iron from cast iron) are applicable to the component materials used at Oyster Creek. Susceptible materials at Oyster Creek are exposed to stagnant-flow conditions, corrosive environments and dissolved oxygen, which are conducive to selective leaching as shown in Table 5.2.

The Selective Leaching of Materials aging management program ensures the integrity of the components, as listed in Table 5.2, that may be susceptible to selective leaching. The implementing documents for this aging management program are listed in Table 5.1.

Exceptions to NUREG-1801, Element 1:

None.

Enhancements to NUREG-1801, Element 1:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 1, Scope of Program.

3.1 Preventive Actions

NUREG-1801:

The one-time visual inspection and hardness measurement is an inspection/verification program; thus, there is no preventive action. However, it is noted that monitoring of water chemistry to control pH and concentration of corrosive contaminants, and treatment with hydrazine to minimize dissolved oxygen in water are effective in reducing selective leaching.

Oyster Creek:

The selective leaching of materials program consists of inspection/verification activities including hardness tests that detect component degradation prior to loss of their intended functions. The Selective Leaching of Materials program will develop a new procedure to perform visual inspections and hardness tests to determine if selective leaching is occurring. As such, there are no preventive or mitigative attributes associated with this program.

In applicable systems at Oyster Creek (treated water and CCW systems), water chemistry is monitored to minimize corrosive contaminants, to control pH, and in some cases corrosion-inhibiting additives are used. These activities are considered effective in reducing selective leaching.

Exceptions to NUREG-1801, Element 2:

None.

Enhancements to NUREG-1801, Element 2:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 2, Preventive Actions.

3.2 Parameters Monitored or Inspected

NUREG-1801:

a) The visual inspection and hardness measurement is to be a one-time inspection.

b) Because selective leaching is a slow acting corrosion process, this measurement is performed just before the beginning of the license renewal period. Follow-up of unacceptable inspection findings includes expansion of the inspection sample size and location.

Oyster Creek:

a) The one-time visual inspection and hardness measurement will be conducted on components made of both cast iron and copper alloys in raw and treated water environments to obtain a comprehensive sample in the determining if selective leaching is occurring at Oyster Creek. The program will develop a new inspection procedure for selective leaching and the maintenance documents to implement it.

b) Oyster Creek is less than 5 years from the end of the current license term, so these inspections will be performed prior to entering the period of extended operation. This time period is consistent with NUREG-1801.

Although selective has been previously identified at Oyster Creek for the Service Water pumps, submerged cast iron components that produced selective leaching is no longer used for components within the scope of license renewal as discussed in section 3.10, paragraph 6. As such, this new inspection will be performed for the remaining material environment combinations that are susceptible to selective leaching.

If loss of material due to selective leaching is identified, further evaluation of the extent of selective leaching will be performed. An evaluation that indicates the end-of-life (violation of minimum wall thickness) of the component prior to plant year 60 will be considered unacceptable. Follow-up of unacceptable inspection findings includes expansion of the inspection sample size. The program will develop a new inspection procedure to identify and evaluate selective leaching, if it is occurring, at Oyster Creek.

Exceptions to NUREG-1801, Element 3:

None.

Enhancements to NUREG-1801, Element 3:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 3, Parameters Monitored or Inspected.

3.3 Detection of Aging Effects

NUREG-1801:

a) The one-time visual inspection and hardness measurement includes close examination of a select set of components to determine whether selective leaching has occurred and whether the resulting loss of strength and/or material will affect the intended functions of these components during the period of extended operation.

b) Selective leaching generally does not cause changes in dimensions and is difficult to detect. However, in certain brasses it causes plug-type dezincification, which can be detected by visual inspection. One acceptable procedure is to visually inspect the susceptible components closely and conduct Brinell Hardness testing on the inside surfaces of the selected set of components to determine if selective leaching has occurred.

c) If it is occurring, an engineering evaluation is initiated to determine acceptability of the affected components for further service.

Oyster Creek:

a) The one-time visual inspection and hardness measurement will be performed in accordance with a new inspection procedure on a representative set of components susceptible to selective leaching to determine if loss of material due to selective leaching has occurred. Detection of selective leaching will require an engineering evaluation to determine acceptability of the affected components to continue to perform their intended functions as discussed in section 3.6. This requirement will be included in the new inspection procedure.

b) Visual inspections will be performed using ASME Section XI VT-1 techniques **(Reference: 4.3.9, step 4)**. Selective leaching generally does not cause changes in dimensions but results in a weakness of the underlying structure **(Reference(s): 4.2.1, App's A, B & C; 4.2.2, pg 25)**, the exception being plug-type dezincification. Thus, visual inspections are supplemented with hardness tests. Laboratory examinations may be performed if visual inspections and hardness tests are unfeasible or inconclusive. These inspection techniques will be included in the new selective leaching inspection procedure.

c) Detection of selective leaching will require an engineering evaluation to determine acceptability of the affected components to continue to perform their intended functions as discussed in section 3.6. This requirement will be included in the new inspection procedure.

<u>Exceptions to NUREG-1801, Element 4:</u>

None.

<u>Enhancements to NUREG-1801, Element 4:</u>

None.

<u>Comparison and Evaluation Conclusion:</u>

This element is consistent with NUREG-1801, Element 4, Detection of Aging Effects.

3.4 Monitoring and Trending

<u>NUREG-1801:</u>

There is no monitoring and trending for the one-time visual inspection and hardness measurement.

<u>Oyster Creek:</u>

There is no monitoring and trending for the one-time visual inspection and hardness measurement. The new inspection procedure will require results that identify selective leaching to be evaluated. The components ability to perform its intended function for the extended period of operation will be ensured and the need to expand sample inspections determined.

Exceptions to NUREG-1801, Element 5:

None.

Enhancements to NUREG-1801, Element 5:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 5, Monitoring and Trending.

3.5 Acceptance Criteria

NUREG-1801:

Identification of selective leaching will define the need for further engineering evaluation before the affected components can be qualified for further service. If necessary, the evaluation will include a root cause analysis.

Oyster Creek:

The presence of selective leaching will initiate evaluations as required by the new inspection procedure that will determine the individual component's continued use (depth of leaching vs. min-wall requirements). Evaluations by the OCGS corrective action program will determine further actions, possibly including a root cause analysis and the need to expand the number of inspections.

Exceptions to NUREG-1801, Element 6:

None.

Enhancements to NUREG-1801, Element 6:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 6, Acceptance Criteria.

3.6 Corrective Actions

NUREG-1801:

Evaluations are performed for test or inspection results that do not satisfy established acceptance criteria. The corrective actions program ensures that conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude repetition. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

Oyster Creek:

Evaluations will be performed for test results that identify selective leaching and a condition report will be initiated to document the concern in accordance with plant administrative procedures and the new procedure for selective leaching inspection. The corrective actions program ensures that conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition will be determined and an action plan will be developed to preclude repetition. Preclusion of repetition has been demonstrated by material change to corrosion resistant materials in the service water pumps after identification of selective leaching as discussed in section 3.10, paragraph 6. The requirements of 10 CFR Part 50, Appendix B are implemented for addressing corrective actions.

Exceptions to NUREG-1801, Element 7:

None.

Enhancements to NUREG-1801, Element 7:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 7, Corrective Actions.

3.7 Confirmation Process

NUREG-1801:

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process and administrative controls.

Oyster Creek:

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

Exceptions to NUREG-1801, Element 8:

None.

Enhancements to NUREG-1801, Element 8:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 8, Confirmation Process.

3.8 Administrative Controls

NUREG-1801:

See Item 8, above.

Oyster Creek:

See Item 8, above.

Exceptions to NUREG-1801, Element 9:

None.

Enhancements to NUREG-1801, Element 9

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 9, Administrative Controls.

3.9 Operating Experience

NUREG-1801:

One-time inspection is a new program to be applied by the applicant. The elements that comprise these inspections (e.g., the scope of the inspections and inspection techniques) are consistent with industry practice and staff expectations.

Oyster Creek:

Selective leaching 'one-time' inspections will be performed prior to the period of extended operation. Inspection techniques include visual inspections and hardness testing consistent with the requirements of NUREG-1801. The selection of component materials included are consistent with industry and staff guidance. **(Reference(s): 4.1.4, Chapter XI, program XI.M33; 4.2.1, App's A, B, C & E)**

Operating experience, both internal and external, is used in two ways at Oyster Creek to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Oyster Creek. The first way in which operating experience is used is through the Oyster Creek Operating Experience process. The Operating Experience process screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The second way is through the process for managing programs. This process requires the review of program related operating experience by the program owner.

Both of these processes review operating experience from both external and internal (also referred to as in-house) sources. External operating experience may include such things as INPO documents (e.g., SOERs, SERs, SENs, etc.), NRC documents (e.g., GLs, LERs, INs, etc.), General Electric documents (e.g., RCSILs, SILs, TILs, etc.), and other documents (e.g., 10CFR Part 21 Reports, NERs, etc.). Internal operating experience may include such things as event investigations, trending reports, and lessons learned from in-house events as captured in program notebooks, self-assessments, and in the 10 CFR Part 50, Appendix B corrective action process.

Demonstration that the Oyster Creek Selective Leaching of Materials aging management program to effectively manage loss of material in components susceptible to selective leaching will be achieved through objective evidence. The following industry operating experience and site-specific findings at Oyster Creek have been utilized in creating the Oyster Creek Selective Leaching of Materials aging management program:

Industry operating experience has identified graphitization of submerged pump components from long-term immersion in saltwater environments **(Reference: 4.3.2)** and dezincification of copper alloy components. Graphitization has occurred in the Oyster Creek Service Water system and the Circulating Water system at the intake structure **(Reference: 4.3.1)**. In the case of the non-nuclear service water pumps the pump suction bowls were at one time all made of cast iron. Submergence in the intake bay for years at a time caused severe graphitization of these bowls. This diagnosis was made at the time by a materials engineer on the staff of the pump company and was confirmed based on visual observation by the materials engineer of the previous plant owner.

At this time, cast iron is no longer used or specified for use in the submerged portions of the service water pumps. Replacement parts are constructed from corrosion resistant materials. Additionally, the Emergency Service Water pumps do not contain cast iron parts. **(Reference: 4.3.1)**

In the case of the circulating water pumps, the suction column sections (4) for each of the four pumps were all originally purchased with cast iron parts. Again, evidence of graphitic corrosion was found occurring early in their life. Steps were taken to replace the sections with new sections fabricated of stainless steel or carbon steel as deemed necessary. In addition, to prevent galvanic corrosion, insulation kits were installed between flanges where dissimilar metals met. At the present time, there remain a few sections still made of the original cast iron, but these are heavily coated. These sections are visually inspected by the repair facility during overhauls in which the pump is removed from service and shipped to them. The circulating water pumps are not within the scope of License Renewal.

As such, sample inspections at Oyster Creek will include remaining cast iron components subjected to a saltwater environment.

Once implemented the Oyster Creek Selective Leaching of Materials aging management program will manage loss of material such that intended function(s) of components susceptible to selective leaching will be maintained consistent with the CLB for the period of extended operation.

3.11 Conclusion

The new Oyster Creek Selective Leaching of Materials aging management program will manage loss of material due to selective leaching for the components listed in Table 5.2. The Oyster Creek Selective Leaching of Materials program's elements have been evaluated against NUREG-1801 in Section 3.0. Program exceptions have been identified in Section 2.3. Program enhancements have been identified in Section 2.4. The implementing documents for this aging management program are listed in Table 5.1. The relevant operating experience has been reviewed and a demonstration of the Oyster Creek's Appendix B program effectiveness is provided in Section 3.10.

Based on the above, the implementation of the new Oyster Creek Selective Leaching of Materials inspection activities will provide reasonable assurance that the loss of material due selective leaching will be identified prior to the loss of intended functions.

4.0 REFERENCES

4.1 Generic to Aging Management Programs

4.1.1 10 CFR 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*

4.1.2 10 CFR 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*

4.1.3 NUREG-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,* Revision 1, dated September 2005

4.1.4 NUREG-1801, *Generic Aging Lessons Learned (GALL) Report*, Revision 1 dated September 2005

4.2 Industry Standards

4.2.1 EPRI Technical Report 1003056, *Mechanical Implementation Guideline and Mechanical Tools*, Revision 3, November 2001

4.2.2 EPRI Technical Report 1007933, *Aging Assessment Field Guide*, December 2003

4.2.3 Closed Cooling Water Chemistry Guidelines, Revision 1, EPRI TR 1007820 Chemistry

4.3 Oyster Creek References

4.3.1 Leaching at Oyster Creek, Email from J Camire to C Micklo, 10/6/2005

4.3.2 Selective Leaching, Email from M Hayse to C Micklo, 11/16/2004

4.3.3 AMP-109, Selective Leaching of Materials, Operating Experience request, 10/4/05 (Provided to W Wang 10/6/05)

4.3.4 PBD-AMP-B.1.22, rev 0, Fuel Oil Chemistry

4.3.5 PBD-AMP-B.1.39, rev 0, Lube Oil Analysis

4.3.6 PBD-AMP-B.1.14, rev 0, Closed Cycle Cooling Water System

4.3.7 CY-AB-120-110, rev 8, Condensate and Feedwater Chemistry

4.3.8 636.1.010, rev 24, Diesel Generator Inspection

4.3.9 ER-AA-335-014, rev 1, VT-1 Visual Inspection

4.3.10 CY-AA-120-400, rev 8, Closed Cooling Water Chemistry

4.3.11 CY-AA-120-4000, rev 1, Closed Cooling Water Chemistry Strategic Plan

5.0 TABLES

5.1 Aging Management Program Implementing Documents

#	Document No.	Procedure Title	Commitment No.	Status
1	New PM SEL-LEA1	Selective Leaching Inspection Work Order (cast iron – raw water)	00330592.25.02	ACC/ASG
2	New PM SEL-LEA2	Selective Leaching Inspection Work Order (cast iron – treated water, Cont Spray pump)	00330592.25.03	ACC/ASG

3	New PM SEL-LEA3	Selective Leaching-Lea Inspection Work Order (copper alloy – raw water)	00330592.25.04	ACC/ASG
4	New PM SEL-LEA4	Selective Leaching Inspection Work Order (copper alloy – treated water)	00330592.25.05	ACC/ASG
5	New Procedure	Selective Leaching Inspection	00330592.25.06	ACC/ASG

5.2 Aging Management Review Results

SSC Name	Structure and/or Component	Material	Environment	Aging Effect
Condensate Transfer System	Valve Body	Aluminum Bronze	Treated Water <140F (Internal)	Loss of Material
Emergency Service Water System	Heat Exchangers (Containment Spray)	Aluminum Bronze (tubesheet)	Raw Water – Salt Water (Internal)	Loss of Material
Emergency Service Water System	Heat Exchangers (Containment Spray)	Aluminum Bronze (tubesheet)	Treated Water (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Restricting Orifice	Brass	Closed Cooling Water (Internal)	Loss of Material
Emergency Service Water System	Piping and fittings	Brass	Raw Water – Salt Water (Internal)	Loss of Material
Circulating Water System	Piping and fittings	Brass	Raw Water – Salt Water (Internal)	Loss of Material
Service Water System	Piping and fittings	Brass	Raw Water – Salt Water (Internal)	Loss of Material
Control Rod Drive System	Valve Body	Brass	Treated Water (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Brass	Closed Cooling Water (Internal)	Loss of Material
Service Water System	Piping and fittings	Brass	Raw Water – Salt Water (Internal)	Loss of Material
Water Treatment & Distr. System	Valve Body	Brass	Treated Water (Internal)	Loss of Material
Fire Protection System	Sprinkler Heads	Brass	Raw Water – Fresh Water (Internal)	Loss of Material
Fire Protection System	Sprinkler Heads	Brass	Raw Water – Fresh Water (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Thermowell	Brass	Closed Cooling Water (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Sensor Element (Temperature Control Manifold)	Brass	Closed Cooling Water (Internal)	Loss of Material

Emergency Diesel Generator and Auxiliary System	Restricting Orifice	Brass	Closed Cooling Water (Internal)	Loss of Material
Fire Protection System	Piping and fittings	Brass	Raw Water – Fresh Water (Internal)	Loss of Material
Emergency Service Water System	Valve Body	Brass	Raw Water – Salt Water (Internal)	Loss of Material
Fire Protection System	Valve Body	Brass	Raw Water – Fresh Water (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Heat Exchangers (Radiator)	Brass (tube side components)	Closed Cooling Water (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Heat Exchangers (Radiator)	Brass (tubes)	Closed Cooling Water (Internal)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Heat Exchanger (Lube Oil Cooler)	Brass (tubes)	Closed Cooling Water (Internal)	Loss of Material
Water Treatment & Distr. System	Valve Body	Bronze	Treated Water (Internal)	Loss of Material
Emergency Service Water System	Piping and fittings	Bronze	Raw Water – Salt Water (Internal)	Loss of Material
Fire Protection System	Valve Body	Bronze	Raw Water – Fresh Water (Internal)	Loss of Material
Emergency Service Water System	Sight Glasses	Bronze (Body)	Raw Water – Salt Water (Internal)	Loss of Material
Service Water System	Pump Casing (Service Water Pumps)	Bronze (Bowl Assembly)	Raw Water – Salt Water (Internal)	Loss of Material
Service Water System	Pump Casing (Service Water Pumps)	Bronze (Bowl Assembly)	Raw Water – Salt Water (External)	Loss of Material
Fire Protection System	Pump Casing (Vertical Turbine)	Bronze (bowls)	Raw Water – Fresh Water (Internal)	Loss of Material
Fire Protection System	Pump Casing (Vertical Turbine)	Bronze (bowls)	Raw Water – Fresh Water (External)	Loss of Material
Spent Fuel Pool Cooling System	Pump Casing (Fuel Pool Cooling Pumps & Augmented Fuel Pool Cooling Pumps)	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Heating & Process Steam System	Valve Body	Cast Iron	Auxiliary Steam (Internal)	Loss of Material

Circulating Water System	Valve Body	Cast Iron	Raw Water – Salt Water (Internal)	Loss of Material
Containment Spray System	Pump Casing	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Heating & Process Steam System	Steam Trap	Cast Iron	Boiler Treated Water (Internal)	Loss of Material
Water Treatment & Distr. System	Flow Meter	Cast Iron	Treated Water (Internal)	Loss of Material
Fire Protection System	Valve Body	Cast Iron	Soil (External)	Loss of Material
Fire Protection System	Valve Body	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Heating & Process Steam System	Valve Body	Cast Iron	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Steam Trap	Cast Iron	Auxiliary Steam (Internal)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Valve Body	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Condensate System	Valve Body	Cast Iron	Treated Water (Internal)	Loss of Material
Reactor Water Cleanup System	Valve Body	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Filter Aid Pumps)	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Sludge Pump)	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Filter Precoat Pump)	Cast Iron	Treated Water <140F (Internal)	Loss of Material
Heating & Process Steam System	Strainer Body	Cast Iron	Auxiliary Steam (Internal)	Loss of Material
Heating & Process Steam System	Strainer Body	Cast Iron	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Pump Casing - Condensate Return Pumps P-13-1A/B, Chemical Feed Addition Pumps CH-P-6A/B, Boiler No. 1 Feed Pumps CH-P-4A/B, Boiler No. 2 Feed Pumps CH-P-3A/B, Deaerator Feed Pumps CH-P-5A/B, Chemical Recirc Pump CH-P-10	Cast Iron	Boiler Treated Water (Internal)	Loss of Material

Fire Protection System	Tanks (Retarding Chamber)	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Fire Protection System	Fire hydrant	Cast Iron	Soil (External)	Loss of Material
Condensate System	Pump Casing	Cast Iron	Treated Water (Internal)	Loss of Material
Service Water System	Valve Body	Cast Iron	Raw Water – Salt Water (Internal)	Loss of Material
Reactor Building Floor and Equipment Drains	Piping and fittings	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Reactor Building Floor and Equipment Drains	Pump Casing (RBEDT pump)	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Reactor Building Floor and Equipment Drains	Valve Body	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Reactor Building Floor and Equipment Drains	Valve Body	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Chlorination System	Piping and fittings	Cast Iron	Raw Water – Salt Water (Internal)	Loss of Material
Fire Protection System	Fire hydrant	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Chlorination System	Valve Body	Cast Iron	Raw Water – Salt Water (Internal)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Pump Casing (Laundry Drain Tank Pump P-22-002)	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Sanitary Waste System	Piping and fittings	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Pump Casing (RBCCW Pumps)	Cast Iron	Closed Cooling Water (Internal)	Loss of Material
Fire Protection System	Strainer Body	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Piping and fittings	Cast Iron	Closed Cooling Water (Internal)	Loss of Material
Water Treatment & Distr. System	Valve Body	Cast Iron	Treated Water (Internal)	Loss of Material
Fire Protection System	Water Motor Alarm	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material
Turbine Building Closed Cooling Water System	Pump Casing (TBCCW Pumps, Chemical Feed Pump)	Cast Iron	Closed Cooling Water (Internal)	Loss of Material
Drywell Floor and Equipment Drains	Pump Casing (DWEDT pumps)	Cast Iron	Raw Water – Fresh Water (Internal)	Loss of Material

Turbine Building Closed Cooling Water System	Coolers (Hydrogen)	Cast Iron - Tube Side Components	Closed Cooling Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Cleanup Auxiliary Pump)	Cast Iron (Bearing Housing Cooler)	Closed Cooling Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Shutdown Cooling Pumps)	Cast Iron (Bearing Housing Cooler)	Closed Cooling Water (Internal)	Loss of Material
Containment Inerting System	Drain Trap	Cast Iron (Body)	Condensation (Internal)	Loss of Material
Service Water System	Pump Casing (Service Water Pumps)	Cast Iron (Discharge Head and Bowl Assembly)	Raw Water – Salt Water (Internal)	Loss of Material
Service Water System	Pump Casing (Service Water Pumps)	Cast Iron (Discharge Head and Bowl Assembly)	Raw Water – Salt Water (External)	Loss of Material
Fire Protection System	Pump Casing (Vertical Turbine)	Cast Iron (discharge head)	Raw Water – Fresh Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Cleanup Recirc. Pumps Lube Oil)	Cast Iron (Tube Side Components)	Closed Cooling Water (Internal)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Condensate Pump Motor)	Copper Alloy	Closed Cooling Water (Internal)	Loss of Material
Circulating Water System	Flow Indicator	Copper Alloy	Raw Water – Salt Water (Internal)	Loss of Material
Heating & Process Steam System	Valve Body	Copper Alloy	Auxiliary Steam (Internal)	Loss of Material
Heating & Process Steam System	Valve Body	Copper Alloy	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Steam Trap	Copper Alloy	Boiler Treated Water (Internal)	Loss of Material
Heating & Process Steam System	Steam Trap	Copper Alloy	Auxiliary Steam (Internal)	Loss of Material
Turbine Building Closed Cooling Water System	Valve Body	Copper Alloy	Closed Cooling Water (Internal)	Loss of Material
Circulating Water System	Valve Body	Copper Alloy	Raw Water – Salt Water (Internal)	Loss of Material

Reactor Building Closed Cooling Water System	Valve Body	Copper Alloy	Closed Cooling Water (Internal)	Loss of Material
Circulating Water System	Flow Glass	Copper Alloy	Raw Water – Salt Water (Internal)	Loss of Material
Service Water System	Strainer Body	Copper Alloy	Raw Water – Salt Water (Internal)	Loss of Material
Circulating Water System	Strainer Body	Copper Alloy	Raw Water – Salt Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Valve Body	Copper Alloy	Closed Cooling Water (Internal)	Loss of Material
Reactor Building Closed Cooling Water System	Level Glass	Copper Alloy	Closed Cooling Water (Internal)	Loss of Material
Reactor Water Cleanup System	Valve Body	Copper Alloy	Treated Water <140F (Internal)	Loss of Material
Service Water System	Valve Body	Copper Alloy	Raw Water – Salt Water (Internal)	Loss of Material
Service Water System	Valve Body	Copper Alloy	Raw Water – Salt Water (Internal)	Loss of Material
Circulating Water System	Level Glass	Copper Alloy	Raw Water – Salt Water (Internal)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Reactor Recirculation Pump M-G Sets)	Copper Alloy - Tube Side Components	Closed Cooling Water (Internal)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Feedwater Pump Lube Oil)	Copper Alloy - Tube Side Components	Closed Cooling Water (Internal)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Condenser Vacuum Pump)	Copper Alloy - Tube Side Components	Closed Cooling Water (Internal)	Loss of Material
Service Water System	Sight Glasses	Copper Alloy (Body)	Raw Water – Salt Water (Internal)	Loss of Material
Emergency Service Water System	Heat Exchangers (Containment Spray)	Copper Alloy (Tube Side Components)	Raw Water – Salt Water (Internal)	Loss of Material

6.0 ATTACHMENTS

6.1 LRA Appendix A

6.2 LRA Appendix B

Audit Question No.	Source:	Info Only	Status	Discipline	Date Received
AMP-147	AMP Audit	☐	Open		10/7/2005

NRC Representative:	Took Issue:	Assigned to:	Potential Submittal on Docket	Document Reference
Tran, Linh		Corsi, Lou	☐	All

Topic:
AMP Generic Question

Question

Please provide the basis document of the ten program elements review for the following aging management programs:

B.1.1 ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD
B.1.2 Water Chemistry
B.1.3 Reactor Head Closure Studs
B.1.4 BWR Vessel ID Attachment Welds
B.1.5 BWR Feedwater Nozzle
B.1.6 BWR Control Rod Drive Return Line Nozzle
B.1.7 BWR Stress Corrosion Cracking
B.1.8 BWR Penetrations
B.1.10 Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)
B.1.11 Flow-Accelerated Corrosion
B.1.13 Open-Cycle Cooling Water System
B.1.14 Closed-Cycle Cooling Water System
B.1.15 Boraflex Rack Management Program
B.1.16 Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems
B.1.17 Compressed Air Monitoring
B.1.18 BWR Reactor Water Cleanup System
B.1.19 Fire Protection
B.1.20 Fire Water System
B.1.21 Aboveground Outdoor Tanks
B.1.22Fuel Oil Chemistry
B.1.24 One-Time Inspection
B.1.25Selective Leaching of Materials
B.1.26 Buried Piping Inspection
B.1.27 ASME Section XI, Subsection IWE
B.1.28 ASME Section XI, Subsection IWF
B.1.29 10 CFR Part 50, Appendix J
B.1.30 Masonry Wall Program
B.1.31 Structures Monitoring Program
B.1.32 RG 1.27, Inspection of Water-Control Structures Associated with Nuclear Power Plants
B.1.33 Protective Coating Monitoring and Maintenance Program
B.1.34 Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
B.1.35 Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits
B.1.36 Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
B.3.1 Metal Fatigue of Reactor Coolant Pressure Boundary
B.3.2 Environmental Qualification (EQ) Progr

Final Response

This request will be responded to in several steps. That is, batches of aging management program basis documents (PBDs) will be provided over a period of time such that when a set of these PBDs is ready for NRC review, that set will be transmitted. This way, the NRC Audit team can continue their reviews while the Oyster Creek team continues to generate the upgraded PBDs. These transmittals are being made an an ongoing activity as part of the AMP Audit.

11/17/05 Update

The initial (two) PBDs provided to the NRC were the Flow Accelerated Corrosion (FAC) and the Reactor Water Cleanup (RWCU) PBDs. These were e-mailed to NRC Project Manager Donnie Ashley, with a copy to Audit Team lead Greg Cranston, on 11/17/05. They were provided in two formats. PDF versions of the documents were provided, which included copies of the signatures of the preparer, reviewer, program owner (site) and Approver (Project Technical Lead). In addition, as requested by the NRC, Word versions were provided to facilitate the Audit review and report writing process.
- J.G. Hufnagel

11/28/05 Update

Today, 11/28/05, electronic copies (in Word format) of the following approved AMP Basis Documents (PBDs) were provided via e-mail to the NRC Project Manager and NRC AMP/AMR Audit team lead: B.1.02 (Water Chemistry), B.1.22 (Fuel Oil Chemistry), B.1.08 (BWR Penetrations), B.1.19 (Fire Protection), B.1.31 (Structures Monitoring), B.1.01 (ASME Section XI IWB, IWC, IWD), B.1.17 (Compressed Air) and B.1.25 (Selective Leaching). They were sent to NRC in Word format for ease of review and also for ease of docketing the information. Exelon/AmerGen approval signatures on these documents may be reviewed on site (e.g., during the Audits) at the Staff's request.

Followup Actions Required

Scope/Screen Change ☐ LR Drawing Change ☐ Commitment Chang ☐ None ☐

AMR Change ☐ Program Basis Document Chang ☐ Docketed Response ☐

IR#: LRCR #:

Prepared By: Hufnagel, John

Reviewed By:

Approved By:

NRC Acceptance Date:

Prepared Date:

Reviewed Date:

Approved Date:

NRC Response Report

PROGRAM BASIS DOCUMENT

PBD-AMP-B.1.01

Revision 0

ASME SECTION XI INSERVICE INSPECTION, SUBSECTIONS IWB, IWC, AND IWD

GALL PROGRAM XI.M1 - ASME SECTION XI INSERVICE INSPECTION, SUBSECTIONS IWB, IWC, AND IWD

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Revision History:

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Summary of Revisions:

Rev. Number	Reason for the Revision(s)
0	Initial Issue

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1.0 PURPOSE

1.1 Purpose

The purpose of this Program Basis Document is to document and evaluate those activities of the Oyster Creek ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program that are credited for managing the loss of material, cracking, and loss of fracture toughness in piping, piping components, piping elements, isolation condenser components, reactor pressure vessel nozzles and components, and Class 1 pump and valve bodies and valve bonnets as part of Oyster Creek License Renewal to meet the requirements of the License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

This includes the following:

- The identification of the scope of the program;
- The evaluation of program elements against NUREG-1801;
- The review of Operating Experience to demonstrate program effectiveness;
- The identification of required program enhancements;
- The identification of Oyster Creek documents required to implement the program.

1.2 Methodology

The nuclear power plant License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," describes the License Renewal process and provides requirements for the contents of License Renewal Applications. 10 CFR 54.21(a)(3) states:

"For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the Current Licensing Basis (CLB) for the period of extended operation."

The NRC and the industry identified 10 program elements that are useful in describing an aging management program and then demonstrating its effectiveness. These program elements are described in Appendix A.1, Section A.1.2.3 of the Standard Review Plan. NUREG-1801 uses these program elements in Section XI to describe acceptable aging management programs.

The Program Basis Document provides a comparison of the credited Oyster Creek program with the elements of the corresponding NUREG-1801 Chapter XI program XI.M1, ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD. Project Level Instruction PLI-8 "Program Basis Documents" prescribes the methodology for evaluating Aging Management Programs. An evaluation of Oyster Creek's aging management program criteria or activities to those of the NUREG-1801 program elements is performed and a conclusion is reached concerning consistency for each individual program element. A demonstration of overall program effectiveness is made after all program elements are evaluated. Required program enhancements are documented. An overall determination is made as to consistency with the program description in NUREG-1801.

2.0 PROGRAM DESCRIPTION

2.1 Program Description

<u>NUREG-1801:</u>

a) *Title 10 of the Code of Federal Regulations, 10 CFR 50.55a, imposes the inservice inspection (ISI) requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, for Class 1, 2, and 3 pressure-retaining components and their integral attachments in light-water cooled power plants. Inspection, repair, and replacement of these components are covered in Subsections IWB, IWC, and IWD, respectively, in the 2001 edition[1] including the 2002 and 2003 Addenda. The program generally includes periodic visual, surface, and/or volumetric examination and leakage test of all Class 1, 2, and 3 pressure-retaining components and their integral attachments.*

b) *The ASME Section XI inservice inspection program in accordance with Subsections IWB, IWC, or IWD has been shown to be generally effective in managing aging effects in Class 1, 2, or 3 components and their integral attachments in light-water cooled power plants. However, in certain cases, the ASME inservice inspection program is to be augmented to manage effects of aging for license renewal and is so identified in the GALL Report.*

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1 An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code.

Oyster Creek:

The ISI Program is a condition monitoring program that includes ASME Section XI, and Generic Letter 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping."

Portions of the ISI program are being utilized for condition monitoring of reactor pressure vessel components, reactor internal components, reactor coolant pressure retaining piping and components, and isolation condenser within the scope of license renewal.

a) The ASME Section XI portion of the program complies with the requirements of ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1995 edition through 1996 addenda, augmented by Generic Letter 88-01, BWRVIP-75, "Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules," NUREG-0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," and NUREG-0619, "BWR Feedwater Nozzle and CRD Return Line Nozzle Cracking," and is implemented through approved facility procedures and programs. The programs include B.1.05, "BWR Feedwater Nozzles," B.1.06, "BWR Control Rod Drive Return Line Nozzle," B.1.07, "BWR Stress Corrosion Cracking," and B.1.18, "BWR Reactor Water Cleanup System."

   Although NUREG-1801 specifies the 2001 edition including the 2002 and 2003 Addenda of the ASME Section XI Code, Subsections IWB, IWC, and IWD for inspection, repair, and replacement, Oyster Creek's current ISI program plan for the fourth ten-year inspection interval, approved per 10 CFR 50.55a, is based on the 1995 edition including 1996 Addenda. The next 120-month inspection interval for Oyster Creek will incorporate the requirements specified in the version of the ASME Code incorporated into 10 CFR 50.55a twelve months before the start of the inspection interval.

Oyster Creek is currently implementing the guidance of BWRVIP-74, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines."

The reactor vessel flange leak detection line at Oyster Creek is stainless steel and is therefore susceptible to cracking due to SCC and IGSCC. The Oyster Creek ISI Program utilizes a VT-2 visual examination on the line during reactor cavity draindown during each refueling outage. This examination will be credited for managing cracking.

b) The ASME Section XI inservice inspection program in accordance with Subsections IWB, IWC, or IWD has been shown to be generally effective in managing aging effects in Class 1, 2, or 3 components. However, the ASME inservice inspection program is to be augmented to manage effects of aging for license renewal as identified in the GALL Report. In addition to the ISI program inspections of the isolation condenser, NUREG-1801 lines IV.C1-5 and IV.C1-6 recommend additional augmented activities for monitoring water chemistry, temperature and radioactivity of the shell side water, and eddy current testing of tubes to ensure the isolation condenser's tube side components intended function is maintained during the period of extended operation. These additional activities are included in the B.1.1 ASME Section XI Inservice Inspection and B.1.2 Water Chemistry aging management programs.

2.2 Overall NUREG-1801 Consistency

The Oyster Creek Inservice Inspection aging management program is an existing program that is consistent with NUREG-1801 aging management program XI.M1, ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD with the exceptions and enhancements described in paragraphs 2.3 and 2.4 below.

2.3 Summary of Exceptions to NUREG-1801

1. NUREG-1801 specifies the use of ASME Section XI Inservice Inspection Subsection IWB for Class 1 components and additional activities to manage aging of the isolation condenser. At Oyster Creek, the isolation condenser is classified as ISI Class 2 on the tube side and ISI Class 3 on the shell side; therefore Class 1 inspection requirements do not apply.

2. NUREG-1801 specifies the 2001 ASME Section XI B&PV Code, including the 2002 and 2003 Addenda for Subsections IWB, IWC, and IWD. The current Oyster Creek ISI Program Plan for the fourth ten-year inspection interval effective from October 15, 2002 through October 14, 2012, approved per 10CFR50.55a, is based on the 1995 ASME Section XI B&PV Code, including 1996 addenda. The next 120-month inspection interval for Oyster Creek will incorporate the requirements specified in the version of the ASME Code incorporated into 10 CFR 50.55a

twelve months before the start of the inspection interval.

2.4 Summary of Enhancements to NUREG-1801

Enhancement activities, which are in addition to the requirements of ASME Section XI, Subsections IWB, IWC, and IWD, consist of temperature and radioactivity monitoring of the isolation condenser shell-side (cooling) water, eddy current testing of the tubes, and inspections (VT or UT) of the channel head and tube sheets, with verification of the effectiveness of the program through monitoring and trending of results. These enhanced inspection activities detect cracking due to stress corrosion cracking or intergranular stress corrosion cracking, and detect loss of material due to general, pitting and crevice corrosion, in order to ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation. Radioactivity and temperature monitoring of the shell side water will be implemented prior to the start of the period of extended operation. Due to the physical configuration of the isolation condensers and piping at Oyster Creek, eddy current inspection of the tubes, and access to the tubesheet and internal surfaces of the channel head, require cutting and re-welding of pressure boundary piping. Since the Oyster Creek isolation condenser tube bundles were replaced in the "A" isolation condenser in 2000 and in the "B" isolation condenser in 1998, utilizing upgraded materials that are more resistant to intergranular stress corrosion cracking, these inspections will be performed during the first ten years of the extended period of operation.

3.0 EVALUATIONS AND TECHNICAL BASIS

Note

This section is organized by quoting the relevant NUREG-1801 Chapter XI program element (September 2005 version) followed by the related Oyster Creek program attributes and a conclusion of the comparison. Where applicable, the NUREG-1801 program element was separated into logical sub-elements and addressed accordingly.

Implementing procedure references are included in **( )** for information purposes. This information from the source procedure has been either directly extracted from the procedure or summarized for inclusion into this PBD.

3.0 Scope of Program

NUREG-1801:

a) *The ASME Section XI program provides the requirements for ISI, repair, and replacement. The components within the scope of the program are specified in Subsections IWB-1100, IWC-1100, and IWD-1100 for Class 1, 2, and 3 components, respectively, and include all pressure-retaining components and their integral attachments in light-water cooled power plants.*

b) *The components described in Subsections IWB-1220, IWC-1220, and IWD-1220 are exempt from the examination requirements of Subsections IWB-2500, IWC-2500, and IWD-2500.*

Oyster Creek:

a) The OC ISI program details the requirements for the examination, testing, repair, and replacement of components specified in ASME Section XI Subsections IWB-1100, IWC-1100, and IWD-1100 for Class 1, 2, and 3, respectively, including pressure-retaining components and their internal attachments at Oyster Creek Generating Station. **(Reference: OC-1, Section 1, paragraph 1.0)**

   The isolation condenser is classified as ISI Class 2 on the tube side and ISI Class 3 on the shell side. The ISI program provides for condition monitoring of the isolation condenser through inspections in accordance with ASME Section XI, Subsections IWC and IWD.

b) The components described in Subsections IWB-1220, IWC-1220, and IWD-1220 are exempted from the examination requirements of Subsections IWB-2500, IWC-2500, and IWD-2500, per the Oyster Creek ISI program plan. **(Reference: OC-1, Section 2, paragraph 3.1.2.2)**

   The scope of activities includes only those components within the bounds of license renewal for which aging management is required to be demonstrated.

The Oyster Creek ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program manages the aging effect of loss of material, cracking, and loss of fracture toughness for the systems, components, and environments listed in Table 5.2. The implementing documents for this aging management program are listed in Table 5.1 and are described throughout the individual program element discussions. The commitment numbers under which these implementing documents are being revised are contained within the listings in Table 5.1.

<u>Exceptions to NUREG-1801, Element 1:</u>

NUREG-1801 specifies the use of ASME Section XI Inservice Inspection Subsection IWB for Class 1 components and additional activities to manage aging of the isolation condenser. At Oyster Creek, the isolation condenser is classified as ISI Class 2 on the tube side and ISI Class 3 on the shell side; therefore Class 1 inspection requirements do not apply.

<u>Enhancements to NUREG-1801, Element 1:</u>

None.

<u>Comparison and Evaluation Conclusion:</u>

This element is consistent with NUREG-1801, Element 1, Scope of Program with the exception described above.

3.1 Preventive Actions

<u>NUREG-1801:</u>

Operation within the limits prescribed in the Technical Specifications.

<u>Oyster Creek:</u>

Oyster Creek operates within the limits prescribed in its Technical Specifications. Oyster Creek Technical Specifications state that inservice inspection of ASME Code Class 1, Class 2 and Class 3 systems and components shall be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable Addenda as required by 10 CFR, Section 50.55a(g), except where specific written relief has been granted by the NRC pursuant to 10 CFR, Section 50.55a(g)(6)(i). **(Reference: Oyster Creek Technical Specifications, Section 4.3.B)**

The ISI program consists of condition monitoring activities that detect degradation of components before loss of intended function. No preventive or mitigating attributes are associated with these activities.

Exceptions to NUREG-1801, Element 2:

None.

Enhancements to NUREG-1801, Element 2:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 2, Preventive Actions.

3.2 Parameters Monitored or Inspected

NUREG-1801:

The ASME Section XI ISI program detects degradation of components by using the examination and inspection requirements specified in ASME Section XI Tables IWB-2500-1, IWC-2500-1, or IWD-2500-1, respectively, for Class 1, 2, or 3 components.

Oyster Creek:

The Oyster Creek Generating Station ISI program plan provides the Inservice Inspection Summary Table, which includes the examination categories and descriptions as identified in ASME Section XI, Tables IWB-2500-1, IWC-2500-1, and IWD-2500-1. **(Reference: OC-1, Section 1, paragraph 7.0)**

The ISI program provides for condition monitoring in the following components:

Cracking monitoring for susceptible reactor vessel components subject to a steam or reactor water environment, through visual inspections using the examination and inspection requirements specified in ASME Section XI, Table IWB-2500-1.

Cracking monitoring for susceptible reactor internal attachments and ASME Class 1 components subject to a steam or reactor water environment, through surface and volumetric examinations of pressure retaining welds and their heat affected zones in piping components by using the examination and inspection requirements specified in ASME Section XI, Table IWB-2500-1. Aging management of reactor internal components is evaluated in B.1.09, “BWR Vessel Internals”.

Cracking monitoring of the areas of the Oyster Creek isolation condensers subject to a steam or water environment, through surface and volumetric examinations of pressure retaining nozzle welds in vessels and their heat affected zones by using the examination and inspection requirements specified in ASME Section XI, Table IWC-2500-1 for the tube side and IWD-2500-1 for the shell side.

Loss of material monitoring of the isolation condenser subject to a steam or water environment, through system pressure tests by using the examination and inspection requirements specified in ASME Section XI, Table IWC-2500-1 and IWD-2500-1.

ASME Class 1 reactor vessel flange leak detection line through monitoring for leaks during reactor cavity draindown during each refueling outage.

<u>Exceptions to NUREG-1801, Element 3:</u>

None.

<u>Enhancements to NUREG-1801, Element 3:</u>

None.

<u>Comparison and Evaluation Conclusion:</u>

This element is consistent with NUREG-1801, Element 3, Parameters Monitored or Inspected.

3.3 Detection of Aging Effects

<u>NUREG-1801:</u>

a) *The extent and schedule of the inspection and test techniques prescribed by the program are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of the component.*

Inspection can reveal cracking, loss of material due to corrosion, leakage of coolant and indications of degradation due to wear or stress relaxation, such as verification of clearances, settings, physical displacements, loose or missing parts, debris, wear, erosion, or loss of integrity at bolted or welded connections.

b) *Components are examined and tested as specified in Tables IWB-2500-1, IWC-2500-1, and IWD-2500-1, respectively, for*

Class 1, 2, and 3 components. The tables specify the extent and schedule of the inspection and examination methods for the components of the pressure-retaining boundaries. Alternative approved methods that meet the requirements of IWA-2240 are also specified in these tables.

c) The program uses three types of examination — visual, surface, and volumetric — in accordance with the general requirements of Subsection IWA-2000.

Visual VT-1 examination detects discontinuities and imperfections, such as cracks, corrosion, wear, or erosion, on the surface of components. Visual VT-2 examination detects evidence of leakage from pressure-retaining components, as required during the system pressure test. Visual VT-3 examination (a) determines the general mechanical and structural condition of components and their supports by verifying parameters such as clearances, settings, and physical displacements; (b) detects discontinuities and imperfections such as loss of integrity at bolted or welded connections, loose or missing parts, debris, corrosion, wear, or erosion; and (c) observes conditions that could affect operability or functional adequacy of constant-load and spring-type components and supports.

Surface examination uses magnetic particle, liquid penetrant, or eddy current examinations to indicate the presence of surface discontinuities and flaws.

Volumetric examination uses radiographic, ultrasonic, or eddy current examinations to indicate the presence of discontinuities or flaws throughout the volume of material included in the inspection program.

d) For BWRs, the nondestructive examination (NDE) techniques appropriate for inspection of vessel internals, including the uncertainties inherent in delivering and executing an NDE technique in a boiling water reactor (BWR), are included in the approved boiling water reactor vessel and internals project (BWRVIP)-03. Also, an applicant may use the guidelines of the approved BWRVIP-62 for inspection relief for vessel internal components with hydrogen water chemistry provided such relief is submitted under the provisions of 10 CFR 50.55a and approved by the staff.

The ASME Section XI examination categories used in this report are given below.

Class 1 Components, Table IWB-2500-1

Examination category B-B for pressure-retaining welds in vessels other than reactor vessels: This category specifies volumetric examination of circumferential and longitudinal shell-to-head welds and circumferential and meridional head welds in pressurizers, and circumferential and meridional head welds and tubesheet-to-head welds in steam generators (primary side). The welds selected during the first inspection interval are reexamined during successive inspection intervals.

Examination category B-D for full penetration welds of nozzles in reactor vessels, pressurizers, steam generators (primary side), and heat exchangers (primary side): This category specifies volumetric examination of all nozzle-to-vessel welds and the nozzle inside surface.

Examination category B-E for pressure-retaining partial penetration welds in vessels: This category specifies visual VT-2 examination of partial penetration welds in nozzles and penetrations in reactor vessels and pressurizers during the hydrostatic test. In the 1995 edition of the ASME Code, examination category B-E is covered under examination category B-P.

Examination category B-F for pressure-retaining dissimilar metal welds in reactor vessels, pressurizers, steam generators, heat exchangers, and piping: This category specifies volumetric examination of the inside diameter (ID) region and surface examination of the outside diameter (OD) surface for all nozzle-to-safe end butt welds of nominal pipe size (NPS) 4 inch (in.) or larger. Only surface examination is conducted for all butt welds less than NPS 4 in. and for all nozzle-to-safe end socket welds. Examinations are required for each safe end weld in each loop and connecting branch of the reactor coolant system. In the 1995 edition of the ASME Code, examination category B-F for piping is covered under examination category B-J for all pressure-retaining welds in piping.

Examination category B-G-1 for pressure-retaining bolting greater than 2 in. in diameter, and category B-G-2 for pressure-retaining bolting less than 2 in. in diameter in reactor vessels, pressurizers, steam generators, heat exchangers, piping, pumps, and valves: Category B-G-1 specifies volumetric examination of studs in place, from the top of the nut to the bottom of the flange hole; surface and volumetric examination of studs when removed; volumetric examination of flange threads; and visual VT-1 examination of the surfaces of nuts, washers, and bushings. Category B-G-2 specifies visual VT-1 examination of the surfaces of nuts, washers, and bushings. For heat exchangers, piping, pumps, and valves, *examinations are limited to components selected for examination under examination categories B-B, B-J, B-L-2, and B-M-2.*

Examination category B-K for integral attachments for vessels: This category specifies volumetric or surface examination of essentially 100% of the length of the attachment weld at each attachment subject to examination.

Examination category B-J for pressure-retaining welds in piping: This category specifies volumetric examination of the ID region and surface examination of the OD for circumferential and longitudinal welds in each pipe or branch run NPS 4 in. or larger. Surface examination is conducted for circumferential and longitudinal welds in each pipe or branch run less than NPS 4 in. and for all socket welds. The pipe welds selected during the first inspection interval are reexamined during each successive inspection interval.

Examination category B-L-1 for pressure-retaining welds in pump casing, and category B-L-2 for pump casing: Category B-L-1 specifies volumetric examination of all welds, and category B-L-2 specifies visual VT-3 examination of internal surfaces of the pump casing. All welds from at least one pump in each group of pumps performing similar functions in the system (such as recirculating coolant pumps) are inspected during each inspection interval. Visual examination is required only when the pump is disassembled for maintenance, repair, or volumetric examination, but one pump in a particular group of pumps is visually examined at least once during the inspection interval.

Examination category B-M-1 for pressure-retaining welds in valve bodies and category B-M-2 for valve bodies: Category B-M-1 specifies volumetric examination for all welds in valve bodies NPS 4 in. or larger, and surface examination of OD surfaces for all welds in valve bodies less than NPS 4 in. Category B-M-2 specifies visual VT-3 examination of internal surfaces of valve bodies. All welds from at least one valve in each group of valves that are of the same size, construction design (such as globe, gate, or check valves), and manufacturing method, and that perform similar functions in the system (such as the containment isolation valve) are inspected during each inspection interval. Visual examination is required only when the valve is disassembled for maintenance, repair, or volumetric examination, but one valve in a particular group of valves is visually examined at least once during the inspection interval.

Examination category B-N-1 for the interior of reactor vessels: Category B-N-1 specifies visual VT-3 examination of interior surfaces that are made accessible for examination by removal of *components during normal refueling outages.*

Examination category B-N-2 for integrally welded core support structures and interior attachments to reactor vessels: Category B-N-2 specifies visual VT-1 examination of all accessible welds in interior attachments within the beltline region; visual VT-3 examination of all accessible welds in interior attachments beyond the beltline region; and, for BWRs, visual VT-3 examination of all accessible surfaces in the core support structure.

Examination category B-N-3, which is applicable to pressurized water reactors (PWRs), for removable core support structures: Category B-N-3 specifies visual VT-3 examination of all accessible surfaces of reactor core support structures that can be removed from the reactor vessel.

Examination category B-O for pressure-retaining welds in control rod housing: This category specifies volumetric or surface examination of the control rod drive (CRD) housing welds, including the weld buttering.

Examination category B-P for all pressure-retaining components: This category specifies visual VT-2 examination of all pressure-retaining boundary components during the system leakage test and hydrostatic test (IWA-5000 and IWB-5000). The pressure-retaining boundary during the system leakage test corresponds to the reactor coolant system boundary, with all valves in the normal position, which is required for normal reactor operation startup. However, VT-2 visual examination extends to and includes the second closed valve at the boundary extremity. The 1995 edition of the ASME Code eliminated the hydrostatic test because equivalent results are obtained from the leakage test. The pressure-retaining boundary for the hydrostatic test (1989 edition) and system leakage test (1995 edition) conducted at or near the end of each inspection interval extends to all Class 1 pressure-retaining components within the system boundary.

Class 2 Components, Table IWC-2500-1

Examination category C-A for pressure-retaining welds in pressure vessels: This category specifies volumetric examination of circumferential welds at gross structural discontinuities, such as junctions between shells of different thickness or cylindrical shell-to-conical shell junctions, and head-to-shell, shell (or head)-to-flange, and tubesheet-to-shell welds.

Examination category C-F-1 for pressure-retaining welds in austenitic stainless steel or high-alloy piping*: This category specifies, for circumferential and longitudinal welds in each pipe or* *branch run NPS 4 in. or larger, volumetric and surface examination of the ID region, and surface examination of the OD surface for piping welds ≥3/8 in. wall thickness for piping >NPS 4 in. or for piping welds >1/5 in. wall thickness for piping ≥NPS 2 in. and ≤NPS 4 in. Surface examination is conducted for circumferential and longitudinal welds in pipe branch connections of branch piping ≥NPS 2 in. and for socket welds.*

Examination category C-G for all pressure-retaining welds in pumps and valves: This category specifies surface examination of either the inside or outside surface of all welds in the pump casing and valve body. In a group of multiple pumps or valves of similar design, size, function, and service in a system, examination of only one pump or one valve among each group of multiple pumps or valves is required to detect the loss of intended function of the pump or valve.

Examination category C-H for all pressure-retaining components: This category specifies visual VT-2 examination during system pressure tests (IWA-5000 and IWC-5000) of all pressure-retaining boundary components. The pressure-retaining boundary includes only those portions of the system required to operate or support the safety function, up to and including the first normally closed valve (including a safety or relief valve) or valve capable of automatic closure when the safety function is required. The 1995 edition of the ASME Code eliminated the hydrostatic test because equivalent results are obtained from the leakage test.

Class 3 Components, Table IWD-2500-1

Examination category D-A (1989 edition) for systems in support of reactor shutdown function, and category D-B (1989 edition) for systems in support of emergency core cooling, containment heat removal, atmosphere cleanup, and reactor residual heat removal: Categories D-A and D-B specify visual VT-2 examination during system pressure tests (IWA-5000 and IWD-5000) of all pressure-retaining boundary components. The pressure-retaining boundary extends up to and includes the first normally closed valve or valve capable of automatic closure as required to perform the safety-related system function. Examination categories D-A and D-B, from the 1989 edition of the ASME Code, have been combined into examination category D-B for all pressure-retaining components in the 1995 edition of the ASME Code.

<u>Oyster Creek:</u>

a) The extent and schedule of the inspection and test techniques prescribed by the program are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of the component. Inservice Inspection is the program of planned methods and actions utilizing the process of visual, surface, or volumetric examination, for assuring the integrity of structural and pressure retaining safety related components in accordance with the rules of codes and standards. Examinations at Oyster Creek are performed in accordance with the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," per the Oyster Creek Generating Station ISI program plan. **(Reference OC-1, Section 1, paragraph 1.0)**

b) The Oyster Creek ISI program plan provides the extent and schedule of inspections, and the plan's inservice inspection tables provide the examination categories, descriptions, and examination requirements, as specified in ASME Section XI, Table IWB-2500-1 for Class 1 components, Table IWC-2500-1 for Class 2 components, and IWD-2500-1 for Class 3 components. **(Reference OC-1, Section 1, Table 7.0-1)**

c) The Oyster Creek ISI program plan uses three types of examination: visual, surface, and volumetric, in accordance with the general requirements of Subsection IWA-2000.

d) Oyster Creek in-vessel examination procedures are consistent with the requirements of BWRVIP-03 and other appropriate BWRVIP guidelines, as well as the requirements of Section XI of the ASME Boiler and Pressure Vessel Code. Oyster Creek does not currently apply inspection relief for vessel internal components with hydrogen water chemistry in accordance with BWR VIP-62. **(Reference: Oyster Creek Reactor Internals Program Plan OC-5)**

Following are examples of the examination categories presented in the program plan's inservice inspection tables:

The Oyster Creek ISI program plan Category B-F calls for volumetric and surface exams of pressure retaining dissimilar metal welds in 4 inch NPS and larger piping and surface exams in piping less than 4 inch NPS per the Oyster Creek ISI program plan tables. **(Reference OC-1, Section 1)**

ISI program plan Category B-J calls for volumetric and surface exams of pressure retaining welds in 4 inch NPS and larger piping and surface exams in piping less than 4 inch NPS and also socket welds per the Oyster Creek ISI program plan tables. **(Reference OC-1, Section 1)**

ISI program plan Category B-P calls for visual exams during leakage and hydrostatic test of all pressure retaining piping per the Oyster Creek ISI program plan tables. **(Reference: ER-AA-330-001, "Section XI Pressure Testing")**

NUREG-1801, Table IV, item A1.1.5, calls for a plant specific aging management program for the reactor vessel flange leak detection line. The reactor vessel flange leak detection line at Oyster Creek is a Class 1 line. The line is stainless steel and is therefore susceptible to cracking due to SCC and IGSCC. The Oyster Creek inspection utilizes a VT-2 examination of the line during reactor cavity draindown during each refueling outage.

The ISI program is credited with managing loss of fracture toughness due to thermal aging embrittlement in cast austenitic stainless steel valves and pump casings. The pump casings receive VT-3 inspections when they are disassembled for maintenance per the requirements of Category B-L-2 per the Oyster Creek ISI program plan tables. Applicable system valves receive VT-3 inspections when they are disassembled for maintenance per the requirements of Category B-M-2 per the Oyster Creek ISI program plan tables. **(Reference OC-1, Section 1)**

Visual (VT-3) examinations of the accessible areas of the reactor vessel interior surfaces are specified in ASME Code Category B-N-1 items of the Oyster Creek ISI program plan tables. **(Reference OC-1, Section 1)**

ISI Program Plan Category C-A specifies volumetric examination of tubesheet-to-head welds of the isolation condenser per the Oyster Creek ISI program plan tables. **(Reference OC-1, Section 1)**

ISI Program Plan Category C-B specifies volumetric and surface examination of nozzle-to-shell (or head) welds of the isolation condenser per the Oyster Creek ISI program plan tables. **(Reference OC-1, Section 1)**

ISI Program Plan Category C-H calls for visual exams during system pressure tests of the isolation condensers. **(Reference: ER-AA-330-001)**

ISI Program Plan Category D-B specifies visual examination of the isolation condenser per the Oyster Creek ISI program plan tables. **(Reference OC-1, Section 1)**

Exceptions to NUREG-1801, Element 4:

None.

Enhancements to NUREG-1801, Element 4:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 4, Detection of Aging Effects.

3.4 Monitoring and Trending

NUREG-1801:

a) *For Class 1, 2, or 3 components, the inspection schedule of IWB-2400, IWC-2400, or IWD-2400, respectively, and the extent and frequency of IWB-2500-1, IWC-2500-1, or IWD-2500-1, respectively, provides for timely detection of degradation.*

   The sequence of component examinations established during the first inspection interval is repeated during each successive inspection interval, to the extent practical.

b) *If flaw conditions or relevant conditions of degradation are evaluated in accordance with IWB-3100, IWC-3100, or IWD-3100, and the component is qualified as acceptable for continued service, the areas containing such flaw indications and relevant conditions are reexamined during the next three inspection periods of IWB-2110 for Class 1 components, IWC-2410 for Class 2 components, and IWD-2410 for Class 3 components.*

c) *Examinations that reveal indications that exceed the acceptance standards described below are extended to include additional examinations in accordance with IWB-2430, IWC-2430, or IWD-2430 (1995 edition) for Class 1, 2, or, 3 components, respectively.*

Oyster Creek:

a) The required examinations in each examination category for Class 1, 2, and 3 components subject to examination per Section XI, Subsection IWB, IWC, and IWD, shall be completed during the inspection interval in accordance with the schedule and extent of Tables IWB-2412-1, IWC-2412-1, and IWD-2412-

1, respectively, per the Oyster Creek ISI program plan. **(Reference OC-1, Section 3, paragraph 1.3)**

The Oyster Creek ISI program plan provides the extent and frequency of inspections, and the plan's inservice inspection tables provide the examination categories and descriptions as identified in ASME Section XI, Table IWB-2500-1 for Class 1 components, Table IWC-2500-1 for Class 2 components, and Table IWD-2500-1 for Class 3 components. **(Reference OC-1, Table 7.0-1)**

The sequence of component examinations established during the first inspection interval shall be repeated during each successive inspection interval, to the extent practical. **(Reference OC-1, Section 3, paragraph 2.3.1)**

b) In accordance with the 1995 ASME Section XI Code, 1996 addenda, if flaw indications, or relevant conditions of degradation are evaluated in accordance with IWB-3100, and the component is qualified as acceptable for continued service, the areas containing such flaw indications or relevant conditions shall be reexamined during the next three inspection periods for Class 1 components in accordance with IWB-2420(b) per the Oyster Creek ISI program plan. If flaw indications, or relevant conditions of degradation are evaluated in accordance with IWC-3100, and the component is qualified as acceptable for continued service, the areas containing such flaw indications or relevant conditions shall be reexamined during the next inspection period for Class 2 components in accordance with IWC-2420(b) per the Oyster Creek ISI program plan. If flaw indications, or relevant conditions are evaluated in accordance with IWB-3100, and the component qualifies as acceptable for continued service, the areas containing such flaw indications or relevant conditions shall be reexamined during the next inspection period for Class 3 components in accordance with IWD-2420(b) per the Oyster Creek ISI program plan. **(Reference OC-1, Section 3, paragraphs 2.3, 3.3, 4.3)**

c) If examinations reveal flaws or indications exceeding the acceptance standards, the initial expansion of examinations shall comply with the requirements of IWB-2430(a), IWC-2430(a), IWD-2430(a)for Class 1, 2, or 3 respectively, or alternatives approved by the NRC. If the examinations reveal additional indications exceeding the standards of IWB-3000 and IWC-3000, then a second expansion of scope is required in the current outage. This second expansion shall comply with the requirements of IWB-2430(b), IWC-2430(b), and IWD-2430(b) for Class 1, 2, or 3 respectively, or alternatives approved by the NRC. **(Reference OC-1, Section 3, paragraphs 2.4, 3.4, 4.4; ER-AA-330-002, paragraphs 4.12.5, 4.13)**

The reactor vessel flange leak detection line at Oyster Creek is inspected utilizing a VT-2 examination of the line during reactor cavity draindown during each refueling outage.

Exceptions to NUREG-1801, Element 5:

NUREG-1801 specifies the 2001 ASME Section XI B&PV Code, including the 2002 and 2003 Addenda for Subsections IWB, IWC, and IWD. The current Oyster Creek ISI Program Plan for the fourth ten-year inspection interval effective from October 15, 2002 through October 14, 2012, approved per 10CFR50.55a, is based on the 1995 ASME Section XI B&PV Code, including 1996 addenda. The next 120-month inspection interval for Oyster Creek will incorporate the requirements specified in the version of the ASME Code incorporated into 10 CFR 50.55a 12 months before the start of the inspection interval.

Enhancements to NUREG-1801, Element 5:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 5, Monitoring and Trending, with the exception described above.

3.5 Acceptance Criteria

NUREG-1801:

a) *Any indication or relevant conditions of degradation detected are evaluated in accordance with IWB-3000, IWC-3000, or IWD-3000, for Class 1, 2, or 3 components, respectively.*

b) *Examination results are evaluated in accordance with IWB-3100, IWC-3100, or IWD-3100 by comparing the results with the acceptance standards of IWB-3400 and IWB3500, or IWC-3400 and IWC-3500, or IWD3400 and IWD3500, respectively for Class 1 or Class 2 and 3 components.*

Flaws that exceed the size of allowable flaws, as defined in IWB-3500, IWC-3500, or IWD3500, are evaluated by using the analytical procedures of IWB-3600, IWC-3600, or IWD-3600, *respectively, for Class 1 or Class 2, and 3 components.*

c) *Flaws that exceed the size of allowable flaws, as defined in IWB-3500 or IWC-3500, are evaluated by using the analytical procedures of IWB-3600 or IWC-3600, respectively, for Class 1 or Class 2 and 3 components.*

d) *Approved BWRVIP-14, BWRVIP-59, and BWRVIP-60 documents provide guidelines for evaluation of crack growth in stainless steels, nickel alloys, and low-alloy steels, respectively.*

<u>Oyster Creek:</u>

a) Indications and relevant conditions detected during examinations are evaluated in accordance with ASME Section XI, Articles IWB-3000 for Class 1, IWC-3000 for Class 2, and IWD-3000 for Class 3, per the Oyster Creek ISI program. (IWD-3000 for Class 3 components states that the article is in the course of preparation, and that the rules of IWB-3000 may be used.) **(Reference: ER-AA-330-002, paragraph 4.10)**

b) The Oyster Creek ISI program directs evaluation of examination results in accordance with the 1995 ASME Section XI Code, 1996 addenda. Examination results are evaluated in accordance with IWB-3100 or IWC-3100 by comparing the results with the acceptance standards of IWB-3400 and IWB3500, or IWC-3400 and IWC-3500, respectively for Class 1 and Class 3, or Class 2 components. (IWD-3000 for Class 3 components states that the article is in the course of preparation, and that the rules of IWB-3000 may be used.) **(Reference ER-AA-330-002, paragraph 4.10)**

c) When a flaw exceeds the applicable acceptance standards of IWB-3500 or IWC-3500, an issue report is initiated in accordance with applicable procedures. The flaw shall not be acceptable for service until an analytical evaluation is performed in accordance with IWB-3600 and IWC-3600 respectively, to determine its acceptability for continued service without repair or replacement. It is a best practice that this analytical evaluation shall be submitted to the NRC Staff for preliminary approval prior to returning the component to service per the Oyster Creek ISI program. If the flaw is an IGSCC flaw, then NRC approval of the analytical analysis shall be required before resumption of operation. **(Reference: ER-AA-330-002, paragraph 4.12)**

d) As applicable, flaw evaluations include the guidance of BWRVIP-14, BWRVIP-59, and BWRVIP-60 for crack growth in stainless steels, nickel alloys, and low-alloy steels, respectively.

(Reference OC-5, paragraph 1.6)

Exceptions to NUREG-1801, Element 6:

NUREG-1801 specifies the 2001 ASME Section XI B&PV Code, including the 2002 and 2003 Addenda for Subsections IWB, IWC, and IWD. The current Oyster Creek ISI Program Plan for the fourth ten-year inspection interval effective from October 15, 2002 through October 14, 2012, approved per 10CFR50.55a, is based on the 1995 ASME Section XI B&PV Code, including 1996 addenda. The next 120-month inspection interval for Oyster Creek will incorporate the requirements specified in the version of the ASME Code incorporated into 10 CFR 50.55a 12 months before the start of the inspection interval.

Enhancements to NUREG-1801, Element 6:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 6, Acceptance Criteria, with the exception described above.

3.6 Corrective Actions

NUREG-1801:

a) *For Class 1, 2, and 3, respectively, repair is performed in conformance with IWB-4000, IWC-4000, and IWD-4000, and replacement according to IWB-7000, IWC-7000, and IWD-7000.*

b) *Approved BWRVIP-44 and BWRVIP-45 documents, respectively, provide guidelines for weld repair of nickel alloys and for weldability of irradiated structural components.*

As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

Oyster Creek:

a) Repairs and Replacements are performed in accordance with the 1995 ASME Section XI Code, 1996 addenda, which specifies the requirements in IWA-4000, per the Oyster Creek ISI program. **(Reference: ER-AA-330 paragraphs 5.1, 5.2; ER-AA-330-009 paragraphs 1.2.3, 4.3.1, 4.7.2, 4.9.1, 4.14.1, and 15.1)** The 1995 ASME Section XI Code, 1996 addenda does not contain IWB-4000, IWC-4000, IWD-4000, IWB-7000, IWC-7000, or IWD-7000 series articles.

b) In the event that weld repair of nickel alloys and weldability of irradiated structural components were performed, the guidance of BWRVIP-44 and BWRVIP-45 would be met. **(Reference ER-AB-331, paragraph 1.1)**

Evaluations are performed for test or inspection results that do not satisfy established criteria and an issue report is initiated to document the concern in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The corrective action process ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence. **(Reference: ER-AA-330-002, paragraph 4.12)**

<u>Exceptions to NUREG-1801, Element 7:</u>

None.

<u>Enhancements to NUREG-1801, Element 7:</u>

None.

<u>Comparison and Evaluation Conclusion:</u>

This element is consistent with NUREG-1801, Element 7, Corrective Actions.

3.7 Confirmation Process

<u>NUREG-1801:</u>

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process and administrative controls.

<u>Oyster Creek:</u>

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

Exceptions to NUREG-1801, Element 8:

None.

Enhancements to NUREG-1801, Element 8:

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 8, Confirmation Process.

3.8 Administrative Controls

NUREG-1801:

See Item 8, above.

Oyster Creek:

See Item 8, above.

Exceptions to NUREG-1801, Element 9:

None.

Enhancements to NUREG-1801, Element 9

None.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Element 9, Administrative Controls.

3.9 Operating Experience

NUREG-1801:

a) *Because the ASME Code is a consensus document that has been widely used over a long period, it has been shown to be generally effective in managing aging effects in Class 1, 2, and 3 components and their integral attachments in light-water cooled power plants (see Chapter I of the GALL Report, Vol. 2).*

Some specific examples of operating experience of component degradation are as follows:

BWR: *Cracking due to intergranular stress corrosion cracking (IGSCC) has occurred in small- and large-diameter BWR piping made of austenitic stainless steels and nickel alloys. The IGSCC has also occurred in a number of vessel internal components, such as core shrouds, access hole covers, top guides, and core spray spargers (NRC Bulletin 80-13, NRC Information Notice [IN] 95-17, NRC Generic Letter [GL] 94-03, and NUREG-1544). Cracking due to thermal and mechanical loading have occurred in high-pressure coolant injection (HPCI) piping (NRC IN 89-80) and instrument lines (NRC Licensee Event Report [LER] 50-249/99-003-1). Jet pump BWRs are designed with access holes in the shroud support plate at the bottom of the annulus between the core shroud and the reactor vessel wall. These holes are used for access during construction and are subsequently closed by welding a plate over the hole. Both circumferential (NRC IN 88-03) and radial cracking (NRC IN 92-57) have been observed in access hole covers. Failure of the isolation condenser tube bundles due to thermal fatigue and transgranular stress corrosion cracking (TGSCC) caused by leaky valves has also occurred (NRC LER 50-219/98-014).*

<u>Oyster Creek:</u>

a) The OC ISI program invokes the requirements of the ASME Section XI Code. Because the ASME Code is a consensus document that has been widely used over a long period, it has been shown to be generally effective in managing aging effects in Class 1, 2, and 3 components and their integral attachments in light-water cooled power plants. The Operating Experience (OE) of the ISI program did not show any adverse trend of its performance. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the ISI program as described in the Oyster Creek Generating Station ISI program plan and Exelon procedures will effectively monitor the condition of the pressure retaining components within LR boundaries that are subject to a steam or water environment, so that their design function will be maintained during the extended license period. Appropriate guidance for reevaluation, repair or replacement is provided for any indication of degradation detected by the OC ISI program. Periodic self-assessments of the ISI program are performed to identify the areas that need improvement to maintain the quality performance of the program.

Operating experience, both internal and external, is used in two ways at Oyster Creek to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Oyster Creek. The first way in which operating experience is used is through the Oyster Creek Operating Experience process. The Operating Experience process screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The second way is through the process for managing programs. This process requires the review of program related operating experience by the program owner.

Both of these processes review operating experience from both external and internal (also referred to as in-house) sources. External operating experience may include such things as INPO documents (e.g., SOERs, SERs, SENs, etc.), NRC documents (e.g., GLs, LERs, INs, etc.), General Electric documents (e.g., RCSILs, SILs, TILs, etc.), and other documents (e.g., 10CFR Part 21 Reports, NERs, etc.). Internal operating experience may include such things as event investigations, trending reports, and lessons learned from in-house events as captured in program notebooks, self-assessments, and in the 10 CFR Part 50, Appendix B corrective action process.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that managing loss of material, cracking, and loss of fracture toughness is being adequately managed in piping and other components. The following examples of operating experience provide objective evidence that the ISI program is effective in assuring that intended functions will be maintained consistent with the CLB for the period of extended operation:

Following are some examples:

A focused-area self-assessment at Oyster Creek indicated that Code Cases and Relief Requests were not easily found in the program documents and the listings were incomplete. The ISI Program plan was updated to include a summary of all Relief Requests in effect in Section 4 of the ISI plan and to include a listing of all Code Cases invoked in the plan. This example provides objective evidence that program deficiencies are identified and entered into the corrective action process and that the program is updated as necessary to ensure that it remains effective for condition monitoring of piping and components within the scope of license renewal. (CAP O2004-1736)

A focused-area self-assessment at Oyster Creek indicated that although a Relief Request for examination of a reactor pressure vessel support skirt weld had been granted, no provision to augment the ASME Code-required surface examination with a volumetric (UT) examination of the restricted area was addressed. A new exam record was added to the ISI database to reflect the required UT examination. This example provides objective evidence that program deficiencies are identified and entered into the corrective action process and that the program is updated as necessary to ensure that it remains effective for condition monitoring of piping and components within the scope of license renewal. (CAP O2004-1736)

Examples of inspections which detected degradation and the corrective actions are:

An NDE examination of ESW piping for corrosion in 2002 identified an elbow with a measured wall thickness below the minimum pipe wall thickness. An evaluation was performed providing an operability justification until the following outage and the elbow was replaced during that outage. This example provides objective evidence that the program provides appropriate guidance for evaluation and disposition of piping and components within the scope of license renewal. (CAP O2002-1648)

During a Class 1 pressure test of Core Spray piping following a refueling outage, leakage was identified at a field weld. The indication was dispositioned for repair via the corrective action process. An expanded scope of examination of similar type welds was performed, with no additional indications found, supporting the conclusion that the observed defect was not a generic issue. This example provides objective evidence that the program provides appropriate guidance for inspection and evaluation, that deficiencies are entered into the corrective action process, and that appropriate action (expansion of scope due to observed conditions) is taken as necessary to ensure effective condition monitoring of piping and components within the scope of license renewal. (CAP O2002-1781)

The results of the program evaluation indicate that the Oyster Creek ISI program is effective in monitoring degradation, and corrective actions have been taken when acceptance criteria have not been met. In addition, self-assessments have been effective in identifying and correcting program deficiencies. Therefore, it is concluded that the Oyster Creek ASME Section XI program is effective in managing the effects of aging.

3.10 Conclusion

The Oyster Creek ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program is credited for managing the aging effect of loss of material, cracking, and loss of fracture toughness for the systems, components, and environments listed in Table 5.2. The Oyster Creek ISI program's elements have been evaluated against NUREG-1801 in Section 3.0. Program exceptions have been identified in Section 2.3. Program enhancements have been identified in Section 2.4. The implementing documents and commitment numbers for this aging management program are listed in Table 5.1. The relevant operating experience has been reviewed and a demonstration of program effectiveness is provided in Section 3.10.

Based on the above, the continued implementation of the Oyster Creek ISI aging management program provides reasonable assurance that the aging effects will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained during the period of extended operation.

4.0 REFERENCES

4.1 Generic to Aging Management Programs

4.1.1 10 CFR 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*

4.1.2 10 CFR 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*

4.1.3 NUREG-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,* Revision 1, dated September 2005

4.1.4 NUREG-1801, *Generic Aging Lessons Learned (GALL) Report*, Revision 1, dated September 2005

4.2 Industry Standards

4.2.1 ASME Boiler and Pressure Vessel Code, Section XI, Division 1, "Rules for Inservice Inspection of Nuclear Power

Plant Components," the 1995 Edition, 1996 Addenda

4.2.2 Code of Federal Regulations, Title 10, Part 50, Paragraph 50.55a, "Codes and Standards"

4.3 Oyster Creek Program References

4.3.1 Oyster Creek Nuclear Generating Station Technical Specifications

4.3.2 OC-2 Oyster Creek Generating Station IGSCC Program

4.3.3 OC-3 Oyster Creek Generating Station Repair/Replacement Program

4.3.4 ER-AB-331-1001 BWR RX Internals

5.0 TABLES

5.1 Aging Management Program Implementing Documents

Procedure Number	Procedure Title	Commitment No.	Status
OC-1	Oyster Creek Generating Station ISI Program Plan	00330592.01.01	ACC/ASG
OC-4	Oyster Creek Generating Station Inservice Pressure Testing Program Plan	00330592.01.07	ACC/ASG
OC-5	Oyster Creek Generating Station Reactor Vessel Internals Program	00330592.01.09	ACC/ASG
ER-AA-330	Conduct of Inservice Inspection Activities	00330592.01.06	ACC/ASG
ER-AA-330-001	Section XI Pressure Testing	00330592.01.05	ACC/ASG
ER-AA-330-002	Inservice Inspection of Section XI Welds and Components	00330592.01.04	ACC/ASG
ER-AA-330-009	ASME Section XI Repair/Replacement Program	00330592.01.02	ACC/ASG

ER-AB-331	BWR RX Internals Management Program Activities	00330592.01.10	ACC/ASG
307	Isolation Condenser System	00330592.01.08	ACC/ASG
(NEW)	[PM Activity for additional Isolation Condenser examination requirements]	00330592.01.03	ACC/ASG

5.2 Aging Management Review Results

SSC Name	Structure and/or	Material	Environment	Aging Effect
Control Rod Drive System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Control Rod Drive System	Piping and fittings	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Control Rod Drive System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Core Spray System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Core Spray System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Core Spray System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Piping and fittings	Chrome Moly	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Piping and fittings	Chrome Moly	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Piping and fittings	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Piping and fittings	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Feedwater System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Heat Exchangers	Stainless Steel	Treated Water (Internal)	Loss of Material
Isolation Condenser System	Heat Exchangers	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Heat Exchangers	Stainless Steel	Treated Water < 140F (External)	Loss of Material
Isolation Condenser System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Isolation Condenser System	Valve Body	CASS	Steam (Internal)	Loss of Fracture Toughness
Main Steam System	Condensing chamber	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Main Steam System	Condensing chamber	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Steam System	Condensing chamber	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Main Steam System	Condensing chamber	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Steam System	Piping and fittings	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Main Steam System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth

Main Steam System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Main Steam System	Piping and fittings	Carbon and low	Steam (Internal)	Cracking Initiation and Growth
Main Steam System	Piping and fittings	Carbon and low	Steam (Internal)	Cracking Initiation and Growth
Main Steam System	Valve Body	Carbon and low	Steam (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Condensing chamber	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Condensing chamber	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Condensing chamber	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Condensing chamber	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Nuclear Boiler Instrumentation	Valve Body	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Post-Accident Sampling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Post-Accident Sampling System	Piping and fittings	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Post-Accident Sampling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Piping and fittings	Stainless Steel	Steam (Internal)	Cracking Initiation and Growth
Reactor Head Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzle (Bottom head	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzle Safe Ends	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzles (Core Spray)	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzles (Feedwater)	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzles (Isolation	Carbon and low	Steam (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzles (Main Steam)	Carbon and low	Steam (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Nozzles (Recirculation	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Top Head Enclosure	Carbon and low	Steam (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Top Head Enclosure	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth

Reactor Pressure Vessel	Top Head Flange	Carbon and low alloy steel (with stainless steel	Steam (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Vessel Bottom Head	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Vessel Shell (Upper,	Carbon and low	Treated Water >482F (Internal)	Cracking Initiation and Growth
Reactor Pressure Vessel	Vessel Shell Flange	Carbon and low	Steam (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Recirculation System	Pump Casing	CASS	Treated Water >482F (Internal)	Loss of Fracture Toughness
Reactor Recirculation System	Valve Body	CASS	Treated Water >482F (Internal)	Loss of Fracture Toughness
Reactor Water Cleanup System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Piping and fittings	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Reactor Water Cleanup System	Valve Body	CASS	Treated Water >482F (Internal)	Loss of Fracture Toughness
Reactor Water Cleanup System	Valve Body	CASS	Treated Water >482F (Internal)	Loss of Fracture Toughness
Shutdown Cooling System	Flow Element	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Flow Element	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Flow Element	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Flow Element	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Piping and fittings	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Shutdown Cooling System	Piping and fittings	Carbon and low	Treated Water (Internal)	Cracking Initiation and Growth
Standby Liquid Control System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth
Standby Liquid Control System	Piping and fittings	Stainless Steel	Treated Water (Internal)	Cracking Initiation and Growth

6.0 ATTACHMENTS

6.1 LRA Appendix A

6.2 LRA Appendix B

PROGRAM BASIS DOCUMENT

PBD-AMP-B.1.31

Revision 0

STRUCTURES MONITORING PROGRAM

GALL PROGRAM XI.S6 - STRUCTURES MONITORING PROGRAM

Prepared By: ______________________

Reviewed By: ______________________

Program Owner Review: ______________________

Technical Lead Approval: ______________________

Revision History:

Revision	*Prepared by:*	*Reviewed by:*	*Program Owner:*	*Approved by:*
0	*A. M. Ouaou*	*T. Quintenz*	*S. Niogi*	*Don Warfel*
Date				

Summary of Revisions:

Rev. Number	Reason for the Revision(s)
0	Initial Issue

TABLE OF CONTENTS

0.0 PURPOSE AND METHODOLOGY

0.1 Purpose

The purpose of this Program Basis Document is to document and evaluate those activities of the Oyster Creek Structures Monitoring aging management program that are credited for managing loss of material, cracking, change in material properties, reduction in anchor capacity due to local degradation of concrete, reduction or loss of isolation function, loss of sealing, loss of preload, and loss of form of Oyster Creek and Forked River Combustion Turbines structures, structural components and commodities, external surface of mechanical components, and Oyster Creek water control structures and masonry walls as part of Oyster Creek License Renewal to meet the requirements of the License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

This includes the following:

- The identification of the scope of the program;
- The evaluation of program elements against NUREG-1801;
- The review of Operating Experience to demonstrate program effectiveness;
- The identification of required program enhancements; and
- The identification of Oyster Creek documents required to implement the program.

0.2 Methodology

The nuclear power plant License Renewal Rule 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," describes the License Renewal process and provides requirements for the contents of License Renewal Applications. 10 CFR 54.21(a)(3) states:

"For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the Current Licensing Basis (CLB) for the period of extended operation."

The NRC and the industry identified 10 program elements that are useful in describing an aging management program and then demonstrating its effectiveness. These program elements are described in Appendix A.1, Section A.1.2.3 of the Standard Review

Plan. NUREG-1801 uses these program elements in Section XI to describe acceptable aging management programs.

This Program Basis Document also provides a comparison of the credited Oyster Creek program with the elements of the corresponding NUREG-1801 Chapter XI program XI.S6, Structures Monitoring Program. Project Level Instruction PLI-8 "Aging Management Basis Documents" prescribes the methodology for evaluating Aging Management Programs. An evaluation of Oyster Creek's aging management program criteria or activities to those of the NUREG-1801 program elements is performed and a conclusion is reached concerning consistency for each individual program element. A demonstration of overall program effectiveness is made after all program elements are evaluated. Required program enhancements are documented. An overall determination is made as to consistency with the program description in NUREG-1801.

1.0 PROGRAM DESCRIPTION

1.1 Program Description

<u>NUREG-1801:</u>

a) *Implementation of structures monitoring under 10 CFR 50.65 (the Maintenance Rule) is addressed in Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.160, Rev. 2, and NUMARC 93-01, Rev. 2. These two documents provide guidance for development of licensee-specific programs to monitor the condition of structures and structural components within the scope of the Maintenance Rule, such that there is no loss of structure or structural component intended function.*

b) *Because structures monitoring programs are licensee-specific, the Evaluation and Technical Basis for this aging management program (AMP) is based on the implementation guidance provided in Regulatory Guide 1.160, Rev. 2, and NUMARC 93-01, Rev. 2. Existing licensee-specific programs developed for the implementation of structures monitoring under 10 CFR 50.65 are acceptable for license renewal provided these programs satisfy the 10 attributes described below.*

c) *If protective coatings are relied upon to manage the effects of aging for any structures included in the scope of this AMP, the structures monitoring program is to address protective coating monitoring and maintenance.*

<u>Oyster Creek:</u>

a) The Oyster Creek Structures Monitoring Program was developed and implemented to meet the regulatory requirements of 10 C FR 50.65, Maintenance Rule, USNRC Regulatory Guide 1.160, and NUMARC 93-01, Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants. The program includes masonry walls evaluated in accordance with NRC IEB 80-11, "Masonry Wall Design" and incorporates guidance in NRC IN 87-67, "Lessons learned from Regional Inspection of Licensee Actions in Response to IE Bulletin 80-11". The program elements also incorporate the requirements of NRC Regulatory Guide 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants."

b) The program is implemented through station procedure **(Reference: 125.6)**, which identifies structures and structural components within the scope of Maintenance Rule and some structures in scope of License Renewal. The scope of the program will be enhanced to include additional structures and structural components that are in scope of license renewal. In some cases the added structure or component is included in the existing inspections; however there are no procedural requirements to perform the inspection for the particular structure or component. In this case the enhancement consists of revising procedure 125.6 to specifically address the structure or component.

   The program will also be enhanced to require periodic inspection of concrete surfaces exposed to salt water and the fire pond water. Inspection criteria will be enhanced to include loss of material due corrosion, change in material properties due to leaching of calcium hydroxide, and loss of sealing. For more details of enhancements, see program elements below. The enhancements will be incorporated in the program procedure (**Reference: 125.6**) and implemented prior to the period of extended operation.

   The scope of the program will also be enhanced to include the requirements NUREG-1801 Rev. 1 XI.M36, Exterior Surfaces Monitoring. The requirement of this new AMP apply to exterior surfaces of Oyster Creek and Forked River Combustion Turbine (FRCT) mechanical components that have been determined to be in scope of license renewal and are not covered by other programs

   The program relies on periodic visual inspections, by qualified individuals (**Reference: 125.6, paragraphs 1.0 and 4.2**); to identify and evaluate degradations of structures and components such that there is no loss of structure or component intended function. The program also relies on procurement controls (**Reference: SM-AA-300**) and installation practices (**Reference: 2400-GMM-3900.52**) to ensure that only approved lubricants and proper torque are applied to structural bolting, consistent with NUREG-1801 XI.M18, Bolting Integrity Program.

The program will be enhanced to require periodic sampling and testing of groundwater and to review chemistry results to confirm that the environment remains non-aggressive for concrete structures during the period of extended operation

Observed conditions that have the potential for impacting an intended function are evaluated or corrected in accordance with the Oyster Creek corrective action process.

c) Protective coatings are not relied upon to manage the effects of aging for structures included in the scope of this AMP. As a result, protective coatings are not addressed.

1.2 Overall NUREG-1801 Consistency

The Oyster Creek Structures Monitoring aging management program is an existing program, when enhanced, will be consistent with NUREG-1801 aging management program XI.S6, Structures Monitoring. The program takes exception to the frequency specified in NUREG-1801 Rev 1 XI.M36, External Surfaces Monitoring, for monitoring external surfaces of mechanical components.

1.3 Summary of Exceptions to NUREG-1801

The existing Oyster Creek Structures Monitoring aging management program, with enhancements, is found to be adequate to manage aging effects of structures and structural components during the period of extended operation with the following exception.

The program takes exception to the frequency specified in NUREG–1801 Rev. 1 XI.M36, External Surfaces Monitoring, for monitoring external surfaces of Oyster Creek and FRCT mechanical components. The frequency specified by Oyster Creek Structures Monitoring Program is every 4 years; whereas the frequency specified in XI.M36 is at least once per refueling cycle.

Technical basis for this exception is provided in Section 3.4, Detection of Aging Effects. *This is a new exception based on the reconciliation of this aging management program from draft January 2005 NUREG-1801, Rev. 1 to the approved September 2005 NUREG-1801, Rev. 1.*

1.4 Summary of Enhancements to NUREG-1801

The existing Oyster Creek Structures Monitoring Program implementing procedure (**Reference: 125.6**) will be revised to include the following enhancements:

- Add buildings, structural components and commodities that are not in scope of Maintenance Rule but have been determined to be in the scope of License Renewal. These include miscellaneous platforms, flood and secondary containment doors, penetration seals, sump liners, structural seals, anchors, and embedment.
- Component supports, other than those in scope of ASME XI, Subsection IWF.
- Inspection of external surfaces of Oyster Creek and FRCT mechanical components that are not covered by other programs, including HVAC duct, damper housings, and HVAC closure bolting. Inspection and acceptance criteria of the external surfaces will be the same as those specified for structural steel components and structural bolting.
- The program will be enhanced to require visual inspection of external surfaces of mechanical steel components that are not covered by other programs for leakage from or onto external surfaces, worn, flaking, or oxide-coated surfaces, corrosion stains on thermal insulation, and protective coating degradation (cracking and flaking). These enhanced requirements are applicable to both Oyster Creek and FRCT mechanical components. *This is a new commitment based on the reconciliation of this aging management program from draft January 2005 NUREG-1801, Rev. 1 to the approved September 2005 NUREG-1801, Rev. 1.*
- The visual inspection of insulated surfaces will require the removal of insulation. Removal of insulation will be on a sampling basis that bounds insulation material type, susceptibility of insulated piping or component material to potential degradations that could result from being in contact with insulation, and system operating temperature.

- Inspection of electrical panels and racks, junction boxes, instrument racks and panels, cable trays, offsite power structural components and their foundations, and anchorage.
- Periodic sampling, testing, and analysis of ground water to confirm that the environment remains non-aggressive for buried reinforced concrete.
- Periodic inspection of components submerged in salt water (Intake Structure and Canal, Dilution structure) and in the water of the fire pond dam, including trash racks at the Intake Structure and Canal.
- Inspection of penetration seals, structural seals, and other elastomers for change in material properties.
- Inspection of vibration isolators, associated with component supports other than those covered by ASME XI, Subsection IWF, for reduction or loss of isolation function.
- The current inspection criteria will be revised to add loss of material, due to corrosion for steel components, and change in material properties, due to leaching of calcium hydroxide and aggressive chemical attack for reinforced concrete. Wooden piles and sheeting will be inspected for loss of material and change in material properties.
- Periodic inspection of the Fire Pond Dam for loss of material and loss of form.

2.0 EVALUATIONS AND TECHNICAL BASIS

<u>Note</u>

This section is organized by quoting the relevant NUREG-1801 Chapter XI program element (September 2005 version) followed by the related Oyster Creek program attributes and a conclusion of the comparison. Where applicable, the NUREG-1801 program element was separated into logical sub-elements and addressed accordingly.

Implementing procedure references are included in **( )** for information purposes. This information from the source procedure has been either directly extracted from the procedure or summarized for inclusion into this PBD.

2.0 Scope of Program

<u>NUREG-1801:</u>

The applicant specifies the structure/aging effect combinations that *are managed by its structures monitoring program.*

Oyster Creek:

The scope of the existing program (**Reference: 125.6, paragraph 2.0**) includes buildings and structural components that satisfy Maintenance Rule scoping basis. These include some structures that are in scope of license renewal such as the reactor building, turbine building, intake structure and canal, structures inside primary containment, diesel generator building, dilution structure, ventilation stack, condensate transfer building, fire pump houses, and the new radwaste building. Elements of each building in scope of the program include:

- Reinforced concrete components (foundation, walls, slabs, beams, columns)
- Structural steel components, including structural bolts
- Masonry block walls (IEB 80-11)
- Canal slopes and earthen dikes (Reg. Guide 1.127)

The scope of the program will be enhanced as described below to include additional structures, components, and commodities that are not in scope of the existing program but require inspection prior to and during the period of extended operation.

The Oyster Creek Structures Monitoring aging management program manages the aging effects of loss of material, cracking, change in material properties, reduction in anchor capacity due to local degradation of concrete, reduction or loss of isolation function, loss of sealing, loss of preload, and loss of form for the systems, structures, components, and environments listed in Table 5.2. The implementing documents for this aging management program are listed in Table 5.1 and are described throughout the individual program element discussions. The commitment numbers under which these implementing documents are being revised are contained within the listings in Table 5.1.

Exceptions to NUREG-1801, Element 1:

None

Enhancements to NUREG-1801, Element 1:

The following structures and components will be added to the scope of the program.

- Chlorination facility, Exhaust Tunnel, Heating Boiler house, Oyster Creek Substation, Fire Pond Dam, and Miscellaneous Yard Structures
- Panels and enclosures
- Exposed surfaces of concrete anchors and embedments.
- Penetration seals other than fire seals. Fire seals are included with fire protection activities
- Doors other than fire rated doors. Fire rated doors are included with fire protection activities.
- Structural seals (secondary containment, and flood barriers)
- Components supports including, electrical cable trays, electrical conduit, tubing, HVAC ducts, instrument racks, battery racks, and supports for piping and components that are not within the scope of ASME Section XI, Subsection IWF.
- Concrete surfaces exposed to salt water and fire pond water (RG Guides 1.127).
- Miscellaneous steel
- Foundation and anchorage of equipment, tanks, panels and enclosures.
- Duct banks, and manholes
- Offsite power transmission tower
- Submerged steel and wooden components at the Intake Structure and Canal, Dilution Structure, and Fire Pond Dam.
- Liner for containment drywell and reactor building sumps
- Steel and wooden bulkheads

The scope of the program will also be enhanced to include inspection of exterior surfaces of Oyster Creek and Forked River Combustion Turbines mechanical components that are not covered by other programs, including exterior surfaces of HVAC ducts, damper housings and duct closure bolting within the scope of license renewal. Components that will be added to scope of the program include piping components, valves, tanks, vessels, etc. located in indoor or outdoor air environments. The scope of the program is limited to components whose exterior surfaces are not monitored by other programs such as ASME Section XI, ISI Programs and fire protection activities.

The program will also be enhanced to require periodic sampling of ground water to confirm that the environment is non-aggressive for buried reinforced concrete during the period of extended operation.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801 Programs, XI.S6 and XI.M36, Element 1, Scope of Program, with the enhancements described above.

2.1 Preventive Actions

NUREG-1801:

No preventive actions are specified.

Oyster Creek:

This program specifies no preventive actions. The program is a condition monitoring program that utilizes inspections to identify aging effects prior to loss of intended function (**Reference: 125.6, paragraph 1.0**).

Exceptions to NUREG-1801, Element 2:

None

Enhancements to NUREG-1801, Element 2:

None

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801 Programs, XI.S6 and XI.M36, Element 2, Preventive Actions.

2.2 Parameters Monitored or Inspected

NUREG-1801:

a) *For each structure/aging effect combination, the specific parameters monitored or inspected are selected to ensure that aging degradation leading to loss of intended functions will be detected and the extent of degradation can be determined.*

b) *Parameters monitored or inspected are to be commensurate with industry codes, standards and guidelines, and are to also consider industry and plant-specific operating experience.*

c) *Although not required, ACI 349.3R-96 and ANSI/ASCE 11-90 provide an acceptable basis for selection of parameters to be monitored or inspected for concrete and steel structural elements and for steel liners, joints, coatings, and waterproofing membranes (if applicable).*

d) *If necessary for managing settlement and erosion of porous concrete subfoundations, the continued functionality of a site de-watering system is to be monitored.*

e) *The plant-specific structures monitoring program is to contain sufficient detail on parameters monitored or inspected to conclude that this program attribute is satisfied.*

Oyster Creek:

a) For each structure and aging effect combination, the specific parameters monitored or inspected are selected to ensure that aging degradation leading to loss of intended functions will be detected and the extent of degradation can be determined **(Reference: 125.6, paragraph 4.0, 7.0)**. Parameters monitored or inspected are based on aging effects identified for Oyster Creek material and environment combinations documented in PP-15, Standard Materials, Environments and Aging Effects. Where required, the existing aging management activities are enhanced to ensure that parameters monitored will detect degradations that could lead to a loss of an intended function.

Parameters monitored under the existing program include the following,

- Reinforced concrete structures are monitored for loss of material, and cracking. The aging effects are monitored by inspecting concrete surfaces for spalling, scaling, rebar corrosion, rust stain, water stains, water intrusion, rebar exposure, disintegration, and cracking
- Structural steel members and connections are monitored for loose or missing bolts, which are considered loss of preload, cracked welds, and loose or distorted structural members.
- Masonry block walls are monitored for cracks, and loose blocks
- The intake canal slopes and embankments are monitored for loss of form by inspecting for cracks, sink holes, and embankment collapse.

- Program enhancements required to ensure that parameters monitored will detect degradations that could lead to a loss of an intended function are summarized below. In some cases the enhancement is included as part of existing activities. However, there are no procedural requirements or commitment to perform the activity. For these cases, the enhancement consists of revising the program implementing procedure (**Reference: 125.6 paragraph 7.0**) to proceduralize the performed inspections.

b) Parameters monitored or inspected are developed to implement the requirements of 10 CFR 50.65, Maintenance Rule, USNRC Regulatory Guide 1.160, IEB 80-11, and RG. 1.127 for water control structures. The parameters monitored or inspected are based on industry standards, including ACI 349.3R-96, Evaluation of Existing Nuclear Safety-Related Concrete Structures, NEI 96-03, Guideline for Monitoring the Condition of Structures at Nuclear power Plants, NUMARC 93-01, Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants, and NUREG-1522, Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures **(Reference: 125.6 paragraph 7.0)**.

c) Concrete parameters monitored or inspected are based on ACI 349.3R-96. Structural steel and steel liner inspection parameters are based on design codes and standards including American Institute of Steel Construction (AISC). ANSI/ASCE 11-90 is not specifically referenced in program implementing documents, however its elements are incorporated in the program.

d) Oyster creek structures are founded on highly dense soil and settlement is not a concern. Observed total settlements of the reactor building foundation have ranged from 2/3 to ¾ inches, which compares well with the predicted settlement of less that one (**Reference: 4.3.7**). Thus a settlement monitoring is not required; nor is a de-watering system relied upon to control settlement. Porous concrete is not incorporated into the design of Oyster Creek sub-foundation.

e) The enhanced Oyster Creek Structures Monitoring Program contains sufficient detail on parameters monitored or inspected to conclude with reasonable assurance that NUREG-1801 XI.S6, Structures Monitoring Program, and XI.M36, External Surfaces Monitoring Program, attributes are satisfied.

<u>Exceptions to NUREG-1801, Element 3:</u>

None

Enhancements to NUREG-1801, Element 3:

The existing Oyster Creek Structures Monitoring Program implementing procedure (**Reference: 125.6**) will be revised to include the following enhancements:

- For concrete structures, the program will be enhanced to require visual inspection for change in material properties due to leaching of calcium hydroxide and aggressive chemical attack. The visual inspection consists of observing concrete surfaces for significant leaching or disintegration. Concrete structures will also be observed for a reduction in anchor capacity due to local concrete degradation. This will be accomplished by visual inspection of concrete surfaces around anchors for cracking, and spalling.
- The program will be enhanced to add loss of material due to corrosion for structural steel members and other steel components, such as embedments, panels and enclosures, doors, siding, metal deck, structural bolting, anchors, and miscellaneous steel.
- The program will be enhanced to require inspection of penetration seals and structural seals, for change in material properties by inspecting the seals for cracking and hardening.
- The program will be enhanced to require monitoring of vibration isolators, associated with component supports other than those covered by ASME XI, Subsection IWF, for reduction or loss of isolation function by inspecting the isolators for cracking and hardening.
- The program will be enhanced to require visual inspection of external surfaces of mechanical steel components that are not covered by other programs for loss of material due to corrosion. Mechanical elastomers, such as hoses, will be inspected for a change in material properties by observing the elastomer for cracking and hardening. These enhanced requirements are applicable to both Oyster Creek and FRCT mechanical components.
- Groundwater will be monitored for pH, chlorides, and sulfates.
- The program will be enhanced to require visual inspection of external surfaces of mechanical steel components that are not covered by other programs for leakage from or onto external

surfaces, worn, flaking, or oxide-coated surfaces, corrosion stains on thermal insulation, and protective coating degradation (cracking and flaking). These enhanced requirements are applicable to both Oyster Creek and FRCT mechanical components. *This is new commitment based on the reconciliation of this aging management program from draft January 2005 NUREG-1801, Rev. 1 to the approved September 2005 NUREG-1801, Rev. 1.*

- The program will be enhanced to require removal of piping and component insulation to permit visual inspection of insulated surfaces. Removal of insulation will be on a sampling basis that bounds insulation material type, susceptibility of insulated piping or component material to potential degradations that could result from being in contact with insulation, and system operating temperature. These enhanced requirements are applicable to both Oyster Creek and FRCT mechanical components.
- The program will be enhanced to require inspection of exterior surfaces of HVAC ducts, damper housings, for loss of material and HVAC closure bolting for loss of material and loose or missing bolts nuts. These enhanced requirements are applicable to both Oyster Creek and FRCT components.

<u>Comparison and Evaluation Conclusion:</u>

This element is consistent with NUREG-1801 Programs, XI.S6 and XI.M36, Element 3, Parameters Monitored or Inspected, with the enhancements described above.

2.3 Detection of Aging Effects

<u>NUREG-1801:</u>

a) For each structure/aging effect combination, the inspection methods, inspection schedule, and inspector qualifications are selected to ensure that aging degradation will be detected and quantified before there is loss of intended functions.

b) Inspection methods, inspection schedule, and inspector qualifications are to be commensurate with industry codes, standards and guidelines, and are to also consider industry and plant-specific operating experience.

c) Although not required, ACI 349.3R-96 and ANSI/ASCE 11-90 provide an acceptable basis for addressing detection of aging effects.

d) *The plant-specific structures monitoring program is to contain sufficient detail on detection to conclude that this program attribute is satisfied.*

Oyster Creek:

a) The Structures Monitoring Program requires monitoring of each structure/aging effects by qualified individuals every 4 years to ensure age related degradations would be detected and quantified before there is a loss of intended function (**Reference: 125.6, paragraph 1.0 and 4.2**).

b) Inspection methods, inspection schedule, and inspector qualification are consistent with industry guidelines and NRC guidance for implementing the requirements of 10 CFR 50.65 (**Reference: 125.6, paragraph 1.0**). Inspection methods consist of visual inspections conducted on a frequency of every 4 years in accessible areas of the plant. The program contains provisions for more frequent inspections to ensure that observed conditions that have the potential for impacting an intended function are evaluated or corrected in accordance with the corrective action process. Inaccessible areas, such as buried structures are inspected when they become uncovered. External surfaces of Oyster Creek and FRCT mechanical components, including HVAC ducts, damper housings, and bolting will be inspected on a frequency of every 4 years consistent with inspection frequency for structures. This constitutes an exception to NUREG-1801 Rev. 1 AMP XI.M36, which requires these inspections be performed at least once per refueling outage. Technical basis for the exception is provided below.

   Qualification of individuals responsible for inspections and assessment of the results is required to have a B.S. degree and/or Professional Engineer license, and a minimum of five years experience working on the building structures of Nuclear Power Plants (**Reference: 125.6, paragraph 4.2**). These requirements consider industry and plant-specific operating experience and are consistent with industry standards for implementing 10CFR 50.65 requirements.

c) Detection of concrete aging effects is based on ACI 349.3R-96. For structures and components, other than concrete, detection of aging is based on the applicable design codes, standards and guidelines (**Reference: 125.6, paragraph 4.0**).

d) The Oyster Creek Structures Monitoring Program is established to implement the requirements of 10 CFR 50.65. The enhanced program for license renewal provides adequate details for detection of age related degradations to ensure that SSCs in the scope of the program will perform their intended function during the period of extended operation (**Reference: 125.6**).

<u>Exceptions to NUREG-1801, Element 4:</u>

The Oyster Creek Structures Monitoring Program is consistent with NUREG-1801 XI.S6, Structures Monitoring Program for detection of aging of structures and structural components with the following exception.

The program takes exception to the inspection frequency of at least once per refueling cycle specified in NUREG-1801 Rev. 1 XI.M36, External Surfaces Monitoring, for monitoring external surfaces of mechanical components. The specified frequency by the Oyster Creek program is every 4 years. Technical basis for this exception is follows.

- The frequency of 4 years specified for monitoring of exterior surfaces of mechanical components is consistent with the frequency specified for exterior surfaces of supporting structures. The 4-year frequency is consistent with industry guidelines and has proven effective in detecting loss of material due to corrosion, and change in material properties of structural elastomer on exterior surfaces of structures. Consequently this frequency will also be effective for detecting loss of material and change in material properties on exterior surfaces of mechanical components before an intended function is impacted.
- Industry and plant-specific operating experience review has not identified any instances of significant loss of material or change in material properties of external surfaces of mechanical components subject to indoor air environment (see section 3.10 below).
- Mechanical components subject to outdoor air are constructed from stainless steel, aluminum, which are not susceptible to accelerated corrosion, or carbon steel components protected by protective coatings such as galvanizing, or painting. Plant operating experience indicates that monitoring of exterior surfaces of components made of these materials and protective coatings on a frequency of 4 years provides reasonable assurance that

loss of material will be detected before an intended function is affected.

- Studies by EPRI (**Reference: 4.2.13, fig. 4.1-1**) provides corrosion rate curve for carbon steels. This curve was constructed from 55 individual tests representing at least five different steels and six different test locations and environments. The curve shows 0.926 mils per year thickness loss during the first 1 1/2 years, decreasing to 0.21 mils per year after 15 ½ years. EPRI also conducted corrosion tests of ASTM A-36 structural steel at four nuclear plants located in Elma and Richland, Washington; and Midland, Michigan. The tests were conducted for up to 24 months. EPRI concluded that based on the test results the corrosion rate is 0.5 mils per year. If the corrosion rate is conservatively taken as 0.926 mils per year, then the loss of material projected for 4 years is less than 4 mils. This loss of material is insignificant and will not impact the intended function of mechanical components (**Reference: 4.2.13, 4.2.14**).

This is a new exception based on the reconciliation of this aging management program from draft January 2005 NUREG-1801, Rev. 1 to the approved September 2005 NUREG-1801, Rev. 1.

Enhancements to NUREG-1801, Element 4:

The program will be enhanced to require inspection of submerged water-control structures when dewatered, or on a frequency not to exceed 10 years.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801 XI.S6, Structures Monitoring Program for detection of aging effects of structures and structural components with no exceptions.

This element is consistent with exceptions with NUREG-1801 Rev. 1 XI.M36, External Surfaces Monitoring, for monitoring external surfaces of mechanical components. The specified frequency by the Oyster Creek program is every 4 years; while XI.M36 requires a frequency of at least every refueling cycle. Technical basis for this exception is that, based on plant specific operating experience and industry experience, the 4-year frequency is adequate to provide reasonable assurance that aging effects will be detected and corrected before a loss of an intended function.

2.4 Monitoring and Trending

NUREG-1801:

a) *Regulatory Position 1.5, "Monitoring of Structures," in RG 1.160, Rev. 2, provides an acceptable basis for meeting the attribute.*

b) *A structure is monitored in accordance with 10 CFR 50.65 (a)(2) provided there is no significant degradation of the structure.*

c) *A structure is monitored in accordance with 10 CFR 50.65 (a)(1) if the extent of degradation is such that the structure may not meet its design basis or, if allowed to continue uncorrected until the next normally scheduled assessment, may not meet its design basis.*

Oyster Creek:

a) The program requires monitoring of Oyster Creek structures and components in accordance with 10CFR50.65 and RG 1.160 Rev. 2, Regulatory Position 1.5 (**Reference: 125.6, paragraph 7.2**).

b) Structures and components are monitored in accordance with 10 CFR50.65 (a)(2) if inspection results did not identify significant degradation (**Reference: 125.6, paragraph 7.2**).

c) The program contains provisions for increased inspection frequency and trending of structures and components, consistent with 10CFR50.65 (a)(1), if the degradation is such that the structure or component may not meet its design basis, or, if allowed to continue uncorrected until the next normally scheduled assessment, may not met its design basis (**Reference: 125.6, paragraph 7.2**).

Exceptions to NUREG-1801, Element 5:

None

Enhancements to NUREG-1801, Element 5:

None

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801 Programs, XI.S6 and XI.M36, Element 5, Monitoring and Trending.

2.5 Acceptance Criteria

NUREG-1801:

a) *For each structure/aging effect combination, the acceptance criteria are selected to ensure that the need for corrective actions will be identified before loss of intended functions.*

b) *Acceptance criteria are to be commensurate with industry codes, standards and guidelines, and are to also consider industry and plant-specific operating experience.*

c) *Although not required, ACI 349.3R-96 provides an acceptable basis for developing acceptance criteria for concrete structural elements, steel liners, joints, coatings, and waterproofing membranes.*

d) *The plant-specific structures monitoring program is to contain sufficient detail on acceptance criteria to conclude that this program attribute is satisfied.*

Oyster Creek:

a) Inspection results are evaluated by qualified engineers based on acceptance criteria selected for each structure/aging effect to ensure that the need for corrective actions would be identified before loss of intended functions (**Reference: 125.6, paragraphs 4.2 and 7.0**).

b) Identified degradation are evaluated by qualified individuals based on industry codes, standards, and guidelines including ACI 318, ACI 349.3R, American Institute of Steel Construction (AISC). Development of acceptance criteria considers industry and plant specific operating experience. These criteria are directed at identification and evaluation of degradations that may affect the ability of the structure or component to perform its intended function (**Reference: 125.6, paragraphs 4.0 and 7.0**).

c) ACI 349.3R-96 was used to develop acceptance criteria for concrete structural elements (**Reference: 125.6, paragraph 6.0**).

d) The enhanced Oyster Creek Structures Monitoring Program requires that identified degradations be assessed and evaluated by qualified engineering personnel, considering the extent of the degradation using design basis codes and standards that include ACI 318, ACI 349.3R, AISC, and ASME/ANSI. The program implementing procedure provides sufficient details on acceptance criteria for structures and exterior surfaces of mechanical components to ensure that significant degradations are identified and corrected before a loss of an intended function (**Reference: 125.6**).

Exceptions to NUREG-1801, Element 6:

None

Enhancements to NUREG-1801, Element 6:

The existing Oyster Creek Structures Monitoring Program implementing procedure (**Reference: 125.6**) will be revised to require that qualified individuals evaluate identified degradations on external surfaces of mechanical components. Acceptance criteria will be consistent with industry standards, design codes and guidelines, including ANSI or ASME as applicable. This is applicable to Oyster Creek and FRCT exterior surfaces of mechanical components.

Acceptance criteria to establish if groundwater is aggressive for concrete structures (pH <5.5, or chlorides > 500 ppm, or sulfates > 1500 ppm) will be consistent with industry standards, and NUREG-1801.

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801 Programs, XI.S6 and XI.M36, Element 6, Acceptance Criteria, with the enhancements described above.

2.6 Corrective Actions

NUREG-1801:

As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

Oyster Creek:

Evaluations are performed for inspection results that do not satisfy established criteria and an Issue Report (IR) is initiated to document the concern in accordance with 10 CFR 50, Appendix B, Corrective Action Program. The corrective action process ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude repetition.

Exceptions to NUREG-1801, Element 7:

None

Enhancements to NUREG-1801, Element 7:

None

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801 Programs, XI.S6 and XI.M36, Element 7, Corrective Actions.

2.7 Confirmation Process

NUREG-1801:

As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process.

Oyster Creek:

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

Exceptions to NUREG-1801, Element 8:

None

Enhancements to NUREG-1801, Element 8:

None

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801, Programs XI.S6 and XI.M36, Element 8, Confirmation Process.

2.8 Administrative Controls

NUREG-1801:

As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to *address the administrative controls.*

Oyster Creek:

See Item 8, above.

Exceptions to NUREG-1801, Element 9:

None

Enhancements to NUREG-1801, Element 9

None

Comparison and Evaluation Conclusion:

This element is consistent with NUREG-1801 Programs, XI.S6 and XI.M36, Element 9, Administrative Controls.

2.9 Operating Experience

NUREG-1801:

Although in many plants structures monitoring programs have only recently been implemented, plant maintenance has been ongoing since initial plant operation. A plant-specific program that includes the attributes described above will be an effective AMP for license renewal.

Oyster Creek:

Operating experience, both internal and external, is used in two ways at Oyster Creek to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Oyster Creek. The first way in which operating experience is used is through the Oyster Creek Operating Experience process. The Operating Experience process screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The second way is through the process for managing programs. This process requires the review of program related operating experience by the program owner.

Both of these processes review operating experience from both external and internal (also referred to as in-house) sources. External operating experience may include such things as INPO documents (e.g., SOERs, SERs, SENs, etc.), NRC documents (e.g., GLs, LERs, INs, etc.), Westinghouse documents (e.g., TBs, etc.), General Electric documents (e.g., RCSILs, SILs, TILs, etc.), and other documents (e.g., 10CFR Part 21 Reports, NERs, etc.). Internal operating experience may include such things as event investigations, trending reports, and lessons learned from in-house events as captured in program notebooks, self-assessments, and in the 10 CFR Part 50, Appendix B corrective action process.

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that the Structures Monitoring Program has been effective in identifying aging effects of structures and structural components through visual detection of degrading components and plant maintenance activities in place prior to the implementation of Procedure **(Reference: 125.6)**. The enhanced program will provide the same effectiveness for managing the aging effects of structures, exterior surfaces of mechanical components, and commodities added to the scope of the program. The following examples of operating experience **(Reference: 4.3.6, unless noted otherwise below)** provide objective evidence that the Structures Monitoring Program is effective in assuring that intended function(s) will be maintained consistent with the CLB for the period of extended operation:

<u>Concrete cracking:</u>

Reactor Building Exterior- a review of documentation going back to early 1997 indicates the identification of cracking on the exterior surfaces of the Reactor Building. Notable cracking has been observed on the west wall with minor cracking on the east and south walls. The documented review of the condition indicates the cause to be from combination of concrete shrinkage and temperature changes. The reason for the differences in degree of cracking on the west wall as opposed to the east and south walls is attributed to the fact the west wall does not have a scored exterior wall at the control joints unlike the east and south walls. The condition has been monitored during Maintenance Rule Structure Monitoring Inspections; documented, and dispositioned not to be a structural capability concern, but a concern over the life of the plant because of rebar corrosion. Repairs were completed on areas deemed to be of concern for long-term operation of the plant. The conditions continue to be monitored and assessed through routine structure inspections. This example provides objective evidence that concrete cracking will be detected, and that engineering evaluations and corrective actions are performed prior to the loss of intended function.

Reactor Building Interior-on the interior of the west wall above 95-foot elevation there is documented crack in the proximity to the Standby Liquid Control System. This crack has been cosmetically repaired and occurred in the score joint. No structural concerns were documented in the inspection reports. This example provides objective evidence that cracking is detected, and that engineering evaluations and corrective actions are performed prior to any loss of intended function.

Drywell Shield Wall- Cracking of the drywell shield wall is documented in the NRC SEP review of the plant under Topic III-7B. The cracking is located above elevation 95 foot on the cylindrical portion of the shield wall. The cracking is attributed to elevated temperatures experienced over the life of the plant at this location. The crack patterns have been mapped, and inspected repeatedly. There have been no changes in the condition, which would indicate a structural concern was present or impending. This example provides objective evidence that concrete cracking will be detected, and that updates to the program are made as necessary to ensure that any corrective actions are performed prior to the loss of intended function.

Spent Fuel Pool Support Beams. In the middle of 1980's cracking around the spent fuel pool area of the reactor building was identified. Subsequently crack monitors were installed to monitor crack growth and a finite element analysis was performed to evaluate the design. Conclusions were drawn the cracking was predictable from the stresses found and further NDT determined the cracks not to be deep. The conclusion drawn was there was no structural concern, crack changes were not discernable, and that further monitoring of the crack monitors was not justified. But, continual monitoring of the areas is within the scope of the Structure Monitoring Program, and would be conducted on a periodic basis per the program (**Reference: 4.3.4**). This example provides objective evidence that any detected cracking will be evaluated, and that the program will be updated as necessary to enhance monitoring such that any required corrective actions are performed prior to the loss of intended function.

Intake Structure and canal - Inspection of the intake canal, performed in 2001, identified cracks and fissures, voids, holes, and localized washout of coatings that protect embankment slopes from erosion. The degradations were evaluated and determined not to impact the intended function of the intake canal. These degradations are tracked for repair in accordance with the corrective action process. This example provides objective evidence that any detected deficiencies will be evaluated to determine if corrective actions are necessary to prevent loss of intended function, and that deficiencies are entered into the 10 CFR Part 50, Appendix B Corrective Action process.

Ventilation Tunnel - A recent inspection identified localized spalling of the columns beneath the fan pad structure in the ventilation tunnel. The spalling has been attributed to failure to install the engineered configuration during construction. This condition is being monitored on a more frequent basis and corrective actions have been identified. The Mechanical/Structural Group on site is acquiring funding for the repairs. This example provides objective evidence that deficiencies are detected, evaluated, and tracked on an enhanced schedule to ensure corrective action prior to loss of intended function.

Inspections conducted in 2002, concluded that degradations discussed above have not become worse and remain essentially the same as identified in previous inspections. In addition minor cracking, rust stains, water stains, localized exposed rebars and rebar corrosion, and damage to siding were observed. The degradations were evaluated and determined not to have an impact on the structural integrity of affected structures. AR #A2050926 was generated to track painting of the steel platform near the top of the ventilation stack. These examples provide objective evidence that deficiencies are evaluated and corrective actions taken prior to loss of intended function.

Additional searches of Oyster Creek corrective action process (CAP) database identified 217 instances of corrosion cases on exterior surfaces of mechanical components and structures. For 216 cases, engineering evaluation concluded that the observed corrosion is limited to surface rust and does not impact the intended function of the component or structure. For the remaining one case, a unistrut support member for 3/8 " diameter tubing, corrosion was more extensive but the unitstrut was evaluated and determined capable of performing its intended function. These examples provide objective evidence that deficiencies are entered into the corrective action process and that engineering evaluations are performed to determine what if any corrective actions need to be taken prior to loss of intended function.

The operating experience of Structures Monitoring Program did not show any adverse trend in performance. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. There is sufficient confidence that the implementation of Structures Monitoring Program as described in the implementing procedures (**Reference: 125.6 and 2400-GMM-3900.52**) will effectively manage aging effects through the period of extended operation.

2.10 Conclusion

The Oyster Creek Structures Monitoring aging management program is credited for managing loss of material, cracking, change in material properties, reduction in anchor capacity due to local degradation of concrete, reduction or Loss of isolation function, loss of sealing, loss of preload, and loss of form for the structures, and exterior surfaces of mechanical components, and environments listed in Table 5.2. The Oyster Creek Structures Monitoring program's elements have been evaluated against NUREG-1801 in Section 3.0. Program exceptions have been identified in Section 2.3. Program enhancements have been identified in Section 2.4. The implementing documents and commitment numbers for this aging management program are listed in Table 5.1. The relevant operating experience has been reviewed and a demonstration of program effectiveness is provided in Section 3.10.

Based on the above, the continued implementation of the enhanced Oyster Creek Structures Monitoring aging management program provides reasonable assurance that loss of material, cracking, change in material properties, reduction in anchor capacity due to local degradation of concrete, reduction or loss of isolation function, loss of sealing, loss of preload, and loss of form will be adequately managed so that the intended functions of components within the scope of license renewal will be maintained during the period of extended operation.

3.0 REFERENCES

3.1 Generic Aging Management Programs

3.1.1 10 CFR 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*

3.1.2 10 CFR 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*

3.1.3 NUREG-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants*, Revision 1, dated September 2005

3.1.4 NUREG-1801, *Generic Aging Lessons Learned (GALL) Report*, Revision 1, dated September 2005

3.2 Industry Standards

3.2.1 10 CFR Part 50, Section 65, *Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,* Office of the Federal Register, National Archives and Records Administration, 2000

3.2.2 ACI 349.3R-96, *Evaluation of Existing Nuclear Safety-Related Concrete Structures*

3.2.3 NRC Regulatory Guide 1.160, Revision 2, *Monitoring the Effectiveness of Maintenance At Nuclear Power Plants*, U.S. Nuclear Regulatory Commission, March 1997

3.2.4 NUMARC 93-01, Revision 2, *Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants*, Nuclear Management and Resources Council, Inc.

3.2.5 NRC IEB 80-11, *Masonry Wall Design*

3.2.6 NRC IN 87-67, *Lessons learned from Regional Inspection of Licensee Actions in Response to IE Bulletin 80-11*

3.2.7 EPRI TR-114881, *Aging Effects for Structures and Structural Components (Structural Tools),* B&W Owners Group Generic License Renewal Program, BAW-2279P, 1997, Final Report, April 2000

3.2.8 NEI 96-03, *Industry Guideline for Monitoring the Condition of Structures at Nuclear Power Plants*, Revision D (draft)

3.2.9 Regulatory Guide 1.127, *Inspection of Water-Control Structures Associated with Nuclear Power Plants*, Revision 1, U.S. Nuclear Regulatory Commission, March 1978

3.2.10 NUREG-0822, *Systematic Evaluation Program (SEP), Topic III-7B*

3.2.11 NUREG 1522, Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures, June 1995

3.2.12 NUREG 1526, Lessons Learned from Early Implementation of the Maintenance Rule at Nine Nuclear Power Plants, June 1995

3.2.13 EPRI TR-103840, BWR Containment Industry Report, July 1994.

3.2.14 AMR-PP-01-DRE-QCD Rev 0 DRF A22-00108-03, Corrosion of Steel in an Inside (Sheltered Environment)

3.2.15 ACI 318 Building Code Requirements for Reinforced Concrete

3.2.16 AISC Specification for the Design, Fabrication and Erection of Structural Steel Buildings

3.2.17 ANSI/ASME B31.1, Power Piping, 1986 Edition with all Addenda.

3.2.18 ANSI B31.1, Power Piping, 1977 Edition with Addenda

3.3 Oyster Creek Program References

3.3.1 Procedure 125.6, *Building Structure Monitoring Plan*

3.3.2 Procedure 2400-GMM-3900.52, *Inspection and Torquing of Bolted Connections*

3.3.3 Procedure SM-AA-300, *Procurement Engineering Support Activities*

3.3.4 "Oyster Creek Nuclear Generating Station Structural Evaluation of the Spent Fuel Pool," by ABB Impell Corp. #03-0370-1341, June 1992

3.3.5 PE 125-1 #126-94, Crack Monitoring Program for Reactor Building Drywell Concrete Shield Wall above El. 95'

3.3.6 Attachment 125.6-1, "Plant Structure Walkdown/Monitoring Report", 2001, 2002, and 2004

3.3.7 GPU letter to NRC dated June 28, 1982 on SEP Safety Topic II-4.F, Settlement of Foundations and Buried Equipment – Oyster Creek Nuclear Generating Station.

4.0 TABLES

4.1 Aging Management Program Implementing Documents

Procedure Number	Procedure Title	Commitment No.	Status
125.6	Building Structure Monitoring Plan	0330592.31.02	ACC/ASG
2400-GMM-3900.52	Inspection and Torquing of Bolted Connections	0330592.31.03	ACC/ASG

4.2 Aging Management Review Results

SSC Name	Structure and/or Component	Material	Environment	Aging Effect
4160V Switchgear Room Ventilation	Closure bolting	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Louvers	Aluminum	Outdoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Louvers	Galvanized Steel	Outdoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Ductwork	Galvanized Steel	Outdoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Bird Screen	Aluminum	Outdoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Bird Screen	Stainless Steel	Outdoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Damper housing	Galvanized Steel	Outdoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Damper housing	Aluminum	Outdoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Closure bolting	Stainless Steel	Outdoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Closure bolting	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
480V Switchgear Room Ventilation	Closure bolting	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Battery and MG Set Room Ventilation	Ductwork	Galvanized Steel	Outdoor Air (External)	Loss of Material
Battery and MG Set Room Ventilation	Closure bolting	Stainless Steel	Outdoor Air (External)	Loss of Material
Battery and MG Set Room Ventilation	Closure bolting	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Battery and MG Set Room Ventilation	Closure bolting	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Battery and MG Set Room Ventilation	Damper housing	Galvanized Steel	Outdoor Air (External)	Loss of Material
Battery and MG Set Room Ventilation	Bird Screen	Aluminum	Outdoor Air (External)	Loss of Material
Battery and MG Set Room Ventilation	Louvers	Aluminum	Outdoor Air (External)	Loss of Material
C Battery Room Heating & Ventilation	Bird Screen	Stainless Steel	Outdoor Air (External)	Loss of Material

C Battery Room Heating & Ventilation	Closure bolting	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Chlorination Facility	Reinforced concrete foundation	Concrete	Soil	Cracking
Chlorination Facility	Reinforced concrete foundation	Concrete	Outdoor Air	Cracking
Chlorination Facility	Reinforced concrete foundation	Concrete	Outdoor Air	Loss of Material
Chlorination Facility	Reinforced concrete foundation	Concrete	Outdoor Air	Change in Material Properties
Chlorination Facility	Structural steel: Beams, Columns	Carbon and low alloy steel	Indoor Air	Loss of Material
Chlorination Facility	Metal Siding	Aluminum	Outdoor Air	Loss of Material
Chlorination Facility	Metal Deck	Galvanized Steel	Outdoor Air	Loss of Material
Chlorination Facility	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss of Material
Chlorination Facility	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss Of Preload
Chlorination Facility	Panels and enclosures	Stainless Steel	Outdoor Air	Loss of Material
Chlorination Facility	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
Chlorination Facility	Panels and enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Chlorination Facility	Reinforced concrete foundation	Concrete	Indoor Air	Change in Material Properties
Chlorination Facility	Reinforced concrete foundation	Concrete	Outdoor Air	Cracking
Chlorination Facility	Reinforced concrete foundation	Concrete	Outdoor Air	Cracking
Chlorination Facility	Reinforced concrete foundation	Concrete	Outdoor Air	Loss of Material
Chlorination Facility	Seals	Elastomer	Outdoor Air	Change in Material Properties
Chlorination Facility	Seals	Elastomer	Indoor Air	Change in Material Properties
Chlorination Facility	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Chlorination Facility	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
Chlorination Facility	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Chlorination Facility	Panels and enclosures	Stainless Steel	Outdoor Air	Loss of Material
Chlorination Facility	Panels and enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Chlorination Facility	Reinforced concrete foundation	Concrete	Indoor Air	Loss of Material
Chlorination Facility	Door	Carbon and low alloy steel	Indoor Air	Loss of Material
Chlorination Facility	Door	Carbon and low alloy steel	Outdoor Air	Loss of Material
Chlorination Facility	Reinforced concrete foundation	Concrete	Soil	Cracking
Chlorination System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Chlorination System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material

Chlorination System	Valve Body	Cast Iron	Indoor Air (External)	Loss of Material
Chlorination System	Piping and fittings	Cast Iron	Indoor Air (External)	Loss of Material
Circulating Water System	Valve Body	Cast Iron	Indoor Air (External)	Loss of Material
Circulating Water System	Level Glass	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Circulating Water System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Circulating Water System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Circulating Water System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Circulating Water System	Expansion Joint	Elastomer	Indoor Air (External)	Change in Material Properties
Component Supports Commodity Group	Supports for HVAC ducts (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Supports for HVAC ducts (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Containment Atmosphere	Loss of Material
Component Supports Commodity Group	Supports for HVAC ducts (support members, welds, bolted connections, support anchorage to building structure)	Galvanized Steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Supports for Non-ASME Piping and Components (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material
Component Supports Commodity Group	Supports for Non-ASME Piping and Components (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Supports for Tube Track and Instrument Tubing (support Members, Welds, Bolted Connections, support anchorage to building structure)	Carbon and low alloy steel	Containment Atmosphere	Loss of Material
Component Supports Commodity Group	Supports for Tube Track and Instrument Tubing (support Members, Welds, Bolted Connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material
Component Supports Commodity Group	Supports for Cable Trays (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Containment Atmosphere	Loss of Material

Component Supports Commodity Group	Supports for Non-ASME Piping and Components (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Containment Atmosphere	Loss of Material
Component Supports Commodity Group	Supports for HVAC ducts (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material
Component Supports Commodity Group	Supports for conduits (support members, welds, bolted connections, support anchorage to building structure)	Galvanized Steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Supports for conduits (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Containment Atmosphere	Loss of Material
Component Supports Commodity Group	Supports for conduits (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Supports for Cable Trays (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material
Component Supports Commodity Group	Supports for Panels and Enclosures, Racks (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Supports for Spray Shields (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material
Component Supports Commodity Group	Supports for Masonry Walls (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material
Component Supports Commodity Group	Supports for Platforms, Pipe Whip Restraints, Jet Impingement and Spray Shields, and Other Miscellaneous Structures (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Indoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Supports for conduits (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material

Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Outdoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Supports for HVAC Components (vibration isolation elements)	Elastomer	Indoor Air	Reduction or Loss of Isolation Function
Component Supports Commodity Group	Supports for HVAC Components (vibration isolation elements)	Elastomer	Outdoor Air	Reduction or Loss of Isolation Function
Component Supports Commodity Group	Supports for Non-ASME Piping and Components (support members, welds, bolted connections, support anchorage to building structure)	Galvanized Steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Supports for Platforms, Pipe Whip Restraints, Jet Impingement and Spray Shields, and Other Miscellaneous Structures (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Containment Atmosphere	Loss of Material
Component Supports Commodity Group	Supports for HVAC Components, and Other Miscellaneous Mechanical Equipment (support members, welds, bolted connections, support anchorage to building structure)	Galvanized Steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Supports for HVAC Components, and Other Miscellaneous Mechanical Equipment (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Supports for HVAC Components, and Other Miscellaneous Mechanical Equipment (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Containment Atmosphere	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Containment Atmosphere	Reduction in Anchor Capacity Due to Local Concrete Degradation

Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Containment Atmosphere	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Supports for Platforms, Pipe Whip Restraints, Jet Impingement and Spray Shields, and Other Miscellaneous Structures (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Outdoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Supports for Panels and Enclosures, Racks (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Indoor Air	Loss of Material
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Indoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Supports for Panels and Enclosures, Racks (support members, welds, bolted connections, support anchorage to building structure)	Carbon and low alloy steel	Containment Atmosphere	Loss of Material
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Containment Atmosphere	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Supports for Panels and Enclosures, Racks (support members, welds, bolted connections, support anchorage to building structure)	Galvanized Steel	Outdoor Air	Loss of Material
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Outdoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Indoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation

Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Indoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Indoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Indoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Outdoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Component Supports Commodity Group	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Outdoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Condensate System	Valve Body	Cast Iron	Indoor Air (External)	Loss of Material
Condensate System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate System	Expansion Joint	Elastomer	Indoor Air (External)	Change in Material Properties
Condensate System	Flow Element	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate System	Heat Exchangers	Carbon and low alloy steel - Tube side components	Indoor Air (External)	Loss of Material
Condensate System	Sensor Element	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate System	Tanks	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate System	Filter Housing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate System	Restricting Orifice	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate System	Pump Casing	Cast Iron	Indoor Air (External)	Loss of Material
Condensate Transfer Building	Equipment Foundation	Concrete	Indoor Air	Change in Material Properties
Condensate Transfer Building	Equipment Foundation	Concrete	Indoor Air	Loss of Material
Condensate Transfer Building	Equipment Foundation	Concrete	Indoor Air	Cracking

Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Outdoor Air	Cracking
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Outdoor Air	Loss of Material
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Soil	Cracking
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Indoor Air	Loss of Material
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Indoor Air	Cracking
Condensate Transfer Building	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss Of Preload
Condensate Transfer Building	Metal Siding	Aluminum	Outdoor Air	Loss of Material
Condensate Transfer Building	Equipment Foundation	Concrete	Indoor Air	Cracking
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Outdoor Air	Change in Material Properties
Condensate Transfer Building	Seals	Elastomer	Outdoor Air	Change in Material Properties
Condensate Transfer Building	Seals	Elastomer	Indoor Air	Change in Material Properties
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Soil	Cracking
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Indoor Air	Cracking
Condensate Transfer Building	Metal Deck	Galvanized Steel	Outdoor Air	Loss of Material
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Indoor Air	Change in Material Properties
Condensate Transfer Building	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss of Material
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Outdoor Air	Loss of Material
Condensate Transfer Building	Structural Steel: Beams, Columns	Carbon and low alloy steel	Indoor Air	Loss of Material
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Outdoor Air	Cracking
Condensate Transfer Building	Reinforced Concrete Foundation (includes piers)	Concrete	Outdoor Air	Cracking
Condensate Transfer Building	Door	Carbon and low alloy steel	Outdoor Air	Loss of Material
Condensate Transfer Building	Door	Carbon and low alloy steel	Indoor Air	Loss of Material
Condensate Transfer System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Condensate Transfer System	Piping and fittings	Stainless Steel	Outside Air (External)	Loss of Material
Condensate Transfer System	Valve Body	Stainless Steel	Outdoor Air (External)	Loss of Material

Condensate Transfer System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate Transfer System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate Transfer System	Piping and fittings	Aluminum	Outdoor Air (External)	Loss of Material
Condensate Transfer System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Condensate Transfer System	Expansion Joint	Elastomer	Indoor Air (External)	Change in Material Properties
Containment Inerting System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Containment Inerting System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Containment Inerting System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Containment Inerting System	Piping and fittings	Stainless Steel	Outdoor Air (External)	Loss of Material
Containment Inerting System	Drain Trap	Cast Iron (Body)	Indoor Air (External)	Loss of Material
Containment Inerting System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Containment Inerting System	Valve Body	Stainless Steel	Outdoor Air (External)	Loss of Material
Containment Inerting System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Containment Spray System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Containment Spray System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Containment Spray System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Containment Spray System	Pump Casing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Containment Spray System	Pump Casing	Cast Iron	Indoor Air (External)	Loss of Material
Containment Vacuum Breakers	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Containment Vacuum Breakers	Valve Body (Vacuum Breakers)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Containment Vacuum Breakers	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Control Rod Drive System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Control Rod Drive System	Pump Casing	Carbon and low alloy steel (Oil pump)	Indoor Air (External)	Loss of Material
Control Rod Drive System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Control Rod Drive System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Control Rod Drive System	Gear Box	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Control Rod Drive System	Accumulator	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Control Room HVAC	Closure bolting	Stainless Steel	Outdoor Air (External)	Loss of Material
Control Room HVAC	Bird Screen	Galvanized Steel	Outdoor Air (External)	Loss of Material
Control Room HVAC	Closure bolting	Galvanized Steel	Outdoor Air (External)	Loss of Material
Control Room HVAC	Ductwork	Galvanized Steel	Outdoor Air (External)	Loss of Material
Control Room HVAC	Damper housing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

Control Room HVAC	Damper housing	Galvanized Steel	Outdoor Air (External)	Loss of Material
Control Room HVAC	Louvers	Galvanized Steel	Outdoor Air (External)	Loss of Material
Control Room HVAC	Louvers	Aluminum	Outdoor Air (External)	Loss of Material
Control Room HVAC	Closure bolting	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Control Room HVAC	Bird Screen	Aluminum	Outdoor Air (External)	Loss of Material
Core Spray System	Pump Casing (Main and Booster Pumps)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Core Spray System	Sight Glasses	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Core Spray System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Core Spray System	Pump Casing (Fill Pumps)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Core Spray System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Core Spray System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Core Spray System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Drywell Floor and Equipment Drains	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Drywell Floor and Equipment Drains	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Drywell Floor and Equipment Drains	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Drywell Floor and Equipment Drains	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Pump Casing (Fuel Oil)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Filter (Inertial Air Bin)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Fan Housing (Radiator Fan)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Filter Housing (Lube Oil)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

Emergency Diesel Generator and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Valve Body	Stainless Steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Pump Casing (Lube Oil)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Heat Exchanger (Lube Oil Cooler)	Carbon and low alloy steel (shell side components)	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Filter Housing (Fuel Oil)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Fan Housing (Dust Bin Blower Fan)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Louvers	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Tanks (Water Tank)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Sensor Element (Temperature Control Manifold)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Temperature Control Manifold (Water Cooling)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Piping and fittings	Stainless Steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Ductwork	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Muffler	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Tanks (Immersion Heater)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Exhaust Stack	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Tanks (Fuel Day Tank)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Flame Arrestor (Fuel Oil Tank)	Galvanized Steel	Outdoor Air	Loss of Material
Emergency Diesel Generator and Auxiliary System	Flame Arrestor (Fuel Oil Tank)	Galvanized Steel	Outdoor Air	Loss of Material
Emergency Diesel Generator and Auxiliary System	Filter Housing (Air Cooling)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Sight Glasses	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

Emergency Diesel Generator and Auxiliary System	Bird Screen	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator and Auxiliary System	Flexible Hose	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Diesel Generator Building	Miscellaneous steel (catwalks, handrails, ladders, platforms, grating, and associated supports)	Carbon and low alloy steel	Indoor Air	Loss of Material
Emergency Diesel Generator Building	Miscellaneous steel (catwalks, handrails, ladders, platforms, grating, and associated supports)	Galvanized Steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Concrete embedments	Carbon and low alloy steel	Indoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Change in Material Properties
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Indoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Indoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Concrete embedments	Galvanized Steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Curb	Concrete	Outdoor Air	Change in Material Properties
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Soil	Cracking
Emergency Diesel Generator Building	Emergency Diesel Generator Enclosure	Carbon and low alloy steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Structural Bolts	Alloy Steel	Outdoor Air	Loss Of Preload

Emergency Diesel Generator Building	Curb	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Curb	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Indoor Air	Loss of Material
Emergency Diesel Generator Building	Curb	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Curb	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Emergency Diesel Generator Enclosure	Carbon and low alloy steel	Indoor Air	Loss of Material
Emergency Diesel Generator Building	Panels and enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Emergency Diesel Generator Building	Panels and enclosures	Carbon and low alloy steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Panels and enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Emergency Diesel Generator Building	Panels and enclosures	Galvanized Steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Panels and enclosures	Galvanized Steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Panels and enclosures	Carbon and low alloy steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Curb	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Change in Material Properties
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Indoor Air	Change in Material Properties
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Soil	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Soil	Cracking

Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Soil	Cracking
Emergency Diesel Generator Building	Structural Bolts	Alloy Steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Structural Steel (Plate)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete foundation	Concrete	Soil	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Change in Material Properties
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete foundation	Concrete	Soil	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Indoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Indoor Air	Cracking
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Indoor Air	Loss of Material
Emergency Diesel Generator Building	Reinforced concrete Walls, Slabs (Includes Removable Roof Slab)	Concrete	Outdoor Air	Change in Material Properties

Emergency Service Water System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Service Water System	Pump Casing (ESW Pumps)	Stainless Steel	Outdoor Air (External)	Loss of Material
Emergency Service Water System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Service Water System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Service Water System	Piping and fittings	Stainless Steel	Outdoor Air (External)	Loss of Material
Emergency Service Water System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Emergency Service Water System	Expansion Joint	Elastomer	Outdoor Air (External)	Change in Material Properties
Emergency Service Water System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Service Water System	Valve Body	Stainless Steel	Outdoor Air (External)	Loss of Material
Emergency Service Water System	Heat Exchangers (Containment Spray)	Carbon and low alloy steel (Shell Side Components)	Indoor Air (External)	Loss of Material
Emergency Service Water System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Emergency Service Water System	Piping and fittings	Brass	Outdoor Air (External)	Loss of Material
Emergency Service Water System	Valve Body	Brass	Outdoor Air (External)	Loss of Material
Emergency Service Water System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Exhaust Tunnel	Curb	Concrete	Outdoor Air	Change in Material Properties
Exhaust Tunnel	Penetration seals	Grout	Soil	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Indoor Air	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Indoor Air	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Indoor Air	Change in Material Properties
Exhaust Tunnel	Curb	Concrete	Outdoor Air	Cracking
Exhaust Tunnel	Curb	Concrete	Outdoor Air	Cracking
Exhaust Tunnel	Penetration seals	Grout	Indoor Air	Cracking
Exhaust Tunnel	Seals (Gap)	Tar	Indoor Air	Loss of Sealing

Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Indoor Air	Change in Material Properties
Exhaust Tunnel	Curb	Concrete	Outdoor Air	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Loss of Material
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Soil	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Soil	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Indoor Air	Loss of Material
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Loss of Material
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Loss of Material
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Change in Material Properties
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Indoor Air	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Indoor Air	Loss of Material
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Loss of Material
Exhaust Tunnel	Penetration seals	Elastomer	Indoor Air	Change in Material Properties
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Change in Material Properties
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Cracking
Exhaust Tunnel	Curb	Concrete	Outdoor Air	Loss of Material
Exhaust Tunnel	Curb	Concrete	Outdoor Air	Loss of Material
Exhaust Tunnel	Hatch Cover	Galvanized Steel	Outdoor Air	Loss of Material
Exhaust Tunnel	Door	Carbon and low alloy steel	Outdoor Air	Loss of Material
Exhaust Tunnel	Door	Carbon and low alloy steel	Indoor Air	Loss of Material
Exhaust Tunnel	Penetration seals	Elastomer	Soil	Change in Material Properties
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Indoor Air	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Soil	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Soil	Cracking
Exhaust Tunnel	Reinforced concrete Slabs, Walls	Concrete	Outdoor Air	Cracking
Feedwater System	Pump Casing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Heat Exchangers	Carbon and low alloy steel - Tube Side Components	Indoor Air (External)	Loss of Material

Feedwater System	Flow Element	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Tanks	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Filter Housing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Dissolution Column	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Piping and fittings	Chrome Moly steels	Indoor Air (External)	Loss of Material
Feedwater System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Expansion Joint	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Piping and fittings	Chrome Moly steels	Indoor Air (External)	Loss of Material
Feedwater System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Flow Element	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Feedwater System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Fire Protection System	Dikes	Carbon and low alloy steel	Outdoor Air	Loss of Material
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Outdoor Air	Cracking
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Outdoor Air	Loss of Material
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Indoor Air	Cracking
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Indoor Air	Loss of Material
Fire Protection System	Expansion Joint	Elastomer	Indoor Air (External)	Change in Material Properties
Fire Protection System	Fire Barrier Walls and Slabs	Concrete	Outdoor Air	Change in Material Properties
Fire Protection System	Flexible Hose	Elastomer	Indoor Air (External)	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Loss of Material
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Indoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Cracking
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Outdoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Outdoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Outdoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Indoor Air	Cracking

Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Outdoor Air	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Indoor Air	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Outdoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Outdoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Outdoor Air	Change in Material Properties
Fire Pumphouses	Structural Steel	Carbon and low alloy steel	Indoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Loss of Material
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Soil	Cracking
Fire Pumphouses	Metal Siding	Carbon and low alloy steel	Outdoor Air	Loss of Material
Fire Pumphouses	Metal Siding	Carbon and low alloy steel	Indoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Water - Flowing	Change in Material Properties
Fire Pumphouses	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Loss of Material
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Cracking
Fire Pumphouses	Metal Deck	Carbon and low alloy steel	Indoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Cracking
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Aggressive Environment	Cracking
Fire Pumphouses	Metal Deck	Carbon and low alloy steel	Outdoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Indoor Air	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Outdoor Air	Cracking
Fire Pumphouses	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss Of Preload
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Cracking
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Cracking
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Loss of Material
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Loss of Material

Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Cracking
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Soil	Cracking
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Indoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Indoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Indoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Outdoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Outdoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Outdoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Outdoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Outdoor Air	Cracking
Fire Pumphouses	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Fire Pumphouses	Seals	Elastomer	Outdoor Air	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Soil	Cracking
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Soil	Cracking
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Cracking
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Aggressive Environment	Loss of Material
Fire Pumphouses	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Outdoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Foundation	Concrete	Water - Flowing	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Slab	Concrete	Indoor Air	Loss of Material
Fire Pumphouses	Seals	Elastomer	Indoor Air	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Outdoor Air	Change in Material Properties
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Outdoor Air	Cracking
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Outdoor Air	Loss of Material
Fire Pumphouses	Reinforced Concrete Walls	Concrete	Outdoor Air	Loss of Material
Hardened Vent System	Enclosure Boot	Elastomer	Indoor Air (Internal)	Change in Material Properties
Hardened Vent System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material

Hardened Vent System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Hardened Vent System	Enclosure Boot	Elastomer	Outdoor Air (External)	Change in Material Properties
Heating & Process Steam System	Valve Body	Cast Iron	Indoor Air (External)	Loss of Material
Heating & Process Steam System	Flexible Connection	Elastomer	Indoor Air (External)	Change in Material Properties
Heating & Process Steam System	Steam Trap	Cast Iron	Indoor Air (External)	Loss of Material
Heating & Process Steam System	Strainer Body	Cast Iron	Outdoor Air (External)	Loss of Material
Heating & Process Steam System	Strainer Body	Cast Iron	Indoor Air (External)	Loss of Material
Heating & Process Steam System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Heating & Process Steam System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Heating & Process Steam System	Pump Casing - Condensate Return Pumps P-13-1A/B, Chemical Feed Addition Pumps CH-P-6A/B, Boiler No. 1 Feed Pumps CH-P-4A/B, Boiler No. 2 Feed Pumps CH-P-3A/B, Deaerator Feed Pumps CH-P-5A/B, Chemical Recirc Pump CH-P-10	Cast Iron	Indoor Air (External)	Loss of Material
Heating & Process Steam System	Sight Glasses	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Heating & Process Steam System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Heating & Process Steam System	Strainer Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Heating & Process Steam System	Tanks - Deaerator CH-T-2, Condensate Return Unit T-13-1, Heating Boiler Condensate Storage Tank T-13-2, Heating Boiler Flash Tank T-13-3	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Heating & Process Steam System	Steam Trap	Cast Iron	Outdoor Air (External)	Loss of Material
Heating & Process Steam System	Soot Blowers	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Heating & Process Steam System	Valve Body	Copper Alloy	Outdoor Air (External)	Loss of Material
Heating & Process Steam System	Valve Body	Cast Iron	Outdoor Air (External)	Loss of Material

Heating & Process Steam System	Valve Body	Stainless Steel	Outdoor Air (External)	Loss of Material
Heating & Process Steam System	Tanks - Chemical Feed Addition Tanks CH-T-3A/B	Polymers	Indoor Air (External)	Change in Material Properties
Heating & Process Steam System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Heating & Process Steam System	Steam Trap	Copper Alloy	Outdoor Air (External)	Loss of Material
Heating & Process Steam System	Piping and fittings	Stainless Steel	Outdoor Air (External)	Loss of Material
Heating & Process Steam System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Heating Boiler House	Panels and Enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Heating Boiler House	Structural Steel: Beams, Columns, Girts, Bracing, Connection plates and angles	Carbon and low alloy steel	Indoor Air	Loss of Material
Heating Boiler House	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss of Material
Heating Boiler House	Metal Siding	Carbon and low alloy steel	Outdoor Air	Loss of Material
Heating Boiler House	Metal Siding	Carbon and low alloy steel	Indoor Air	Loss of Material
Heating Boiler House	Equipment Foundation	Concrete	Indoor Air	Loss of Material
Heating Boiler House	Equipment Foundation	Concrete	Indoor Air	Cracking
Heating Boiler House	Equipment Foundation	Concrete	Indoor Air	Cracking
Heating Boiler House	Metal Deck	Galvanized Steel	Outdoor Air	Loss of Material
Heating Boiler House	Door	Carbon and low alloy steel	Indoor Air	Loss of Material
Heating Boiler House	Door	Carbon and low alloy steel	Outdoor Air	Loss of Material
Heating Boiler House	Removable Panel (in Siding)	Galvanized Steel	Outdoor Air	Loss of Material
Heating Boiler House	Seals	Elastomer	Outdoor Air	Change in Material Properties
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Outdoor Air	Cracking
Heating Boiler House	Panels and Enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Soil	Cracking
Heating Boiler House	Equipment Foundation	Concrete	Indoor Air	Change in Material Properties
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Indoor Air	Loss of Material
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Indoor Air	Cracking
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Indoor Air	Cracking
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Indoor Air	Change in Material Properties

Heating Boiler House	Reinforced Concrete Foundation	Concrete	Outdoor Air	Loss of Material
Heating Boiler House	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss Of Preload
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Outdoor Air	Loss of Material
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Outdoor Air	Cracking
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Outdoor Air	Cracking
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Outdoor Air	Change in Material Properties
Heating Boiler House	Reinforced Concrete Foundation	Concrete	Soil	Cracking
Heating Boiler House	Seals	Elastomer	Indoor Air	Change in Material Properties
Instrument (Control) Air System	Accumulator	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Instrument (Control) Air System	Piping and fittings	Brass	Outdoor Air (External)	Loss of Material
Instrument (Control) Air System	Piping and fittings	Copper	Outdoor Air (External)	Loss of Material
Instrument (Control) Air System	Piping and fittings	Brass	Outdoor Air (External)	Loss of Material
Instrument (Control) Air System	Piping and fittings	Copper	Outdoor Air (External)	Loss of Material
Instrument (Control) Air System	Accumulator	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Instrument (Control) Air System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Instrument (Control) Air System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Instrument (Control) Air System	Valve Body	Brass	Outdoor Air (External)	Loss of Material
Instrument (Control) Air System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Instrument (Control) Air System	Filter Housing	Zinc	Indoor Air (External)	Loss of Material
Instrument (Control) Air System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Instrument (Control) Air System	Filter Housing	Zinc	Indoor Air (External)	Loss of Material
Intake Structure and Canal (Ultimate Heat Sink)	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Intake Structure and Canal (Ultimate Heat Sink)	Trash Racks	Galvanized Steel	Water - Standing	Loss of Material
Intake Structure and Canal (Ultimate Heat Sink)	Trash Racks	Galvanized Steel	Outdoor Air	Loss of Material
Isolation Condenser System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Isolation Condenser System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Isolation Condenser System	Bird Screen	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Isolation Condenser System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Isolation Condenser System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Isolation Condenser System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

Isolation Condenser System	Heat Exchangers (isolation condensers)	Carbon and low alloy steel (Shell Side Components)	Indoor Air (External)	Loss of Material
Isolation Condenser System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Main Fuel Oil Storage & Transfer System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Fuel Oil Storage & Transfer System	Flow Meter	Cast Iron	Indoor Air (External)	Loss of Material
Main Fuel Oil Storage & Transfer System	Pump Casing	Cast Iron	Indoor Air (External)	Loss of Material
Main Fuel Oil Storage & Transfer System	Strainer Body	Cast Iron	Indoor Air (External)	Loss of Material
Main Fuel Oil Storage & Transfer System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Heat Exchangers	Carbon and low alloy steel - Shell Side Components	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Tanks	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Sensor Element (CE)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Pump Casing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Flow Element	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Filter Housing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Gauge Snubber	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Generator and Auxiliary System	Restricting Orifice	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Steam System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Steam System	Steam Trap	Chrome Moly steels	Indoor Air (External)	Loss of Material
Main Steam System	Eductor	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Steam System	Valve Body (Bypass Valves)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Steam System	Valve Body (Steam Chest)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

Main Steam System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Steam System	Steam Trap	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Steam System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Steam System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Steam System	Condensing chamber	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Steam System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Turbine Casing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Filter Housing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Pump Casing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Tanks	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Steam Trap	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Accumulator	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Coolers	Carbon and low alloy steel - Shell side Component	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Flow Element	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Main Turbine and Auxiliary System	Heat Exchangers	Carbon and low alloy steel - Shell side component	Indoor Air (External)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Pump Casing (Laundry Drain Tank Pump P-22-002)	Cast Iron	Indoor Air (External)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Tanks (Regeneration System Waste Tank 1-1 Low and High Conductivity Compartments)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

Miscellaneous Floor and Equipment Drain System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Tanks (Oil Separator DS-Y-105 and Oil Receiver DS-T-1)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Valve Body	Cast Iron	Indoor Air (External)	Loss of Material
Miscellaneous Floor and Equipment Drain System	Tanks (Laundry Drain Tank T-22-002)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Miscellaneous Yard Structures	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Concrete Embedments	Carbon and low alloy steel	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Curb	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Change in Material Properties
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Aggressive Environment	Change in Material Properties
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Aggressive Environment	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Change in Material Properties
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Soil	Cracking

Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Tank Foundations (CST, Fire Water, CO2, N2, Fuel Oil)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Water - Flowing	Change in Material Properties
Miscellaneous Yard Structures	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Transmission Towers	Galvanized Steel	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Tank Foundations (CST, Fire Water, CO2, N2, Fuel Oil)	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Tank Foundations (CST, Fire Water, CO2, N2, Fuel Oil)	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Tank Foundations (CST, Fire Water, CO2, N2, Fuel Oil)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Tank Foundations (CST, Fire Water, CO2, N2, Fuel Oil)	Concrete	Outdoor Air	Change in Material Properties
Miscellaneous Yard Structures	Tank Foundations (CST, Fire Water, CO2, N2, Fuel Oil)	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Tank Foundations (CST, Fire Water, CO2, N2, Fuel Oil)	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Structural Bolts	Carbon and low alloy steel	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Aggressive Environment	Loss of Material
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Aggressive Environment	Cracking
Miscellaneous Yard Structures	Tank Foundations (CST, Fire Water, CO2, N2, Fuel Oil)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Equipment and Component Foundations (Startup, Unit Substation, and SBO Transformers, N2 Supply, SGTS Fans and Motors, HVAC Components, etc.)	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Loss of Material

Miscellaneous Yard Structures	Equipment and Component Foundations (Startup, Unit Substation, and SBO Transformers, N2 Supply, SGTS Fans and Motors, HVAC Components, etc.)	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Equipment and Component Foundations (Startup, Unit Substation, and SBO Transformers, N2 Supply, SGTS Fans and Motors, HVAC Components, etc.)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Equipment and Component Foundations (Startup, Unit Substation, and SBO Transformers, N2 Supply, SGTS Fans and Motors, HVAC Components, etc.)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Equipment and Component Foundations (Startup, Unit Substation, and SBO Transformers, N2 Supply, SGTS Fans and Motors, HVAC Components, etc.)	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Miscellaneous Steel (Manhole Covers)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Equipment and Component Foundations (Startup, Unit Substation, and SBO Transformers, N2 Supply, SGTS Fans and Motors, HVAC Components, etc.)	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Miscellaneous Steel (Platforms)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Curb	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Curb	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Curb	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Curb	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Curb	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Curb	Concrete	Outdoor Air	Change in Material Properties
Miscellaneous Yard Structures	Equipment and Component Foundations (Startup, Unit Substation, and SBO Transformers, N2 Supply, SGTS Fans and Motors, HVAC Components, etc.)	Concrete	Outdoor Air	Change in Material Properties
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Change in Material Properties

Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Equipment and Component Foundations (Startup, Unit Substation, and SBO Transformers, N2 Supply, SGTS Fans and Motors, HVAC Components, etc.)	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Curb	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Change in Material Properties
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Soil	Cracking
Miscellaneous Yard Structures	Panels and Enclosures (Startup, Unit Substation, and SBO Transformers)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Panels and Enclosures (Startup, Unit Substation, and SBO Transformers)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Reinforced Concrete Trench, Manhole, Ductbank	Concrete	Outdoor Air	Loss of Material
Miscellaneous Yard Structures	Reinforced Concrete Walls, Slabs (SWS Seal Well)	Concrete	Outdoor Air	Cracking
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Indoor Air	Change in Material Properties
New Radwaste Building	Penetration Seals	Elastomer	Indoor Air	Change in Material Properties
New Radwaste Building	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Indoor Air	Cracking
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Indoor Air	Cracking

New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Indoor Air	Loss of Material
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
New Radwaste Building	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
New Radwaste Building	Reinforced concrete foundation	Concrete	Indoor Air	Loss of Material
New Radwaste Building	Reinforced concrete foundation	Concrete	Soil	Cracking
New Radwaste Building	Reinforced concrete foundation	Concrete	Soil	Cracking
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
New Radwaste Building	Reinforced concrete foundation	Concrete	Indoor Air	Change in Material Properties
New Radwaste Building	Reinforced concrete Walls (above and below grade)	Concrete	Soil	Cracking
New Radwaste Building	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
New Radwaste Building	Reinforced concrete foundation	Concrete	Indoor Air	Loss of Material
New Radwaste Building	Reinforced concrete foundation	Concrete	Soil	Cracking
New Radwaste Building	Reinforced concrete foundation	Concrete	Soil	Cracking
New Radwaste Building	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
New Radwaste Building	Reinforced concrete foundation	Concrete	Indoor Air	Change in Material Properties
Nitrogen Supply System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Nitrogen Supply System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Nitrogen Supply System	Valve Body	Stainless Steel	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Heat Exchangers (Electric Heater)	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Heat Exchangers (Vaporizer)	Aluminum	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Thermowell	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Valve Body	Brass	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Piping and fittings	Stainless Steel	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Pressure Building Coils	Aluminum	Outdoor Air (External)	Loss of Material

Nitrogen Supply System	Rupture Disks	Bronze	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Rupture Disks	Stainless Steel	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Piping and fittings	Copper	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Valve Body	Bronze	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Strainer Body	Bronze	Outdoor Air (External)	Loss of Material
Nitrogen Supply System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Change in Material Properties
Office Building	Cable Tray	Carbon and low alloy steel	Indoor Air	Loss of Material
Office Building	Panels and enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Office Building	Panels and enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Office Building	Concrete embedments	Carbon and low alloy steel	Outdoor Air	Loss of Material
Office Building	Curb	Concrete	Outdoor Air	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Office Building	Curb	Concrete	Outdoor Air	Cracking
Office Building	Curb	Concrete	Outdoor Air	Loss of Material
Office Building	Curb	Concrete	Outdoor Air	Change in Material Properties
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Change in Material Properties
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Office Building	Reinforced concrete foundation	Concrete	Soil	Cracking
Office Building	Reinforced concrete foundation	Concrete	Soil	Cracking
Office Building	Reinforced concrete foundation	Concrete	Indoor Air	Loss of Material
Office Building	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
Office Building	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
Office Building	Reinforced concrete foundation	Concrete	Indoor Air	Change in Material Properties
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Loss of Material
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Loss of Material
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Loss of Material
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Loss of Material

Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Office Building	Curb	Concrete	Outdoor Air	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Soil	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Loss of Material
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Cracking
Office Building	Curb	Concrete	Outdoor Air	Loss of Material
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Change in Material Properties
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Soil	Cracking
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Loss of Material
Office Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Outdoor Air	Change in Material Properties
Office Building	Concrete embedments	Carbon and low alloy steel	Indoor Air	Loss of Material
Oyster Creek Substation	Reinforced Concrete Foundation	Concrete	Soil	Cracking
Oyster Creek Substation	Structural Bolts	Carbon and low alloy steel	Outdoor Air	Loss of Material
Oyster Creek Substation	Metal Siding	Carbon and low alloy steel	Indoor Air	Loss of Material
Oyster Creek Substation	Seals	Elastomer	Outdoor Air	Change in Material Properties
Oyster Creek Substation	Metal Deck	Galvanized Steel	Outdoor Air	Loss of Material
Oyster Creek Substation	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss of Material
Oyster Creek Substation	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss Of Preload
Oyster Creek Substation	Structural Steel	Carbon and low alloy steel	Indoor Air	Loss of Material
Oyster Creek Substation	Seals	Elastomer	Indoor Air	Change in Material Properties
Oyster Creek Substation	Structural Steel	Carbon and low alloy steel	Outdoor Air	Loss of Material
Oyster Creek Substation	Reinforced Concrete Foundation	Concrete	Soil	Cracking
Oyster Creek Substation	Equipment Foundation	Concrete	Outdoor Air	Loss of Material
Oyster Creek Substation	Equipment Foundation	Concrete	Outdoor Air	Loss of Material
Oyster Creek Substation	Equipment Foundation	Concrete	Outdoor Air	Cracking
Oyster Creek Substation	Equipment Foundation	Concrete	Outdoor Air	Cracking
Oyster Creek Substation	Equipment Foundation	Concrete	Outdoor Air	Cracking

Oyster Creek Substation	Equipment Foundation	Concrete	Outdoor Air	Change in Material Properties
Oyster Creek Substation	Door	Carbon and low alloy steel	Outdoor Air	Loss of Material
Oyster Creek Substation	Structural Bolts	Carbon and low alloy steel	Outdoor Air	Loss Of Preload
Oyster Creek Substation	Door	Carbon and low alloy steel	Indoor Air	Loss of Material
Oyster Creek Substation	Reinforced Concrete Foundation	Concrete	Outdoor Air	Cracking
Oyster Creek Substation	Transmission Towers	Carbon and low alloy steel	Outdoor Air	Loss of Material
Oyster Creek Substation	Reinforced Concrete Foundation	Concrete	Outdoor Air	Loss of Material
Oyster Creek Substation	Reinforced Concrete Foundation	Concrete	Outdoor Air	Loss of Material
Oyster Creek Substation	Reinforced Concrete Foundation	Concrete	Outdoor Air	Change in Material Properties
Oyster Creek Substation	Metal Siding	Carbon and low alloy steel	Outdoor Air	Loss of Material
Oyster Creek Substation	Reinforced Concrete Foundation	Concrete	Outdoor Air	Cracking
Oyster Creek Substation	Reinforced Concrete Foundation	Concrete	Outdoor Air	Cracking
Post-Accident Sampling System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Post-Accident Sampling System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Post-Accident Sampling System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Post-Accident Sampling System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Primary Containment	Miscellaneous Steel (catwalks, handrails, ladders, platforms, grating, and associated supports)	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Panels and Enclosures	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Panels and Enclosures	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Liner (Sump)	Stainless Steel	Raw Water – Fresh Water (Internal)	Loss of Material
Primary Containment	Structural Bolting	Carbon and low alloy steel	Containment Atmosphere	Loss of Material
Primary Containment	Biological Shield Wall - Structural Steel	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Reactor Pedestal	Concrete	Containment Atmosphere	Cracking
Primary Containment	Reactor Pedestal	Concrete	Containment Atmosphere	Cracking

Primary Containment	Reactor Pedestal	Concrete	Containment Atmosphere	Loss of Material
Primary Containment	Thermowells	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Primary Containment	Biological Shield Wall - Lateral Support	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Reinforced Concrete Floor Slab (fill slab)	Concrete	Containment Atmosphere (External)	Loss of Material
Primary Containment	Reinforced Concrete Floor Slab (fill slab)	Concrete	Containment Atmosphere (External)	Cracking
Primary Containment	Reinforced Concrete Floor Slab (fill slab)	Concrete	Containment Atmosphere (External)	Cracking
Primary Containment	Biological Shield Wall - Liner Plate	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Reinforced Concrete Floor Slab (fill slab)	Concrete	Containment Atmosphere (External)	Loss of Material
Primary Containment	Reactor Pedestal	Concrete	Containment Atmosphere	Change in Material Properties
Primary Containment	Structural Steel (radial beams, posts, bracing, plate, connections, etc.)	Carbon and low alloy steel	Containment Atmosphere	Loss of Material
Primary Containment	Vent Header Deflector	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Concrete embedment	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Shielding Blocks and Plates	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Beam Seats	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Reinforced Concrete Floor Slab (fill slab)	Concrete	Containment Atmosphere (External)	Change in Material Properties
Primary Containment	Reinforced Concrete Floor Slab (fill slab)	Concrete	Containment Atmosphere (External)	Change in Material Properties
Primary Containment	Structural Bolting	Carbon and low alloy steel	Containment Atmosphere	Loss Of Preload
Primary Containment	Reinforced Concrete Floor Slab (fill slab)	Concrete	Containment Atmosphere (External)	Cracking
Primary Containment	Vent Jet Deflectors	Carbon and low alloy steel	Containment Atmosphere (External)	Loss of Material
Primary Containment	Reinforced Concrete Floor Slab (fill slab)	Concrete	Containment Atmosphere (External)	Cracking
Process Sampling System	Flexible Hose	Elastomer	Indoor Air (External)	Change in Material Properties

Process Sampling System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Process Sampling System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Process Sampling System	Tanks (Reservoir)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Process Sampling System	Pump Casing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Radwaste Area Heating and Ventilation System	Ductwork	Aluminum	Outdoor Air (External)	Loss of Material
Radwaste Area Heating and Ventilation System	Closure bolting	Stainless Steel	Outdoor Air (External)	Loss of Material
Radwaste Area Heating and Ventilation System	Damper housing	Galvanized Steel	Outdoor Air (External)	Loss of Material
Radwaste Area Heating and Ventilation System	Damper housing	Aluminum	Outdoor Air (External)	Loss of Material
Radwaste Area Heating and Ventilation System	Closure bolting	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Reactor Building	Panels and Enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Reactor Building	Instrument Racks	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Seals	Elastomer	Outdoor Air	Change in Material Properties
Reactor Building	Seals	Elastomer	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Pipe Whip Restraints	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Soil	Cracking
Reactor Building	Panels and Enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Structural Steel: Beams, Columns, Girders, Plates, Bracing, Trusses	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete Foundation	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Spray Shields	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Door	Carbon and low alloy steel	Indoor Air	Loss of Material

Reactor Building	Door	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Door	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Reactor Building	Concrete Embedments	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Door	Carbon and low alloy steel	Outdoor Air	Loss of Material
Reactor Building	Curb	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Curb	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material

Reactor Building	Roofing	Roofing Material	Outdoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Loss of Material
Reactor Building	Hatch Plugs	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Soil	Cracking
Reactor Building	Cable Tray	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Curb	Concrete	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Metal Siding	Aluminum	Outdoor Air	Loss of Material
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking

Reactor Building	Equipment Foundation	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Equipment Foundation	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete: Beams, Columns	Concrete	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete: Beams, Columns	Concrete	Indoor Air	Cracking
Reactor Building	Hatch Plugs	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Loss of Material
Reactor Building	Scuppers: Pipe Sleeve, Flashing, Bolts	Aluminum	Outdoor Air	Loss of Material
Reactor Building	Metal Siding	Aluminum	Outdoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Reactor Building	Curb	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Equipment Foundation	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Beams, Columns	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material

Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Scuppers: Pipe Sleeve, Flashing, Bolts	Stainless Steel	Outdoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete Foundation	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Soil	Cracking
Reactor Building	Hatch Plugs	Concrete	Indoor Air	Loss of Material
Reactor Building	Liner (Sump)	Carbon and low alloy steel	Indoor Air (Internal)	Loss of Material
Reactor Building	Liner (Sump)	Carbon and low alloy steel	Raw Water – Fresh Water (Internal)	Loss of Material
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Hatch Plugs	Concrete	Indoor Air	Loss of Material
Reactor Building	Hatch Plugs	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Hatch Plugs	Concrete	Indoor Air	Cracking
Reactor Building	Hatch Plugs	Concrete	Indoor Air	Cracking
Reactor Building	Penetration Seals	Grout	Soil	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Loss of Material
Reactor Building	Curb	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Equipment Foundation	Concrete	Indoor Air	Loss of Material
Reactor Building	Penetration Seals	Grout	Indoor Air	Cracking
Reactor Building	Metal Deck (Roof)	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Metal Siding	Aluminum	Outdoor Air	Loss of Material
Reactor Building	Miscellaneous Steel: Catwalks, Handrails, Ladders, Platforms, Grating	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Penetration Seals	Elastomer	Indoor Air	Change in Material Properties
Reactor Building	Penetration Seals	Carbon and low alloy steel	Indoor Air	Loss of Material

Reactor Building	Penetration Seals	Grout	Indoor Air	Cracking
Reactor Building	Penetration Seals	Carbon and low alloy steel	Indoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Penetration Seals	Carbon and low alloy steel	Outdoor Air	Loss of Material
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Reactor Building	Hatch Plugs	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss Of Preload
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Indoor Air	Cracking
Reactor Building	Reinforced Concrete: Walls, Slabs, Drywell Shield Wall	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete: Beams, Columns	Concrete	Indoor Air	Change in Material Properties
Reactor Building	Reinforced Concrete: Beams, Columns	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Soil	Cracking
Reactor Building	Reinforced Concrete Walls (above and below grade)	Concrete	Soil	Cracking
Reactor Building Closed Cooling Water System	Heat Exchangers (Augmented Fuel Pool Cooling)	Carbon Steel (Covers, Nozzles)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Shutdown Cooling)	Carbon Steel (Shell Side Components)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Cleanup Non-Regenerative)	Carbon Steel (Shell Side Components)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Pump Casing (RBCCW Pumps)	Cast Iron	Indoor Air (External)	Loss of Material

Reactor Building Closed Cooling Water System	Tanks (RBCCW Surge Tank)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Shutdown Cooling)	Carbon Steel (Tube Side Components)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Fuel Pool Cooling)	Carbon Steel (Tube Side Components)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Shutdown Cooling Pumps)	Carbon Steel (Seal Cooler Shell Side Components)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Augmented Fuel Pool Cooling)	Carbon Steel (Carrying Bars)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Shutdown Cooling Pumps)	Cast Iron (Bearing Housing Cooler)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Cleanup Pre-coat Pump)	Carbon Steel (Shell Side Components)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Cleanup Recirc. Pumps Lube Oil)	Cast Iron (Tube Side Components)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Cleanup Auxiliary Pump)	Carbon Steel (Pedestal Cooler)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Coolers (Cleanup Auxiliary Pump)	Cast Iron (Bearing Housing Cooler)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Heat Exchangers (Fuel Pool Cooling)	Carbon Steel (Shell Side Components)	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Tanks (Chemical Mixing Tank)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Pump Casing (Chemical Feed Pump)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Closed Cooling Water System	Piping and fittings	Cast Iron	Indoor Air (External)	Loss of Material

Reactor Building Floor and Equipment Drains	Piping and fittings	Cast Iron	Indoor Air (External)	Loss of Material
Reactor Building Floor and Equipment Drains	Valve Body	Cast Iron	Indoor Air (External)	Loss of Material
Reactor Building Floor and Equipment Drains	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Floor and Equipment Drains	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Floor and Equipment Drains	Pump Casing (RBEDT pump)	Cast Iron	Indoor Air (External)	Loss of Material
Reactor Building Floor and Equipment Drains	Tanks (RBEDT)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Floor and Equipment Drains	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Floor and Equipment Drains	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Ventilation System	Closure bolting	Stainless Steel	Outdoor Air (External)	Loss of Material
Reactor Building Ventilation System	Closure bolting	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Ventilation System	Valve Body (Primary Containment Isolation)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Ventilation System	Valve Body (Primary Containment Isolation)	Cast Iron	Indoor Air (External)	Loss of Material
Reactor Building Ventilation System	Damper housing	Aluminum	Outdoor Air (External)	Loss of Material
Reactor Building Ventilation System	Ductwork	Aluminum	Outdoor Air (External)	Loss of Material
Reactor Building Ventilation System	Piping and fittings (Primary Containment Isolation Valves)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Building Ventilation System	Closure bolting	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Reactor Head Cooling System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Head Cooling System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Head Cooling System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Recirculation System	Oil Mist Eliminator - Reservoir	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Recirculation System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Recirculation System	Filter Housing (oil)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Recirculation System	Coolers (oil)	Carbon and low alloy steel	Indoor Air (External) - shell	Loss of Material

Reactor Recirculation System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Recirculation System	Fluid Drive (M-G Set Coupling) - Reservoir	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Recirculation System	Sight Glasses (oil)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Filter Housing (Cleanup Filter)	Carbon Steel (with elastomer lining)	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Tanks (Cleanup Recirc. Pumps Lube Oil)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Coolers (Cleanup Recirc. Pumps Lube Oil)	Carbon Steel (Shell Side Components)	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Filter Precoat Pump)	Cast Iron	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Filter Aid Pumps)	Cast Iron	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Tanks (Cleanup Filter Aid Mix Tank)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Sight Glasses	Carbon and low alloy steel (Body)	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Valve Body	Cast Iron	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Tanks (Cleanup Filter and Precoat Tank)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Pump Casing (Cleanup Sludge Pump)	Cast Iron	Indoor Air (External)	Loss of Material
Reactor Water Cleanup System	Tanks (Cleanup Filter Sludge Receiver)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Roof Drains and Overboard Discharge	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Roof Drains and Overboard Discharge	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Sanitary Waste System	Piping and fittings	Cast Iron	Indoor Air (External)	Loss of Material

Service Water System	Piping and fittings	Copper Alloy	Outdoor Air (External)	Loss of Material
Service Water System	Valve Body	Aluminum	Outdoor Air (External)	Loss of Material
Service Water System	Heat Exchangers (TBCCW)	Carbon and low alloy steel (Tube Side Components)	Indoor Air (External)	Loss of Material
Service Water System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Service Water System	Piping and fittings	Stainless Steel	Outdoor Air (External)	Loss of Material
Service Water System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Service Water System	Piping and fittings	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Service Water System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Service Water System	Pump Casing (Service Water Pumps)	Cast Iron (Discharge Head and Bowl Assembly)	Outdoor Air (External)	Loss of Material
Service Water System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Service Water System	Heat Exchangers (RBCCW)	Carbon Steel (Tube Side Components)	Indoor Air (External)	Loss of Material
Service Water System	Heat Exchangers (RBCCW)	Carbon Steel (Shell Side Components)	Indoor Air (External)	Loss of Material
Service Water System	Expansion Joint	Elastomer	Outdoor Air (External)	Change in Material Properties
Service Water System	Valve Body	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Service Water System	Piping and fittings	Bronze	Outdoor Air (External)	Loss of Material
Service Water System	Piping and fittings	Brass	Outdoor Air (External)	Loss of Material
Service Water System	Valve Body	Copper Alloy	Outdoor Air (External)	Loss of Material
Service Water System	Pump Casing (Service Water Pumps)	Stainless Steel (Column Pipe)	Outdoor Air (External)	Loss of Material
Service Water System	Rotameter	Stainless Steel	Outdoor Air (External)	Loss of Material
Service Water System	Pump Casing (Rad Monitor Sample Pump)	Stainless Steel	Outdoor Air (External)	Loss of Material
Service Water System	Tanks (Service Water Pump Oil Reservoir)	Aluminum	Outdoor Air (External)	Loss of Material
Service Water System	Valve Body	Cast Iron	Indoor Air (External)	Loss of Material
Service Water System	Valve Body	Cast Iron	Outdoor Air (External)	Loss of Material
Service Water System	Valve Body	Stainless Steel	Outdoor Air (External)	Loss of Material
Service Water System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Shutdown Cooling System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Shutdown Cooling System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Shutdown Cooling System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Shutdown Cooling System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

Shutdown Cooling System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Shutdown Cooling System	Flow Element	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Shutdown Cooling System	Pump Casing	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Spent Fuel Pool Cooling System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Spent Fuel Pool Cooling System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Spent Fuel Pool Cooling System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Spent Fuel Pool Cooling System	Thermowells	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Spent Fuel Pool Cooling System	Pump Casing (Fuel Pool Cooling Pumps & Augmented Fuel Pool Cooling Pumps)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Spent Fuel Pool Cooling System	Pump Casing (Fuel Pool Cooling Pumps & Augmented Fuel Pool Cooling Pumps)	Cast Iron	Indoor Air (External)	Loss of Material
Spent Fuel Pool Cooling System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Standby Gas Treatment System (SGTS)	Closure bolting	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Standby Gas Treatment System (SGTS)	Ductwork	Aluminum	Outdoor Air (External)	Loss of Material
Standby Gas Treatment System (SGTS)	Damper Housing	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Standby Gas Treatment System (SGTS)	Closure bolting	Stainless Steel	Outdoor Air (External)	Loss of Material
Standby Gas Treatment System (SGTS)	Closure bolting	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Accumulator	Alloy Steel	Indoor Air (External)	Loss of Material
Standby Liquid Control System (Liquid Poison System)	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Station Blackout System - Electrical Commodities	Phase Bus Enclosure Assemblies	Carbon and low alloy steel	Indoor Air (Internal)	Loss of Material
Station Blackout System - Electrical Commodities	Phase Bus Enclosure Assemblies	Elastomer	Indoor Air (Internal)	Change in Material Properties
Station Blackout System - Electrical Commodities	Phase Bus Enclosure Assemblies	Carbon and low alloy steel	Outdoor Air (External)	Loss of Material
Station Blackout System - Electrical Commodities	Phase Bus Enclosure Assemblies	Elastomer	Outdoor Air (External)	Change in Material Properties

Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Soil	Cracking
Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Indoor Air	Change in Material Properties
Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Indoor Air	Cracking
Station Blackout System - Structural Components	Structural bolts	Carbon and low alloy steel	Indoor Air	Loss Of Preload
Station Blackout System - Structural Components	Structural bolts	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Supports for combustion turbines (skid, turbine support legs)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Concrete embedment	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Supports for panels and enclosures (support members, welds, bolted connections, support anchorage)	Galvanized Steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Supports for conduits (support members, welds, bolted connections, support anchorage)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Outdoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation

Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Supports for panels and enclosures (support members, welds, bolted connections, support anchorage)	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Indoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Station Blackout System - Structural Components	Supports for panels and enclosures (support members, welds, bolted connections, support anchorage)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Indoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Outdoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Station Blackout System - Structural Components	Supports for piping and components (support members, welds, bolted connections, support anchorage)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Indoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Enclosures (combustion turbines, generator accessory, control room, fuel oil forwarding skid)	Carbon and low alloy steel	Indoor Air	Loss of Material

Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Station Blackout System - Structural Components	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Supports for piping and components (support members, welds, bolted connections, support anchorage)	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Panels and enclosures (includes phase bus enclosure assemblies)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Panels and enclosures (includes phase bus enclosure assemblies)	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Panels and enclosures (includes phase bus enclosure assemblies)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Panels and enclosures (includes phase bus enclosure assemblies)	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Concrete embedment	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Soil	Cracking
Station Blackout System - Structural Components	Doors	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Doors	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Indoor Air	Cracking
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Indoor Air	Cracking

Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Indoor Air	Change in Material Properties
Station Blackout System - Structural Components	Enclosures (combustion turbines, generator accessory, control room, fuel oil forwarding skid)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Enclosures (combustion turbines, generator accessory, control room, fuel oil forwarding skid)	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Building concrete at locations of expansion and grouted anchors; grouted pads for support base plates	Concrete; grout	Outdoor Air	Reduction in Anchor Capacity Due to Local Concrete Degradation
Station Blackout System - Structural Components	Enclosures (combustion turbines, generator accessory, control room, fuel oil forwarding skid)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Equipment foundation (above and below grade)	Concrete	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Indoor Air	Cracking
Station Blackout System - Structural Components	Conduits	Galvanized Steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Soil	Cracking
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Soil	Cracking
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Cracking
Station Blackout System - Structural Components	Reinforced concrete trench, manhole, ductbank (above and below grade)	Concrete	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Outdoor Air	Loss of Material

Station Blackout System - Structural Components	Supports for conduits (support members, welds, bolted connections, support anchorage)	Carbon and low alloy steel	Indoor Air	Loss of Material
Station Blackout System - Structural Components	Supports for piping and components (support members, welds, bolted connections, support anchorage)	Galvanized Steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Reinforced concrete foundation (enclosures slab, tanks, supports); above and below grade	Concrete	Outdoor Air	Change in Material Properties
Station Blackout System - Structural Components	Seals, Gaskets	Elastomer	Indoor Air	Change in Material Properties
Station Blackout System - Structural Components	Supports for conduits (support members, welds, bolted connections, support anchorage)	Galvanized Steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Seals, Gaskets	Elastomer	Outdoor Air	Change in Material Properties
Station Blackout System - Structural Components	Piles (turbine generator, exhaust stack)	Wood (Creosote treated)	Soil	Change in Material Properties
Station Blackout System - Structural Components	Piles (turbine generator, exhaust stack)	Wood (Creosote treated)	Soil	Loss of Material
Station Blackout System - Structural Components	Supports for cooling system, exhaust system, ductwork (support members, welds, bolted connections, support anchorage)	Galvanized Steel	Outdoor Air (External)	Loss of Material
Station Blackout System - Structural Components	Cable trays	Galvanized Steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Supports for cable trays (support members, welds, bolted connections, support anchorage)	Galvanized Steel	Outdoor Air	Loss of Material
Station Blackout System - Structural Components	Structural bolts	Galvanized Steel	Outdoor Air	Loss Of Preload
Station Blackout System - Structural Components	Structural bolts	Galvanized Steel	Indoor Air	Loss Of Preload
Station Blackout System - Structural Components	Structural bolts	Galvanized Steel	Outdoor Air	Loss of Material
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Soil	Cracking
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Soil	Cracking
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Soil	Cracking

Turbine Building	Structural Bolts	Carbon and low alloy steel	Outdoor Air	Loss Of Preload
Turbine Building	Roofing	Roofing Material	Outdoor Air	Change in Material Properties
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Soil	Cracking
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Change in Material Properties
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Turbine Building	Miscellaneous steel (catwalks, handrails, ladders, platforms, grating, and associated supports)	Carbon and low alloy steel	Indoor Air	Loss of Material
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Turbine Building	Structural Bolts	Carbon and low alloy steel	Outdoor Air	Loss of Material
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Turbine Building	Hatch Plugs	Concrete	Outdoor Air	Loss of Material
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Loss of Material
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Soil	Cracking
Turbine Building	Hatch Plugs	Concrete	Outdoor Air	Cracking
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Change in Material Properties
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material

Turbine Building	Seals	Elastomer	Indoor Air	Change in Material Properties
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Loss of Material
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Change in Material Properties
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Cracking
Turbine Building	Reinforced concrete Walls, Slabs, Beams	Concrete	Indoor Air	Loss of Material
Turbine Building	Panels and enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Turbine Building	Panels and enclosures	Carbon and low alloy steel	Indoor Air	Loss of Material
Turbine Building	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss of Material
Turbine Building	Seals	Elastomer	Outdoor Air	Change in Material Properties
Turbine Building	Structural Bolts	Carbon and low alloy steel	Indoor Air	Loss Of Preload
Turbine Building	Metal Siding	Galvanized Steel	Outdoor Air	Loss of Material
Turbine Building	Metal Deck	Galvanized Steel	Outdoor Air	Loss of Material
Turbine Building	Penetration seals	Elastomer	Indoor Air	Change in Material Properties
Turbine Building	Concrete embedments	Carbon and low alloy steel	Indoor Air	Loss of Material
Turbine Building	Structural steel: Beams, Columns, Girders, Plate	Galvanized Steel	Outdoor Air	Loss of Material
Turbine Building	Structural steel: Beams, Columns, Girders, Plate	Carbon and low alloy steel	Outdoor Air	Loss of Material
Turbine Building	Structural steel: Beams, Columns, Girders, Plate	Carbon and low alloy steel	Indoor Air	Loss of Material
Turbine Building	Hatch Plugs	Concrete	Outdoor Air	Cracking
Turbine Building	Cable Tray	Carbon and low alloy steel	Indoor Air	Loss of Material
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Turbine Building	Bird Screen	Galvanized Steel	Outdoor Air	Loss of Material
Turbine Building	Hatch Plugs	Concrete	Indoor Air	Cracking
Turbine Building	Hatch Plugs	Concrete	Outdoor Air	Loss of Material
Turbine Building	Equipment Foundation	Concrete	Indoor Air	Change in Material Properties
Turbine Building	Equipment Foundation	Concrete	Indoor Air	Loss of Material
Turbine Building	Equipment Foundation	Concrete	Indoor Air	Cracking

Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Turbine Building	Hatch Plugs	Concrete	Indoor Air	Loss of Material
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Turbine Building	Hatch Plugs	Concrete	Indoor Air	Cracking
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Cracking
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Loss of Material
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Soil	Cracking
Turbine Building	Reinforced concrete foundation	Concrete	Soil	Cracking
Turbine Building	Reinforced concrete foundation	Concrete	Soil	Cracking
Turbine Building	Reinforced Concrete Walls (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Turbine Building	Hatch Plugs	Concrete	Indoor Air	Loss of Material
Turbine Building	Hatch Plugs	Concrete	Indoor Air	Change in Material Properties
Turbine Building	Hatch Plugs	Concrete	Outdoor Air	Cracking
Turbine Building	Hatch Plugs	Concrete	Indoor Air	Change in Material Properties
Turbine Building	Hatch Plugs	Concrete	Outdoor Air	Change in Material Properties
Turbine Building	Hatch Plugs	Concrete	Indoor Air	Cracking
Turbine Building	Hatch Plugs	Concrete	Indoor Air	Cracking
Turbine Building	Equipment Foundation	Concrete	Indoor Air	Cracking
Turbine Building Closed Cooling Water System	Pump Casing (TBCCW Pumps, Chemical Feed Pump)	Cast Iron	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Flow Element	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Valve Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material

Turbine Building Closed Cooling Water System	Coolers (Stator Winding Liquid)	Carbon Steel - Tube Side Components	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Thermowell	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Flow Glass	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Hydrogen)	Cast Iron - Tube Side Components	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Level Glass	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Strainer Body	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Heat Exchangers (TBCCW)	Carbon and low alloy steel - Shell Side Components	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Tanks (Surge, Chemical Mixing, Closed Cooling Water)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Control Room AC)	Carbon Steel - Shell Side Components	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Thermal Control Unit)	Carbon Steel - Shell Side Components	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Service Air Compressor Aftercooler)	Carbon Steel - Shell Side Components	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Service Air Compressor InterCooler)	Carbon Steel - Tube Side Components	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Service Air Compressor Cylinders)	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Turbine Building Closed Cooling Water System	Coolers (Turbine Lube Oil)	Carbon Steel - Tube Side Components	Indoor Air (External)	Loss of Material
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Indoor Air	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Soil	Cracking
Ventilation Stack	Penetration seals	Grout	Outdoor Air	Cracking
Ventilation Stack	Penetration seals	Grout	Outdoor Air	Loss of Material
Ventilation Stack	Reinforced concrete foundation	Concrete	Indoor Air	Loss of Material
Ventilation Stack	Penetration seals	Grout	Indoor Air	Cracking
Ventilation Stack	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Loss of Material

Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Indoor Air	Cracking
Ventilation Stack	Reinforced concrete Slabs	Concrete	Indoor Air	Loss of Material
Ventilation Stack	Reinforced concrete Slabs	Concrete	Indoor Air	Cracking
Ventilation Stack	Concrete embedments	Aluminum	Outdoor Air	Loss of Material
Ventilation Stack	Penetration sleeve, cap plates, capped auxiliary boiler exhaust pipe	Carbon and low alloy steel	Outdoor Air	Loss of Material
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Indoor Air	Loss of Material
Ventilation Stack	Miscellaneous steel (catwalks, handrails, ladders, platforms, grating, and associated supports)	Carbon and low alloy steel	Outdoor Air	Loss of Material
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Cracking
Ventilation Stack	Penetration seals	Elastomer	Indoor Air	Change in Material Properties
Ventilation Stack	Reinforced concrete foundation	Concrete	Soil	Cracking
Ventilation Stack	Reinforced concrete Slabs	Concrete	Indoor Air	Change in Material Properties
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Indoor Air	Change in Material Properties
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Change in Material Properties
Ventilation Stack	Structural Bolts	Galvanized Steel	Outdoor Air	Loss of Material
Ventilation Stack	Structural Bolts	Galvanized Steel	Outdoor Air	Loss Of Preload
Ventilation Stack	Penetration sleeve, cap plates, capped auxiliary boiler exhaust pipe	Carbon and low alloy steel	Indoor Air	Loss of Material
Ventilation Stack	Reinforced concrete foundation	Concrete	Indoor Air	Change in Material Properties
Ventilation Stack	Reinforced concrete Slabs	Concrete	Indoor Air	Cracking
Ventilation Stack	Reinforced concrete Slabs	Concrete	Soil	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Loss of Material
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Cracking

Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Loss of Material
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Soil	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Indoor Air	Loss of Material
Ventilation Stack	Reinforced concrete foundation	Concrete	Soil	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Indoor Air	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Indoor Air	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Cracking
Ventilation Stack	Reinforced concrete foundation	Concrete	Indoor Air	Cracking
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Indoor Air	Change in Material Properties
Ventilation Stack	Reinforced concrete stack (above and below grade)	Concrete	Outdoor Air	Loss of Material
Water Treatment & Distr. System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Water Treatment & Distr. System	Flow Meter	Cast Iron	Indoor Air (External)	Loss of Material
Water Treatment & Distr. System	Piping and fittings	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Water Treatment & Distr. System	Restricting Orifice	Carbon and low alloy steel	Indoor Air (External)	Loss of Material
Water Treatment & Distr. System	Valve Body	Cast Iron	Indoor Air (External)	Loss of Material

5.0 ATTACHMENTS

5.1 LRA Appendix A

5.2 LRA Appendix B