February 19, 2004

10 CFR 54

U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos.	50-259
Tennessee Valley Authority	)		50-260
			50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2 AND 3 - JANUARY 28, 2004 MEETING FOLLOW-UP - ADDITIONAL INFORMATION

By letter dated December 31, 2003, TVA submitted an application to renew the operating licenses for BFN Units 1, 2, and 3. On January 28, 2004, TVA met with the NRC Staff to present an overview of the BFN three-unit application. During the meeting, TVA presented background information on the impact of Unit 1 restart activities on the license renewal application, the results of an aging effects evaluation of Unit 1 structures and components which were layed up during the extended Unit 1 outage, and the impact of planned power uprates on the license renewal application. To assist the NRC Staff in its review of the BFN application, the Enclosure provides additional information on these subjects and other issues which arose during the meeting.

This letter contains no new commitments.

If you have any questions about this information, please contact Gary Adkins, Browns Ferry License Renewal Project Manager, at (423) 751-4363.

I declare under penalty of perjury that the forgoing is true and correct. Executed on this 19th day of February, 2004.

Sincerely,

ORIGINAL SIGNED BY:

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ENCLOSURE
JANUARY 28, 2004 TVA/NRC MEETING FOLLOW-UP
ADDITIONAL INFORMATION

On January 28, 2004, TVA met with the NRC Staff to present an overview of the BFN three-unit license renewal application (LRA). During the meeting, TVA presented background information on the impact of Unit 1 restart activities on the license renewal application, the results of an aging effects evaluation of Unit 1 structures and components on all three units which were layed up during the extended Unit 1 outage, and the impact of planned power uprates on the license renewal application. Several questions were raised by the Staff for which TVA agreed to provide additional information. The following is in response to those requests.

UNIT 1 RESTART ACTIVITIES – ELECTRICAL CABLE REPLACEMENT COMMODITIES
The Staff requested a comparison of the Unit 1 cable planned for replacement to the total amount of Unit 1 cable. The following information reflects Unit 1 modification planning as of January 2004. (The values presented below are current "best estimate" values.)

Total Unit 1 Cable	2,549,200 (linear) feet
Unit 1 Cable Replaced or Added	757,900 feet
Total Unit 1 Safety Related (SR) Cable	446,900 feet
Unit 1 SR Cable Replaced or Added	330,100 feet

AGING EFFECTS EVALUATION OF THE UNIT 1 LAYUP AND PRESERVATION PROGRAM
Section 3.0.1 of the December 30, 2002, BFN LRA contains a summary of the results of TVA's aging evaluation of the Unit 1 Layup and Preservation Program. During the January 28 meeting the Staff requested that TVA provide additional details supporting TVA's conclusion that no new aging effects requiring management during the renewal term were identified by this evaluation. The requested information is provided in the Attachment.

EFFECTS OF PLANNED POWER UPRATE ON THE LICENSE RENEWAL APPLICATION (LRA)
The results presented in the BFN LRA conservatively bound the Units 1, 2, and 3 current licensing basis (CLB) power levels (3293 MWt, 3458 MWt, 3458 MWt, respectively). TVA expects to submit a license amendment request for operation at 3952 MWt for Units 1, 2 and 3 in June, 2004. All evaluations in support of the LRA are valid at the uprated power level, except those associated with Section 4.3, Metal Fatigue. TVA plans to update LRA Section 4.3 to bound the uprated power levels by June 2004.

SOURCE DOCUMENT LISTING FOR THE BFN LRA
During the January 28, 2004 TVA / NRC meeting, TVA was requested to provide a listing of the reference documents used to develop the LRA. A comprehensive source document listing will be provided to the Staff prior to the initial BFN LRA audit or inspection activity.

ATTACHMENT

Aging Effects Evaluation Of The Unit 1 Layup And Preservation Program

Evaluation of the BFN Unit 1 Lay-up and Preservation Program

Revision 1

Prepared By: Marcus Jones 02/19/04

Checked By: M. Hm[illegible] 02/19/04

Approved By: Kenneth A. Br[illegible] 2-19-2004

REVISION LOG

Revision Number	Effective Date	Pages Affected	Description of Revision
0	12-31-04	All	Initial issue.
1	02-18-04	All	Deleted systems 01, 02, 03, and 06 from the Unit 1-Lay-up Program-Dry evaluation and incorporated the affected changes. Deleted system 64 from the Unit 1-Dry Lay-up-Not in Lay-up Program evaluation and incorporated the affected changes. Added systems 01, 02, and 06 to the Unit 1-Dry Lay-up-Not in Lay-up Program evaluation and incorporated the affected changes. Added system 03 to the Unit 1-Lay-up Program-Wet evaluation and incorporated the affected changes. Revaluated the internal environment for the Unit 1-Dry Lay-up-Not in Lay-up Program evaluation to reflect a conservative approach taken to consider a moist air internal environment in place of relatively dry air/gas. General change to revise grammatical errors for the mechanical system/program evaluation details. Added BFN U1 lay-up methodology, BFN U1 aging management comparison tables, and BFN operating experience.

TABLE OF CONTENTS

Evaluation of the BFN Unit 1 Lay-up and Preservation Program

Purpose and Scope

An evaluation of the Unit 1 mechanical systems for the layup environments and materials was performed to identify additional aging effects which would require management during the period of extended operation. This evaluation identifies the potential aging mechanisms and associated aging affects which could affect plant components in a layup condition. These aging mechanisms and associated aging affects were compared to those identified for the operating conditions. The Aging Management Programs (AMPs) credited in the Browns Ferry license renewal application were reviewed to ensure that any potential aging effects resulting from the layup conditions will be effectively managed for the period of extended operation.

Methodology

Unit 1 systems and the Unit 1 portion of common systems not involved in the operation of Units 2 and 3 were placed in layup during the extended outage. The Unit 1 systems in layup consist of systems which are in the Plant Layup and Equipment Preservation Program (referred to as the Layup Program) and those systems which were not part of this program. The Unit 1 systems were placed in one of the four environments during layup:

- Components in dry layup where the target environment is $\leq$ 60 percent relative humidity
- Components in wet layup maintained with an internal environment of flowing, air-saturated, demineralized water.
- Components not included into the Layup Program with an internal environment of moist air. For these components there were no moisture controls during layup.
- Components not included into the Layup Program which had an internal environment of either treated or raw water for an extended period of time.

An Aging Management Review (AMR) of nineteen Unit 1 mechanical systems was performed to bound the layup environments. The approach used for the layup evaluations are:

- Identify the Material/Environment combinations during layup of Unit 1.
- For each of the Material/Environment combinations identify the potential aging mechanism(s)/effect(s).
- Each component type (i.e. piping, fittings, valves, etc) was not evaluated individually. Instead all material/environment combinations associated with all components in each system are evaluated to bound all component types.
- The aging effects of each layup material/environment combination were compared to the operating aging effect evaluation. The operating material / environment / aging effects are contained in the license renewal application and have been compared to NUREG-1801.
- Determine if there are any additional aging effects associated with the layup environment that were not identified for the operating condition environment.
- For any additional aging effects, determine if the components will be inspected for unacceptable conditions resulting from the potential aging effects prior to Unit 1 restart. Also, determine if necessary, that unacceptable conditions will be corrected prior to Unit 1 restart.
- Determine if any additional aging management programs are required during the renewal term.
- Review the operating experience associated with the Unit 1 Layup and Equipment Preservation Program. The Unit 2/3 operating experience was reviewed when performing the AMR of the operating condition environments.

Results

A detailed evaluation was performed for nineteen Unit 1 systems. There were no additional aging management programs required for the period of extended operation. The potential aging effects identified for the layup environments were also identified for the operating environments except for a external environment of inside air where the external surface normally operated above 212 °F and a air/gas internal environment that conservatively considers moist air. The following is a summary of the identified potential aging effects which will require inspection prior to Unit 1 restart:

Inside Air External Environment (External Surface < 212 °F)

Systems Affected: Main Steam, Feedwater and Heater Drains and Vents Systems

Aging Effect: The potential aging effect is loss of material due to general corrosion on external surfaces of carbon steel components < 212 °F during layup. For these systems general corrosion on external surfaces of carbon steel was not considered applicable for the operating environment because the temperature is greater than 212 °F.

Unit 1 Restart Inspection: The piping and components will be inspected for external corrosion prior to Unit 1 restart. If necessary, unacceptable external corrosion effects will be corrected prior to Unit 1 restart.

Air/Gas Internal Environment (w/Moist Air)

Systems Affected: Containment Inerting, Containment Atmosphere Dilution and Feedwater Systems

Aging Effects: The potential aging effects are:

- Loss of material due to crevice and pitting corrosion on internal surfaces of carbon and low alloy steel, stainless steel, nickel alloy, aluminum alloy and copper alloy, cast Iron and cast iron alloy components
- Loss of material due to galvanic corrosion on internal surfaces of carbon and low alloy steel, cast iron and cast iron alloy, aluminum alloy and copper alloy components
- Loss of material due to selective leaching on cast iron and cast iron alloy , copper alloy components;
- Crack initiation/growth due to stress corrosion cracking on aluminum alloy components

For these systems the additional aging effects are due to the possibility of moisture collecting in the system components. For the operating condition the internal environment is air/gas without a significant amount of moisture present. During layup there were no moisture controls on the non-operating Unit 1 portions of these systems. Without moisture controls the possibility of moisture collecting at system low points exists.

Unit 1 Restart Inspection: The piping components will be inspected for unacceptable conditions resulting from the potential aging effects prior to Unit 1 restart. If necessary, unacceptable conditions will be corrected prior to Unit 1 restart.

Operating Experience

The operating experience of Units 2 and 3 was reviewed and no additional aging effects were identified. Since the restart effort for Unit 1 will be similar to that done for Units 2 and 3, no additional aging effects are expected for Unit 1.

Mechanical System/Program Evaluation Detail

for

Unit 1 - Lay-up Program - Dry - REV: 2

Unit 1 Lay-up (63, 66, 71, 73, and 75) (Dry)

1.0. General

U1 systems 63, 66, 71, 73, and 75 were incorporated into the BFN U1 lay-up program. The BFN lay-up program maintained the internal environment of these systems at < 60% de-humidified air.

2.0. NON-FERROUS METALS IN AN AIR/GAS ENVIRONMENT

2.0. A. Copper and copper alloys

This section addresses Unit 1 Lay-up System components made of copper alloys in a relatively dry air/gas environment.

2.1. A. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. While copper zinc alloys are generally resistant to crevice corrosion, copper zinc alloys with greater than 15% zinc are susceptible. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, crevice corrosion is not a concern in the Unit 1 Lay-up Systems.

2.2. A. Pitting Corrosion (Aging Management Required: No)

Pitting corrosion is an aggressive corrosion mechanism. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent in a moist environment. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. While copper zinc alloys are generally resistant to pitting corrosion, copper zinc alloys with greater than 15% zinc are susceptible. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, pitting corrosion is not a concern in the Unit 1 Lay-up Systems.

2.3. A. Galvanic Corrosion (Aging Management Required: No)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Copper alloys will preferentially corrode when coupled with more cathodic metals such as stainless steel, nickel-based alloys, titanium or graphite in an electrolytically conductive environment. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain the presence of electrolytes. Therefore, galvanic corrosion is not a concern in the Unit 1 Lay-up Systems.

2.4. A. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 Lay-up Systems as there is no potential of MIC contamination.

2.5. A. Selective Leaching (Aging Management Required: No)

Copper-zinc alloys containing greater than 15% zinc, in a moist air environment that is subjected to wetted environments, are susceptible to selective leaching, while copper alloys with a copper content in excess of 85% resist dezincification. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to be considered a wetted environment. Therefore, selective leaching is not a concern in the Unit 1 Lay-up Systems.

2.6. A. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

Ammonia and ammonium compounds are the corrosive substances most often associated with SCC of copper alloys. Both oxygen and moisture are necessary for ammonia and other contaminates to be corrosive to copper alloys. Carbon dioxide, sea water, chloride solutions, hydrogen sulfide, and sodium hydroxide are also thought to contribute to the process. Brass alloys containing 64% to 65% copper are extremely susceptible to SCC, with resistance to cracking increasing progressively as the content of copper increases. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to be considered a wetted environment. Therefore, SCC is not a concern in the Unit 1 Lay-up Systems.

2.7. A. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat exchange function. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the Unit 1 lay-up systems.

2.0. B. Aluminum and aluminum alloys

This section addresses Unit 1 Lay-up System components made of aluminum and aluminum alloys in a relatively dry air/gas environment.

2.1. B. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, crevice corrosion is not a concern in the Unit 1 Lay-up Systems.

2.2. B. Pitting Corrosion (Aging Management Required: No)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, pitting corrosion is not a concern in the Unit 1 Lay-up Systems.

2.3. B. Galvanic Corrosion (Aging Management Required: No)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Anodic metals like aluminum will preferentially corrode when coupled with most metals (such as copper, stainless and carbon steels) in an electrolytically conductive environment. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain the presence of electrolytes. Therefore, galvanic corrosion is not a concern in the Unit 1 Lay-up Systems.

2.4. B. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 Lay-up Systems as there is no potential of MIC contamination.

2.5. B. Selective Leaching (Aging Management Required: No)

Selective leaching is the removal of one element from a solid alloy by corrosion processes. Aluminum bronze with greater than 8% aluminum, in a moist air environment, are susceptible to selective leaching. Aluminum is not identified by the mechanical tools document as being susceptible to selective leaching. The components in LR scope for the Unit 1 Lay-up Systems are not subjected to the pooled water environment. Therefore, selective leaching is not a concern for aluminum and aluminum alloys in air/gas environment for Unit 1 Lay-up Systems.

2.6. B. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

Pure aluminum is not susceptible to SCC; however, aluminum alloys containing more than 12% zinc or more that 6% magnesium are very susceptible to cracking under mild corrosive environments. Aluminum alloys are susceptible to SCC in air and water vapor. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to be considered a wetted environment. Therefore, SCC is not a concern in the Unit 1 Lay-up Systems.

2.7. B. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat exchange function. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the Unit 1 lay-up systems.

3.0. CARBON AND LOW ALLOY STEEL IN AN AIR/GAS ENVIRONMENT

This section addresses carbon steel components in a relatively dry air environment.

3.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in air/gas is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

General corrosion occurs in carbon and low alloy steel when both oxygen and moisture are present to allow for an electrolytic reaction.

3.2. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, crevice corrosion is not a concern in the Unit 1 Lay-up Systems.

3.3. Pitting Corrosion (Aging Management Required: No)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. All nuclear plant materials are subject to pitting when associated with halide ions, chlorides, bromides, and hypochlorites. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, pitting corrosion is not a concern in the Unit 1 Lay-up Systems.

3.4. Galvanic Corrosion (Aging Management Required: No)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Carbon and low-alloy steels that are in contact with more cathodic materials such as copper alloys, stainless, CASS, or nickel-based alloys and are subjected to a moist air environment may be susceptible to galvanic corrosion. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain the presence of electrolytes. Therefore, galvanic corrosion is not a concern in the Unit 1 Lay-up Systems.

3.5. Microbiological Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 Lay-up Systems as there is no potential of MIC contamination.

3.6. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat exchange function. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the Unit 1 lay-up systems.

4.0. STAINLESS STEEL IN AN AIR/GAS ENVIRONMENT

This section addresses stainless steel components in a relatively dry air environment.

4.1. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, crevice corrosion is not a concern in the Unit 1 Lay-up Systems.

4.2. Pitting Corrosion (Aging Management Required: No)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, pitting corrosion is not a concern in the Unit 1 Lay-up Systems.

4.3. Microbiological Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 Lay-up Systems as there is no potential of MIC contamination.

4.4. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

For stainless steels in air gas environments, moisture containing contaminants can concentrate resulting in an environment conducive to SCC when the temperature is greater than 140°F. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to be considered a wetted environment. Therefore, SCC is not a concern in the Unit 1 Lay-up Systems.

4.5. Thermal Aging (Aging Management Required: No)

Wrought austenitic stainless steel is not susceptible to thermal embrittlement when exposed to normal nuclear plant operating environments. However, cast austenitic stainless steel (CASS) materials are susceptible to thermal embrittlement depending upon material composition and time at high temperatures. CASS materials subjected to temperatures > 482°F are susceptible to thermal aging. The temperature of these components does not exceed 482°F during lay-up. Therefore, thermal aging is not a concern for the period of extended operation for the applications where stainless steel is used in the Unit 1 Lay-up Systems.

4.6. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat exchange function. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the Unit 1 lay-up systems.

5.0. CAST IRON & CAST IRON ALLOYS IN AN AIR/GAS ENVIRONMENT

This section addresses cast iron components in a relatively dry air environment.

5.1. General Corrosion (Aging Management Required: Yes)

General corrosion of cast iron in air/gas is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

General corrosion occurs in cast iron when both oxygen and moisture are present to allow for an electrolytic reaction.

5.2. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, crevice corrosion is not a concern in the Unit 1 Lay-up Systems.

5.3. Pitting Corrosion (Aging Management Required: No)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, pitting corrosion is not a concern in the Unit 1 Lay-up Systems.

5.4. Galvanic Corrosion (Aging Management Required: No)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Cast iron that is in contact with more cathodic materials such as copper alloys, stainless, CASS, or nickel-based alloys and are subjected to a moist air environment may be susceptible to galvanic corrosion. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to sustain the presence of electrolytes. Therefore, galvanic corrosion is not a concern for cast iron in the Unit 1 Lay-up Systems.

5.5. Microbiological Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 Lay-up Systems as there is no potential of MIC contamination.

5.6. Selective Leaching (Aging Management Required: No)

The most common forms of leaching are graphitic corrosion with loss of the iron matrix from gray cast iron under harsh conditions (i.e., buried pipe). However, gray cast iron can also display the effects of selective leaching in relatively mild wetted environments. The air/gas environment for the Unit 1 Lay-up Systems does not contain the level of moisture necessary to be considered a wetted environment. Therefore, selective leaching is not a concern in the Unit 1 Lay-up Systems.

5.7. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat exchange function. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the Unit 1 lay-up systems.

6.0. POLYMER IN AN AIR/GAS ENVIRONMENT

This section addresses delrin components in a relatively dry air/gas environment.

6.1. Delrin Polymer (Aging Management Required: No)

DELRIN is used in the U1 lay-up systems. Acetal (the generic name for a family of products that includes DELRIN and plastics) provides high strength and stiffness along with increased dimensional stability and ease of machining. A review of available industry information did not identify any aging effects for DELRIN that would be applicable to the air/gas environments experienced in the U1 lay-up systems.

7.0. NICKEL-BASE ALLOYS IN AN AIR/GAS ENVIRONMENT

This section addresses nickel-base alloy components in a relatively dry air environment.

7.1. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfur, chlorine, or iodine. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. Oxygen content in the fluid is required to initiate crevice corrosion. The air/gas environment for the U1 lay-up systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, crevice corrosion is not a concern in the U1 lay-up systems.

7.2. Pitting Corrosion (Aging Management Required: No)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. The air/gas environment for the U1 lay-up systems does not contain the level of moisture necessary to sustain a cyclic wet/dry phenomenon. Therefore, pitting corrosion is not a concern in the U1 lay-up systems.

7.3. Microbiologically Influenced Corrosion (Aging Management Required: No)

MIC is facilitated by stagnant conditions, fouling, internal crevice contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism.

The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the U1 lay-up systems.

7.4. Stress Corrosion Cracking (Aging Management Required: No)

Stress corrosion cracking (SCC) occurs through the combination of high stress (both applied and residual tensile stresses), a corrosive environment, and a susceptible material. The tensile stresses necessary to induce SCC may be either applied (external) or residual (internal), but must be at or near the materials yield point. For nickel-base alloys in moist air environments, a concern arises when moisture containing contaminant concentrate, resulting in an environment conductive to SSC when the temperature is greater than 500°F. The portion of the U1 lay-up systems that are within the scope of BFN license renewal containing nickel based alloys have a normal operating temperature < 500°F while laid up. Therefore, SCC is not a concern for nickel based alloys in an air/gas environment for the U1 lay-up systems.

7.5. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat exchange function. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the Unit 1 lay-up systems.

8.0. ELASTOMERS IN AN AIR/GAS ENVIRONMENT

This section addresses rubber components in a relatively dry air/gas environment.

8.1. Ultraviolet Radiation (Aging Management Required: No)

Rubber is decomposed by exposure to ultraviolet radiation. Ultraviolet radiation sources at nuclear plants include solar radiation and ultraviolet or fluorescent lamps. The deterioration of rubber is greatly accelerated in the presents of oxygen. Cracking and checking, which may occur when rubber is exposed to air and sunlight, are due mainly to reaction with ozone. Ultraviolet degradation may be prevented by means of and opaque covering. Neoprene and nitrile rubbers have good resistance to sunlight and ozone, and silicone and butyl rubber are relatively unaffected by sunlight and ozone. Ultraviolet radiation is negligible to the internal surfaces of the components. Therefore, ultraviolet radiation is not a concern for elastomers in the U1 lay-up systems exposed to an air/gas environment.

8.2. Thermal Exposure (Aging Management Required: No)

Thermal exposure of elastomers can result in decreased tensile strength and ultimate elongation, cracking, chain scission, or cross-linking. Cross-linking makes the elastomers brittle, increases the modulus of elasticity, and promotes surface cracking. Elastomers are tested for short-term and long-term temperature durability. Maximum temperature ratings for elastomers are provided as follows: Butyl Rubber at 150°F, Rubber at 130°F, Neoprene at 160°F, Nitrile Rubber at 175°F, and Silicone at 275°F. In general, if the ambient temperature is less than 95°F, then thermal aging may be considered non-significant for the period of extended operation. Material property changes and cracking owing to thermal stresses is an applicable aging effect for rubber, neoprene, and silicone elastomers in environments where the temperatures exceed the limits defined above. During the normal operation, the temperature of the elastomers within the U1 lay-up systems does not exceed 130°F while laid up. Therefore thermal aging may be considered non-significant for the period of extended operation.

8.3. Ionizing Radiation (Aging Management Required: No)

Ionizing radiation can profoundly alter the molecular structure and macroscopic properties of elastomers. The effects of radiation-induced degradation of elastomers may include embrittlement, cracking or crazing, swelling, discoloration and melting. Rubber, neoprene, and silicone elastomers ultimately become harder, stiffer and eventually brittle when exposed to radiation. The lowest reported dose thresholds for radiation degradation of elastomers common in nuclear power plants are as follows: Butyl Rubber at 10E6 rads, Rubber at 10E7 rads, Neoprene at 10E6 rads, Nitrile Rubber at 10E7 rads, and Silicone at 10E6 rads. Material property changes and cracking owing to radiation is an applicable aging effect for rubber, neoprene, and silicone elastomers in environments where the radiation exceeds the limits defined above. The radiation levels within the U1 lay-up systems are well below the limits addressed for the propagation of ionizing radiation.

9.0. GLASS IN ALL ENVIRONMENTS

9.0. A. Glass in an air/gas environment

This section addresses glass components in a relatively dry an air/gas environment.

9.1. A. Corrosion (Aging Management Required: No)

Glass is used in the sight glasses on the level gages for on the chemical feed and surge tanks. There are no aging mechanisms that must be managed for the period of extended operation for glass in an air/gas environment.

9.0. B. Glass in an inside air environment

This section addresses glass components in an inside environment.

9.1. B. Corrosion (Aging Management Required: No)

Glass is used in the sight glasses on the level gages for on the chemical feed and surge tanks. There are no aging mechanisms that must be managed for the period of extended operation for glass in an air/gas environment.

10.0. ELASTOMERS IN AN INSIDE AIR ENVIRONMENT

This section addresses rubber components in an inside air environment.

10.1. Ultraviolet Radiation (Aging Management Required: Yes)

Rubber is decomposed by exposure to ultraviolet radiation. Ultraviolet radiation includes solar radiation and ultraviolet or fluorescent lamps.

10.2. Thermal Exposure (Aging Management Required: No)

Thermal exposure of elastomers can result in decreased tensile strength and ultimate elongation, cracking, chain scission, or cross-linking. Elastomers are tested for short-term and long-term temperature durability. Maximum temperature rating for rubber is 130°F. In general, if the ambient temperature is less than about 95°F, then thermal aging may be considered non-significant for the period of extended operation. During the normal operation, the temperature of the elastomers within the U1 lay-up systems does not exceed 130°F while laid up. Therefore thermal aging may be considered non-significant for the period of extended operation.

10.3. Ionizing Radiation (Aging Management Required: No)

Ionizing radiation can profoundly alter the molecular structure and macroscopic properties of elastomers. Effects of radiation-induced degradation of elastomers may include embrittlement, cracking or crazing, swelling, discoloration and melting. Rubber ultimately becomes harder, stiffer and eventually brittle when exposed to radiation. The lowest reported dose threshold for radiation degradation of rubber is 1E10. The ionizing radiation the flexible hoses receive is negligible and degradation from this mechanism is not significant.

11.0. POLYMER IN AN INSIDE AIR ENVIRONMENT

This section addresses delrin components in an inside air environment.

11.1. Delrin Polymer (Aging Management Required: No)

DELRIN is used in the U1 lay-up systems. Acetal (the generic name for a family of products that includes DELRIN and plastics) provides high strength and stiffness along with increased dimensional stability and ease of machining. A review of available industry information did not identify any aging effects for DELRIN that would be applicable to the inside air environments experienced by the U1 lay-up systems.

12.0. CARBON AND LOW ALLOY STEEL IN AN INSIDE AIR ENVIRONMENT

This section addresses carbon steel components in an inside air environment.

12.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the U1 lay-up systems.

Carbon steel is considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for carbon and low alloy steels in an inside air environment where the temperature is greater than 212°F.

12.2. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

13.0. STAINLESS STEEL IN AN INSIDE AIR ENVIRONMENT

This section addresses stainless steel components in an inside air environment.

13.1. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

14.0. NON-FERROUS METALS IN A INSIDE AIR ENVIRONMENT

14.0. A. Copper and copper alloys

This section addresses Unit 1 Lay-up System components made of copper alloys in an inside air environment.

14.1. A. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

14.0. B. Aluminum and aluminum alloys

This section addresses Unit 1 Lay-up System components made of aluminum and aluminum alloys in an inside environment.

14.1. B. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

15.0. CAST IRON AND CAST IRON ALLOYS IN AN INSIDE AIR ENVIRONMENT

This section addresses cast iron and cast iron alloys Unit 1 Lay-up System components in an inside air environment.

15.1. General Corrosion (Aging Management Required: Yes)

General corrosion of cast iron in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the U1 lay-up systems.

Cast iron is considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for cast iron in an inside air environment where the temperature is greater than 212°F.

16.0. NICKEL-BASE ALLOYS IN AN INSIDE AIR ENVIRONMENT

This section addresses nickel-based alloy Unit 1 Lay-up System components in an inside air environment.

16.1. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interface supports, crane rails, and door hatch/hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

17.0. CARBON AND LOW ALLOY STEEL BOLTING IN AN INSIDE AIR ENVIRONMENT

This section addresses carbon steel bolting in an inside air environment.

17.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel bolting in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the U1 lay-up systems.

Loss of material degradation due to general corrosion of carbon and low alloy steel bolted joints and cast iron and iron alloy bolted joints are generally attributed to joint leakage or exposure to high-moisture ambient environments. General corrosion is not a concern for carbon and low alloy steels in an inside air environment where the temperature is greater than 212°F.

17.2. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for 'critical bolting applications'. 'Critical bolting applications' constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves. Wear is not a concern for the U1 lay-up systems while in a laid up state.

18.0. STAINLESS STEEL BOLTING IN AN INSIDE AIR ENVIRONMENT

This section addresses stainless steel bolting in an inside air environment.

18.1. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for 'critical bolting applications'. 'Critical bolting applications' constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves. Wear is not a concern for the U1 lay-up systems while in a laid up state.

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To update aging effects

Mechanical System/Program Evaluation Detail

for

Unit 1 - Lay-up Program - Wet - REV: 1

Unit 1 Lay-up (RVI, 03, 10, 68, 69, and 85) (Wet)

1.0. General

U1 systems RVI, 03, 10, 68, 69, and 85 where incorporated into the BFN lay-up program. The BFN U1 lay-up program maintained the internal environment of these systems with flowing, air-saturated, demineralized water the Chemistry Program (CI-13.1). RCPB and Non-RCPB components are addressed.

2.0. NON-FERROUS METALS IN A TREATED WATER ENVIRONMENT

2.0. A. Aluminum and aluminum alloys

This section addresses Unit 1 Lay-up System components made of aluminum and aluminum alloys in a treated water environment.

2.1. A. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of aluminum and aluminum alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for aluminum and aluminum alloys in the Unit 1 Lay-up Systems.

2.2. A. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of aluminum and aluminum alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, aluminum and aluminum alloys are susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces or aluminum and aluminum alloys in the Unit 1 Lay-up Systems.

2.3. A. Galvanic Corrosion (Aging Management Required: No)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Anodic metals like aluminum will preferentially corrode when coupled with most metals (such as copper, stainless, and carbon steels) in an electrolytically conductive environment. Aluminum and aluminum alloys are not in contact with more cathodic materials. Therefore, galvanic corrosion is not a concern.

2.4. A. Flow Accelerated Corrosion (FAC) (Aging Management Required: No)

High-energy piping systems are susceptible to the form of erosion/corrosion called flow accelerated corrosion (FAC). The evaluation of FAC is conservatively treated as a potential aging mechanism in the feed water, steam, and condensate systems of both PWRs and BWRs and for the HPCI and the RCIC systems in BWRs where the material chromium content is < 1% or the pH is < 9.5. FAC rates are greatest at temperatures of 212°F to 392°F and decreases rapidly above and below these temperatures. FAC is not an aging mechanism that must be managed for the period of extended operation in the wet U1 lay-up Systems.

2.5. A. Microbiologically influenced corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 Lay-up Systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

2.6. A. Selective Leaching (Aging Management Required: No)

Copper-zinc alloys containing greater than 15% zinc and aluminum bronze with greater than 8% aluminum, in a moist air environment that is susceptible to wetted environments, are susceptible to selective leaching, while copper alloys with a copper content in excess of 85% resist dezincification. Aluminum is not identified by the mechanical tools document as being susceptible to selective leaching.

2.7. A. Stress Corrosion Cracking (SCC) (Aging Management Required: Yes)

SCC of aluminum and aluminum alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, aluminum alloys are susceptible to SCC in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for SCC of the internal surfaces.

2.8. A. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 Lay-up Systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for aluminum for the period of extended operation for the Unit 1 Lay-up Systems.

2.9. A. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 Lay-up Systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where aluminum and aluminum alloys are used in the Unit 1 Lay-up Systems.

2.0. B. Copper and Copper Alloys

This section addresses Unit 1 Lay-up System components made of copper alloys in a treated water environment.

2.1. B. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of copper alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for copper alloys in the Unit 1 Lay-up Systems.

2.2. B. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of copper alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, copper alloys are susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces or copper alloys in the Unit 1 Lay-up Systems.

2.3. B. Galvanic Corrosion (Aging Management Required: Yes)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Copper and copper alloys are in the middle of the galvanic series with steel, alloy steel and cast iron being more anodic (or active) and the stainless steels, nickel alloys, and titanium being more cathodic (or passive). When copper alloys are galvanically coupled to the more cathodic materials such as stainless steel, titanium or graphite, the copper alloys may demonstrate an increased susceptibility to corrosion. The potential for galvanic corrosion exists in locations not particularly identified where copper and copper alloys are in contact with a more cathodic material.

2.4. B. Flow Accelerated Corrosion (FAC) (Aging Management Required: No)

High-energy piping systems are susceptible to the form of erosion/corrosion called flow accelerated corrosion (FAC). The evaluation of FAC is conservatively treated as a potential aging mechanism in the feed water, steam, and condensate systems of both PWRs and BWRs and for the HPCI and the RCIC systems in BWRs where the material chromium content is < 1% or the pH is < 9.5. FAC rates are greatest at temperatures of 212°F to 392°F and decreases rapidly above and below these temperatures. FAC is not an aging mechanism that must be managed for the period of extended operation in the wet U1 lay-up Systems.

2.5. B. Microbiologically influenced corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 Lay-up Systems contains treat water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

2.6. B. Selective Leaching (Aging Management Required: Yes)

Selective leaching of copper alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Copper-zinc alloys containing greater than 15% zinc, in a treated water environment is susceptible to selective leaching, while copper alloys with a copper content in excess of 85% resist dezincification.

2.7. B. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

Ammonia and ammonium compounds are the corrosive substances most often associated with SCC of copper alloys. Both oxygen and moisture are necessary for ammonia and other contaminates to be corrosive to copper alloys. Carbon dioxide, sea water, chloride solutions, hydrogen sulfide, and sodium hydroxide are also thought to contribute to the process. All copper alloys (both brasses and bronzes) containing in excess of 15% Zn in a contaminated environment is considered susceptible to SCC regardless of any added inhibiting elements such a Sn or As. Ammonia and ammonium compounds are not injected into the Unit 1 Lay-up Systems. Therefore, SCC is no a concern for copper alloys within the Unit 1 Lay-up Systems.

2.8. B. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 Lay-up Systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for copper alloys for the period of extended operation for the Unit 1 Lay-up Systems.

2.9. B. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 Lay-up Systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where copper alloys are used in the Unit 1 Lay-up Systems.

3.0. CARBON AND LOW ALLOY STEEL IN TREATED WATER

This section addresses Unit 1 Lay-up System components made of carbon and low alloy steel in a treated water environment.

3.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

General corrosion has been identified as a potential aging mechanism for the internal surfaces of various carbon steel components of the Unit 1 Lay-up Systems. General corrosion can be mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen eliminates the effect of general corrosion as an internal aging mechanism.

3.2. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of carbon and low alloy steel is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for carbon and low alloy steels in the Unit 1 Lay-up Systems.

3.3. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of carbon and low alloy steel is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, carbon and low alloy steel is susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces of carbon and low alloy steels in the Unit 1 Lay-up Systems.

3.4. Galvanic Corrosion (Aging Management Required: Yes)

Galvanic corrosion of carbon and low alloy steel is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Carbon steels and low-alloy steels that are in contact with stainless, CASS, or nickel-based alloys and are subjected to treated water may be susceptible to galvanic corrosion. The potential for galvanic corrosion exists in several locations not specifically identified where carbon steel components are in contact with a more cathodic material.

3.5. Flow Accelerated Corrosion (FAC) (Aging Management Required: No)

High-energy piping systems are susceptible to the form of erosion/corrosion called flow accelerated corrosion (FAC). The evaluation of FAC is conservatively treated as a potential aging mechanism in the feed water, steam, and condensate systems of both PWRs and BWRs and for the HPCI and the RCIC systems in BWRs where the material chromium content is < 1% or the pH is < 9.5. FAC rates are greatest at temperatures of

212°F to 392°F and decreases rapidly above and below these temperatures. FAC is not an aging mechanism that must be managed for the period of extended operation in the wet U1 lay-up Systems.

3.6. Microbiological Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 Lay-up Systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

3.7. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 Lay-up Systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for carbon and low alloy steel for the period of extended operation for the Unit 1 Lay-up Systems.

3.8. Stress Relaxation (Aging Management Required: No)

Stress relaxation is a potential aging mechanism for bolting/fasteners. Mechanical closure bolting/fasteners are considered separately as a commodity group aging effect for external environments. The only internal mechanical closure bolting/fasteners with a potential aging mechanism are the bolting/fasteners included with the reactor vessel internals. Stress relaxation is not a concern for the Unit 1 Lay-up Systems while in a laid up state.

3.9. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 Lay-up Systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where carbon and low alloy steel is used in the Unit 1 Lay-up Systems.

4.0. STAINLESS STEEL IN A TREATED WATER ENVIRONMENT

This section addresses Unit 1 Lay-up System components made of stainless steel in a treated water environment.

4.1. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of stainless steel in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for stainless steel in the Unit 1

Lay-up Systems.

4.2. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of stainless steel in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, stainless steel is susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces of stainless steel in the Unit 1 Lay-up Systems.

4.3. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 Lay-up Systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

4.4. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

For treated water environments, stainless steel is susceptible to SCC in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb at temperatures > 140°F. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for SCC of the internal surfaces. The normal temperature of the Unit 1 Lay-up Systems is < 140°F while in a laid up state. Therefore, SCC is not a concern.

4.5. Thermal Aging (Aging Management Required: No)

Wrought austenitic stainless steel is not susceptible to thermal embrittlement when exposed to normal nuclear plant operating environments. However, cast austenitic stainless steel (CASS) materials are susceptible to thermal embrittlement depending upon material composition and time at high temperatures. CASS materials subjected to temperatures > 482°F are susceptible to thermal aging. The normal temperature of the Unit 1 Lay-up Systems is < 482°F while in a laid up state. Therefore, thermal aging is not a concern for the period of extended operation for the applications where stainless steel is used in the Unit 1 Lay-up Systems.

4.6. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 Lay-up Systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for stainless steel for the period of extended operation for the Unit 1 Lay-up Systems.

4.7. Stress Relaxation (Aging Management Required: No)

Stress relaxation is a potential aging mechanism for bolting/fasteners. Mechanical closure bolting/fasteners are considered separately as a commodity group aging effect for external environments. The only internal mechanical closure bolting/fasteners with a potential aging mechanism are the bolting/fasteners included with the reactor vessel internals. Stress relaxation is not a concern for the Unit 1 Lay-up Systems while in a laid up state.

4.8. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 Lay-up Systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where stainless steel is used in the Unit 1 Lay-up Systems.

5.0. NICKEL-BASED ALLOYS IN A TREATED WATER ENVIRONMENT

This section addresses Unit 1 Lay-up System components made of nickel-based alloys in a treated water environment.

5.1. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of nickel based alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for nickel based alloys in the Unit 1 Lay-up Systems.

5.2. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of nickel based alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, nickel based alloys are susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chlorides and sulfates to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces of nickel based alloys in the Unit 1 Lay-up Systems.

5.3. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 Lay-up Systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

5.4. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

For treated water environments, nickel based alloys are susceptible to SCC in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb at temperatures > 500°F. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for SCC of the internal surfaces. The portion of the Unit 1 Lay-up Systems that's within the scope of BFN license renewal containing nickel based alloys have a normal operating temperature < 500°F. Therefore, SCC is not a concern for nickel based alloys in treated water for the Unit 1 Lay-up Systems.

5.5. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The portion of the Unit 1 Lay-up Systems within the scope of BFN license renewal is not within the reactor vessel belt line region and is not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for nickel-based alloys for the period of extended operation for the Unit 1 Lay-up Systems.

5.6. Stress Relaxation (Aging Management Required: No)

Stress relaxation is a potential aging mechanism for bolting/fasteners. Mechanical closure bolting/fasteners are considered separately as a commodity group aging effect for external environments. The only internal mechanical closure bolting/fasteners with a potential aging mechanism are the bolting/fasteners included with the reactor vessel internals. Stress relaxation is not a concern for the Unit 1 Lay-up Systems while in a laid up state.

5.7. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate at the bottom of tanks or reservoirs. In treated water applications corrosion product particulates can accumulate in heat exchangers preventing its heat transfer intended function. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 Lay-up Systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not a concern for the Unit 1 Lay-up Systems.

6.0. CAST IRON & CAST IRON ALLOYS IN A TREATED WATER ENVIRONMENT

This section addresses Unit 1 Lay-up System components made of cast iron in a treated water environment.

6.1. General Corrosion (Aging Management Required: Yes)

General corrosion of cast iron and cast iron alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

General corrosion has been identified as a potential aging mechanism for the internal surfaces of various cast iron components of the Unit 1 Lay-up Systems. General corrosion can be mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen eliminates the effect of general corrosion as an internal aging mechanism.

6.2. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of cast iron and cast iron alloys is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for cast iron and cast iron alloys in the Unit 1 Lay-up Systems.

6.3. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of cast iron and cast iron alloys is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, cast iron and cast iron alloys are susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces of cast iron and cast iron alloys in the Unit 1 Lay-up Systems.

6.4. Galvanic Corrosion (Aging Management Required: Yes)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Cast iron and cast iron alloys that are in contact with stainless, CASS, or nickel-based alloys and are subjected to treated water may be susceptible to galvanic corrosion. Cast iron and carbon steel are grouped together in the galvanic series as similar metals. The potential for galvanic corrosion exists in several locations not specifically identified where cast iron components are in contact with a more cathodic material.

6.5. Flow Accelerated Corrosion (Aging Management Required: No)

High-energy piping systems are susceptible to the form of erosion/corrosion called flow accelerated corrosion (FAC). The evaluation of FAC is conservatively treated as a potential aging mechanism in the feed water, steam, and condensate systems of both PWRs and BWRs and for the HPCI and the RCIC systems in BWRs where the material chromium content is < 1% or the pH is < 9.5. FAC rates are greatest at temperatures of 212°F to 392°F and decreases rapidly above and below these temperatures. FAC is not an aging mechanism that must be managed for the period of extended operation in the wet U1 lay-up Systems.

6.6. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 Lay-up Systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

6.7. Selective Leaching (Aging Management Required: Yes)

Selective leaching of cast iron and cast iron alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1

Lay-up Systems.

The most common forms of leaching are graphitic corrosion with loss of the iron matrix from gray cast iron under harsh conditions (i.e., buried pipe). However, gray cast iron can also display the effects of selective leaching in relatively mild environments. Malleable (white) iron does not experience selective leaching. The exact composition of the cast iron components could not be determined. Therefore, selective leaching is a concern for these components.

6.8. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 Lay-up Systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for cast iron for the period of extended operation for the Unit 1 Lay-up Systems.

6.9. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no cast iron heat exchangers within the scope of BFN license renewal within the Unit 1 Lay-up Systems. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where cast iron is used in the Unit 1 Lay-up Systems.

7.0. GLASS IN A TREATED WATER ENVIRONMENT

This section addresses glass in a treated water environment.

7.1. Corrosion (Aging Management Required: No)

Glass fittings in a treated water environment are used the Unit 1 Lay-up Systems. There are no aging mechanisms that must be managed for the period of extended operation for glass in a treated water environment.

8.0. CARBON AND LOW ALLOY STEEL IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 Lay-up System components made of carbon and low alloy steel in an inside air environment.

8.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Carbon steel is considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for carbon and low alloy steels in an inside air environment where the temperature is greater than 212°F.

8.2. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

9.0. STAINLESS STEEL IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 Lay-up System components made of stainless steel in an inside air environment.

9.1. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

10.0. NON-FERROUS METALS IN AN INSIDE AIR ENVIRONMENT

10.0. A. Copper and copper alloys

This section addresses Unit 1 Lay-up System components made of copper alloys in an inside air environment.

10.1. A. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

10.0. B. Aluminum and aluminum alloys

This section addresses Unit 1 Lay-up System components made of aluminum and aluminum alloys in an inside environment.

10.1. B. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

11.0. CAST IRON & CAST IRON ALLOYS IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 Lay-up System components made of cast iron in an inside air environment.

11.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Cast iron and cast iron alloys are considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for cast iron and cast iron alloys in an inside air environment where the temperature is greater than 212°F.

11.2. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interface supports, crane rails, and door hatch/hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

12.0. GLASS IN AN INSIDE AIR ENVIRONMENT (Aging Management Required: No)

Glass is used in the sight glasses as fittings within the Unit 1 Lay-up Systems. There are no aging mechanisms that must be managed for the period of extended operation for glass in a lubricating oil environment.

13.0. NICKEL-BASED ALLOYS IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 Lay-up System components made of nickel-based alloys in an inside air environment.

13.1. Mechanical wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, and the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external stainless steel surfaces of mechanical systems.

14.0. CARBON AND LOW ALLOY STEEL BOLTING IN AN INSIDE AIR ENVIRONMENT

This section addresses carbon steel bolting in an inside air environment.

14.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel bolting in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Loss of material degradation due to general corrosion of carbon and low alloy steel bolted joints and cast iron and iron alloy bolted joints are generally attributed to joint leakage or exposure to high-moisture ambient environments. General corrosion is not a concern for carbon and low alloy steels in an inside air environment where the temperature is greater than 212°F.

14.2. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves. Wear is not a concern for the reactor water recirculation pump and valve bolting while in a laid up state.

14.3. Fatigue (Aging Management Required: No)

The evaluation of cracking due to metal fatigue is a time-limited aging analysis and is addressed during the time-limited aging analysis identification and evaluation. Since fatigue is evaluated separately as a TLAA, fatigue will only be addressed in those AMRs where the GALL specifically includes fatigue as an aging effect requiring management. The GALL identifies fatigue as an aging effect for the reactor water recirculation pump bolting. However, fatigue is not a concern for the reactor water recirculation pump bolting while in a laid up state.

14.4. Stress Relaxation (Aging Management Required: No)

Stress relaxation is a potential aging mechanism for bolting/fasteners. Preload is the tension force developed in a bolted joint when it is tightened. This preload can decrease and may be attributed to stress relaxation. The only internal mechanical closure bolting/fasteners with this potential aging mechanism are the bolting/fasteners included with the reactor vessel internals and bolted joints on the reactor water recirculation pumps. However, stress relaxation is not a concern for these components while in a laid up state.

15.0. STAINLESS STEEL BOLTING IN AN INSIDE AIR ENVIRONMENT

This section addresses stainless steel bolting in an inside air environment

15.1. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves. Wear is not a concern for the reactor water recirculation pump and valve bolting while in a laid up state.

15.2. Fatigue (Aging Management Required: No)

The evaluation of cracking due to metal fatigue is a time-limited aging analysis and is addressed during the time-limited aging analysis identification and evaluation. Since fatigue is evaluated separately as a TLAA, fatigue will only be addressed in those AMRs where the GALL specifically includes fatigue as an aging effect requiring management. The GALL identifies fatigue as an aging effect for the reactor water recirculation pump bolting. However, fatigue is not a concern for the reactor water recirculation pump bolting while in a laid up state.

15.3. Stress Relaxation (Aging Management Required: No)

Stress relaxation is a potential aging mechanism for bolting/fasteners. Preload is the tension force developed in a bolted joint when it is tightened. This preload can decrease and may be attributed to stress relaxation. The only internal mechanical closure bolting/fasteners with this potential aging mechanism are the bolting/fasteners included with the reactor vessel internals and bolted joints on the reactor water recirculation pumps. However, stress relaxation is not a concern for these components while in a laid up state.

16.0. NICKEL-BASE ALLOY BOLTING IN AN INSIDE AIR ENVIRONMENT

This section addresses nickel-base alloy bolting in an inside air environment.

16.1. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves. Wear is not a concern for the U1 lay-up systems while in a laid up state.

17.0. STAINLESS STEEL BOLTING IN A SUBMERGED ENVIRONMENT

This section addresses stainless steel bolting submerged in a treated water environment for the Recirculation System (68).

17.1. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of bolting submerged in a treated water environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Periodic or continuously wetted surfaces are necessary for the onset of pitting corrosion. Bolting materials are considered susceptible to pitting corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water.

17.2. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of bolting submerged in a treated water environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Crevice corrosion occurs most frequently in joints and connections or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads. Periodic or continuously wetted surfaces cause loss of material degradation due to crevice corrosion. Alternate wetting and drying is particularly harmful as this leads to a concentration of atmospheric pollutants and contaminants. Bolting materials are considered susceptible to crevice corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water.

17.3. Microbiological Influenced Corrosion (MIC) (Aging Management Required: No)

MIC of bolting submerged in a treated water environment is not an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

MIC is a corrosive attack accelerated by microbiological activity. This corrosion mechanism typically occurs at temperatures between 50 and 120°F. For external surfaces, this aging mechanism is facilitated by stagnant fluid conditions, contact with untreated water, and contact with contaminated soils. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

17.4. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. Wear is not a concern for the reactor water recirculation bolting while in a laid up state.

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Revised to update the in-scope systems list

Mechanical System/Program Evaluation Detail

for

Unit 1 - Dry Lay-up - Not in Lay-up Program - REV: 1

Unit 1 Laid Up Systems (01, 02, 06, 76, and 84) (Air/gas)

1.0. General

U1 systems 01, 02, 06, 76, and 84 were not incorporated into the BFN lay-up program. The internal environment for the system components within the scope of BFN license renewal contained no moisture controls, and the environment is considered moist air.

2.0. NON-FERROUS METALS IN AN AIR/GAS ENVIRONMENT

2.0. A. Copper and copper alloys

This section addresses Unit 1 laid up system components made of copper alloys in an air/gas environment.

2.1. A. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. While copper zinc alloys are generally resistant to crevice corrosion, copper zinc alloys with greater than 15% zinc are susceptible. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Crevice corrosion is a concern in the Unit 1 laid up systems.

2.2. A. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion is an aggressive corrosion mechanism. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent in a moist environment. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. While copper zinc alloys are generally resistant to pitting corrosion, copper zinc alloys with greater than 15% zinc are susceptible. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Pitting corrosion is a concern in the Unit 1 laid up systems.

2.3. A. Galvanic Corrosion (Aging Management Required: Yes)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Copper alloys will preferentially corrode when coupled with more cathodic metals such as stainless steel, nickel-based alloys, titanium or graphite in an electrolytically conductive environment. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Galvanic corrosion is a concern in the Unit 1 laid up systems.

2.4. A. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 laid up systems as there is no potential of MIC contamination.

2.5. A. Selective Leaching (Aging Management Required: Yes)

Copper-zinc alloys containing greater than 15% zinc, in a moist air environment that is subjected to wetted environments, are susceptible to selective leaching, while copper alloys with a copper content in excess of 85% resist dezincification. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Selective leaching is a concern in the Unit 1 laid up systems.

2.6. A. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

Ammonia and ammonium compounds are the corrosive substances most often associated with SCC of copper alloys. Both oxygen and moisture are necessary for ammonia and other contaminates to be corrosive to copper alloys. Carbon dioxide, sea water, chloride solutions, hydrogen sulfide, and sodium hydroxide are also thought to contribute to the process. Brass alloys containing 64% to 65% copper are extremely susceptible to SCC, with resistance to cracking increasing progressively as the content of copper increases. Ammonia and ammonium compounds are not introduced to these laid up systems. Therefore, SCC is not a concern in the Unit 1 laid up systems.

2.7. A. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where copper and copper alloys are used in the Unit 1 laid up systems.

2.0. B. Aluminum and aluminum alloys

This section addresses Unit 1 laid up system components made of aluminum and aluminum alloys in an air/gas environment.

2.1. B. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Crevice corrosion is a concern in the Unit 1 laid up systems.

2.2. B. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. Pitting corrosion is a concern in the Unit 1 laid up systems.

2.3. B. Galvanic Corrosion (Aging Management Required: Yes)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Anodic metals like aluminum will preferentially corrode when coupled with most metals (such as copper, stainless and carbon steels) in an electrolytically conductive environment. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Galvanic corrosion is a concern in the Unit 1 laid up systems.

2.4. B. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 laid up systems as there is no potential of MIC contamination.

2.5. B. Selective Leaching (Aging Management Required: No)

Selective leaching is the removal of one element from a solid alloy by corrosion processes. Aluminum bronze with greater than 8% aluminum, in a moist air environment, are susceptible to selective leaching. Aluminum is not identified by the mechanical tools document as being susceptible to selective leaching.

2.6. B. Stress Corrosion Cracking (SCC) (Aging Management Required: Yes)

Pure aluminum is not susceptible to SCC; however, aluminum alloys containing more than 12% zinc or more that 6% magnesium are very susceptible to cracking under mild corrosive environments. Aluminum alloys are susceptible to SCC in air and water vapor. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. SCC is a concern in the Unit 1 laid up systems.

2.7. B. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where aluminum and aluminum alloys are used in the Unit 1 laid up systems.

3.0. CARBON AND LOW ALLOY STEEL IN AN AIR/GAS ENVIRONMENT

This section addresses Unit 1 laid up system components made of carbon and low alloy steels in an air/gas environment.

3.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in air/gas is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

General corrosion occurs in carbon and low alloy steel when both oxygen and moisture are present to allow for an electrolytic reaction.

3.2. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO_2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Crevice corrosion is a concern in the Unit 1 laid up systems.

3.3. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. All nuclear plant materials are subject to pitting when associated with halide ions, chlorides, bromides, and hypochlorites. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Pitting corrosion is a concern in the Unit 1 laid up systems.

3.4. Galvanic Corrosion (Aging Management Required: Yes)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Carbon and low-alloy steels that are in contact with more cathodic materials such as copper alloys, stainless, CASS, or nickel-based alloys and are subjected to a moist air environment may be susceptible to galvanic corrosion. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Galvanic corrosion is a concern in the Unit 1 laid up systems.

3.5. Microbiological Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 laid up systems as there is no potential of MIC contamination.

3.6. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal within the Unit 1 laid up systems. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where is used in the Unit 1 laid up systems.

4.0. STAINLESS STEEL IN AN AIR/GAS ENVIRONMENT

This section addresses Unit 1 laid up system components made of stainless steel in an air/gas environment.

4.1. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. Crevice corrosion is a concern in the Unit 1 laid up systems.

4.2. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Pitting corrosion is a concern in the Unit 1 laid up systems.

4.3. Microbiological Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 laid up systems as there is no potential of MIC contamination.

4.4. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

For stainless steels in air gas environments, moisture containing contaminants can concentrate resulting in an environment conducive to SCC when the temperature is greater than 140°F. The air/gas environment for the Unit 1 laid up systems does not contain a temperature greater than 140°F. Therefore, SCC is not a concern in the Unit 1 laid up systems.

4.5. Thermal Aging (Aging Management Required: No)

Wrought austenitic stainless steel is not susceptible to thermal embrittlement when exposed to normal nuclear plant operating environments. However, cast austenitic stainless steel (CASS) materials are susceptible to thermal embrittlement depending upon material composition and time at high temperatures. CASS materials subjected to temperatures > 482°F are susceptible to thermal aging. The temperature of these components does not exceed 482°F during lay-up. Therefore, thermal aging is not a concern for the period of extended operation for the applications where stainless steel is used in the Unit 1 laid up systems.

4.6. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal within the Unit 1 laid up systems. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where is used in the Unit 1 laid up systems.

5.0. CAST IRON CAST IRON ALLOYS IN AN AIR/GAS ENVIRONMENT

This section addresses Unit 1 laid up system components made of cast iron and cast iron alloys in an air/gas environment.

5.1. General Corrosion (Aging Management Required: Yes)

General corrosion of cast iron in air/gas is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

General corrosion occurs in cast iron when both oxygen and moisture are present to allow for an electrolytic reaction.

5.2. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfates or halides. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO2, hydrogen, and fluorocarbon environments, crevice corrosion is not a concern. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Crevice corrosion is a concern in the Unit 1 laid up systems.

5.3. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. In dry air, nitrogen, CO2, hydrogen, and fluorocarbon environments, pitting corrosion is not a concern. Pitting corrosion is a concern in the Unit 1 laid up systems.

5.4. Galvanic Corrosion (Aging Management Required: Yes)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Cast iron that is in contact with more cathodic materials such as copper alloys, stainless, CASS, or nickel-based alloys and are subjected to a moist air environment may be susceptible to galvanic corrosion. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Galvanic corrosion is a concern for cast iron in the Unit 1 laid up systems.

5.5. Microbiological Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is a corrosive attack accelerated by the influence of microbiological activity and usually occurs at temperatures between 50°F and 120°F. MIC is facilitated by stagnant conditions, fouling, internal crevices, contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the Unit 1 laid up systems as there is no potential of MIC contamination.

5.6. Selective Leaching (Aging Management Required: Yes)

The most common forms of leaching are graphitic corrosion with loss of the iron matrix from gray cast iron under harsh conditions (i.e., buried pipe). However, gray cast iron can also display the effects of selective leaching in relatively mild wetted environments. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Selective leaching is a concern in the Unit 1 laid up systems.

5.7. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. There are no heat exchangers within the scope of BFN license renewal within the Unit 1 laid up systems. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where is used in the Unit 1 laid up systems.

6.0. NICKEL-BASED ALLOYS IN AN AIR/GAS ENVIRONMENT

This section addresses Unit 1 laid up system components made of nickel-based alloys in an air/gas environment.

6.1. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion is strongly dependent on the presence of dissolved oxygen and aggressive environments such as the presence of sulfur, chlorine, or iodine. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. Oxygen content in the fluid is required to initiate crevice corrosion The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Crevice corrosion is a concern in the U1 lay-up systems.

6.2. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion is an aggressive corrosion mechanism that occurs most commonly with passive materials such as austenitic stainless steels other than with non-passive materials. Most pitting is associated with halide ions, with chlorides, bromides, and hypochlorites being prevalent. The contaminant level of these aggressive species in the gas sources used in nuclear plants is generally assumed not to be adequate to produce concentration levels that will promote corrosive effects, unless subjected to cyclic wet/dry conditions. Condensation on exposed surfaces can be considered a cyclic phenomenon if it can occur on the internal surfaces of the material. The air/gas environment for the Unit 1 laid up systems contains a non-monitored air environment. Therefore, pooling is a concern. Pitting corrosion is a concern in the U1 lay-up systems.

6.3. Microbiologically Influenced Corrosion (Aging Management Required: No)

MIC is facilitated by stagnant conditions, fouling, internal crevice contact with untreated water from a natural source, and contact with contaminated soils. Air and gas systems are only affected by MIC where stagnant conditions and the pooling of an untreated aqueous solution provide an environment suitable for propagation of the mechanism. The internal environment for these components does not contain moist air in sufficient quantity from an untreated water source or a contaminated oil source to cause MIC. Therefore, MIC is not a concern for the U1 lay-up systems.

6.4. Stress Corrosion Cracking (Aging Management Required: No)

Stress corrosion cracking (SCC) occurs through the combination of high stress (both applied and residual tensile stresses), a corrosive environment, and a susceptible material. The tensile stresses necessary to induce SCC may be either applied (external) or residual (internal), but must be at or near the materials yield point. For nickel-base alloys in moist air environments, a concern arises when moisture containing contaminant concentrate, resulting in an environment conductive to SSC when the temperature is greater than 500°F. The portion of the U1 lay-up systems that are within the scope of BFN license renewal containing nickel based alloys have a normal operating temperature < 500°F while laid up. Therefore, SCC is not a concern for nickel based alloys in an air/gas environment for the U1 lay-up systems.

6.5. Particulate Fouling (Aging Management Required: No)

Particulate Fouling is an aging effect for mechanical components that can cause loss of the heat transfer intended function. Fouling of the air side can occur from the accumulation and build up of dust, dirt, and debris on and between the fins of open coil/fin type coolers. The potential for particulate fouling due to precipitation or corrosion products is evaluated for heat exchangers. However, there are no nickel based alloy heat exchangers within the scope of BFN license renewal for the U1 lay-up systems. Therefore, particulate fouling is not a concern in the U1 lay-up systems.

7.0. POLYMER IN AN AIR/GAS ENVIRONMENT

This section addresses polymers in an air/gas environment.

7.1. Polymer (Aging Management Required: No)

DELRIN is used in the U1 lay-up systems. Acetal (the generic name for a family of products that includes DELRIN and plastics) provides high strength and stiffness along with increased dimensional stability and ease of machining. A review of available industry information did not identify any aging effects for DELRIN that would be applicable to the air/gas environments experienced in the U1 lay-up systems.

8.0. CARBON AND LOW ALLOY STEEL IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 laid up system components made of carbon and low alloy steel in an inside air environment.

8.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Carbon steel is considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for carbon and low alloy steels in an inside air environment where the temperature is greater than 212°F.

8.2. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

9.0. STAINLESS STEEL IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 laid up system components made of stainless steel in an inside air environment.

9.1. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

10.0 NICKEL-BASED ALLOYS IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 laid up system components made of nickel-based alloys in an inside air environment.

10.1 Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interface supports, crane rails, and door hatch/hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

11.0. NON-FERROUS METALS IN A INSIDE AIR ENVIRONMENT

11.0. A. Aluminum and aluminum alloys

This section addresses Unit 1 laid up system components made of aluminum and aluminum alloys in an inside air environment.

11.1. A. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

11.0. B. Copper and copper alloys

This section addresses Unit 1 laid up system components made of copper and copper alloys in an inside air environment.

11.1. B. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

12.0. CAST IRON AND CAST IRON ALLOYS IN AN INSIDE AIR ENVIRONMENT

This section addresses cast iron and cast iron alloys Unit 1 laid up systems components in an inside air environment.

12.1. General Corrosion (Aging Management Required: Yes)

General corrosion of cast iron in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Cast iron is considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for cast iron in an inside air environment where the temperature is greater than 212°F.

13.0. POLYMER IN AN INSIDE AIR ENVIRONMENT

This section addresses polymers in an inside air environment.

13.1. Polymer (Aging Management Required: No)

DELRIN is used in the U1 lay-up systems. Acetal (the generic name for a family of products that includes DELRIN and plastics) provides high strength and stiffness along with increased dimensional stability and ease of machining. A review of available industry information did not identify any aging effects for DELRIN that would be applicable to the inside air environments experienced by the U1 lay-up systems.

14.0. CARBON AND LOW ALLOY STEEL IN AN OUTSIDE AIR ENVIRONMENT

This section addresses carbon and low alloy steel Unit 1 laid up systems components in an outside air environment.

14.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in an outside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Carbon steel is considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for carbon and low alloy steels in an inside air environment where the temperature is greater than 212°F.

14.2. Pitting Corrosion (Aging Management Required: No)

Periodic or continuously wetted surfaces are necessary for the onset of pitting corrosion. Carbon and low alloy steel is considered susceptible to pitting corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, pitting corrosion is not a concern in an outside air environment.

14.3. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads. Periodic or continuously wetted surfaces cause loss of material degradation due to crevice corrosion. Alternate wetting and drying is particularly harmful as this leads to a concentration of atmospheric pollutants and contaminants. Carbon and low alloy steel is considered susceptible to crevice corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, crevice corrosion is not a concern in an outside air environment.

14.4. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

15.0. STAINLESS STEEL IN AN OUTSIDE AIR ENVIRONMENT

This section addresses stainless steel Unit 1 laid up systems components in an outside air environment.

15.1. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

16.0. NON-FERROUS METALS IN AN OUTSIDE AIR ENVIRONMENT

16.0. A. Aluminum and aluminum alloys

This section addresses aluminum and aluminum alloy Unit 1 laid up systems components in an outside air environment.

16.1. A. Pitting Corrosion (Aging Management Required: No)

Periodic or continuously wetted surfaces are necessary for the onset of pitting corrosion. Aluminum and aluminum alloys are considered susceptible to pitting corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, pitting corrosion is not a concern in an outside air environment.

16.2. A. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads. Periodic or continuously wetted surfaces cause loss of material degradation due to crevice corrosion. Alternate wetting and drying is particularly harmful as this leads to a concentration of atmospheric pollutants and contaminants. Aluminum and aluminum alloys are considered susceptible to crevice corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, crevice corrosion is not a concern in an outside air environment.

16.3. A. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

16.4. A. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

Stress corrosion cracking (SCC) is a type of corrosive attack that occurs through the combined actions of stress, a corrosive environment, and a susceptible material. One method of preventing SCC is through the use of low yield strength materials. Copper alloys are low yield strength metals, therefore SCC is not considered plausible. Aluminum is also a low yield strength material; however aluminum alloys containing appreciable amounts of copper, magnesium, silicon, and zinc may be susceptible to SCC. Outside air is not considered a corrosive environment. Therefore, SCC is not a concern in an outside air environment.

16.0. B. Copper Alloys

This section addresses copper alloy in an outside air environment.

16.1. B. Pitting Corrosion (Aging Management Required: No)

Periodic or continuously wetted surfaces are necessary for the onset of pitting corrosion. Copper alloys considered susceptible to pitting corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, pitting corrosion is not a concern in an outside air environment.

16.2. B. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads. Periodic or continuously wetted surfaces cause loss of material degradation due to crevice corrosion. Alternate wetting and drying is particularly harmful as this leads to a concentration of atmospheric pollutants and contaminants. Copper alloys are considered susceptible to crevice corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, crevice corrosion is not a concern in an outside air environment.

16.3. B. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

17.0. CAST IRON AND CAST IRON ALLOYS IN AN OUTSIDE AIR ENVIRONMENT

This section refers to cast iron Unit 1 Lay-up System components in an outside air environment.

17.1. General Corrosion (Aging Management Required: Yes)

General corrosion of cast iron steel in an outside air environment is an aging mechanism that must be managed for the period of extended operation for the U1 lay-up systems.

Cast iron is considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for cast iron in an outside air environment where the temperature is greater than 212°F.

17.2. Pitting Corrosion (Aging Management Required: No)

Periodic or continuously wetted surfaces are necessary for the onset of pitting corrosion. Cast iron is considered susceptible to pitting corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, pitting corrosion is not a concern in an outside air environment.

17.3. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads. Periodic or continuously wetted surfaces cause loss of material degradation due to crevice corrosion. Alternate wetting and drying is particularly harmful as this leads to a concentration of atmospheric pollutants and contaminants. Cast iron is considered susceptible to crevice corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, crevice corrosion is not a concern in an outside air environment.

18.0. STAINLESS STEEL IN A BURIED ENVIRONMENT

This section addresses stainless steel Unit 1 laid up systems components in a buried environment.

18.2. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of stainless steel is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

With stagnant or low flow conditions, impurities such as halides remain in the pit and dissolution of the metal continues. Pitting corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads where contaminants can concentrate. Components that are buried in wet soils may exhibit damage due to pitting corrosion.

18.3. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of stainless steel is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments. It occurs most frequently in joints and connections, or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion of stainless steel material in a buried or groundwater environment could result in loss of material.

18.4. Microbiological Influenced Corrosion (MIC) (Aging Management Required: Yes)

MIC of stainless steel in raw water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

MIC is facilitated by stagnant conditions, biofouling, internal crevices, and contact with untreated water from a natural source. MIC is a concern for stainless steels buried or subject to wetting or aggressive environments and fluid environments.

18.5 Stress Corrosion Cracking (SCC) (Aging Management Required: No)

Stress corrosion cracking (SCC) is a type of corrosive attack that occurs through the combined actions of stress (both applied and residual tensile stresses), a corrosive environment, and a susceptible material. SCC is either inter-granular stress corrosion cracking (IGSCC) or trans-granular stress corrosion cracking (TGSCC), depending upon the crack path. Per the "External Surfaces Tool" document (Appendix E), stainless steels exposed to buried or alternatively wetted and dried environments (other than normal environments), are susceptible to cracking since these locations typically contain sufficient aggressive contaminants to provide an environment conducive to SSC. Therefore, stress corrosion cracking of stainless steel material in a buried or groundwater environment with a temperature greater than 140°F will result in cracking that requires aging management for the period of extended operation. The Unit 1 Lay-up systems had a normal temperature less than 140°F in a laid up state.

19.0. CARBON AND LOW ALLOY STEEL BOLTING IN AN INSIDE AIR ENVIRONMENT

This section addresses carbon steel bolting in an inside air environment.

19.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel bolting in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Loss of material degradation due to general corrosion of carbon and low alloy steel bolted joints and cast iron and iron alloy bolted joints are generally attributed to joint leakage or exposure to high-moisture ambient environments. General corrosion is not a concern for carbon and low alloy steels in an inside air environment where the temperature is greater than 212°F.

19.2. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves. Wear is not a concern for the Unit 1 laid up system while in a laid up state.

20.0. STAINLESS STEEL BOLTING IN AN INSIDE AIR ENVIRONMENT

This section addresses stainless steel bolting in a inside air environment

20.1. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves. Wear is not a concern for the Unit 1 laid up system while in a laid up state.

21.0. CARBON AND LOW ALLOY STEEL BOLTING IN AN OUTSIDE AIR ENVIRONMENT

This section addresses carbon steel bolting in an outside air environment.

21.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel bolting in an outside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Loss of material degradation due to general corrosion of carbon and low alloy steel bolted joints are generally attributed to joint leakage or exposure to high-moisture ambient environments. The exposure to atmosphere/weather environment, submerged, and buried could result in loss of material and requires aging management for the period of extended operation.

21.2. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. Wear is not a concern for the Unit 1 laid up system while in a laid up state.

22.0. STAINLESS STEEL BOLTING IN AN OUTSIDE AIR ENVIRONMENT

This section addresses stainless steel bolting in an outside air environment

22.1. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. Wear is not a concern for the Unit 1 laid up system while in a laid up state.

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Jones, Marcus 2/12/2004 2:26:04 PM

Revised to update aging effects

Mechanical System/Program Evaluation Detail

for

Unit 1 - Wet Lay-up - Not in Lay-up Program - REV: 1

Unit 1 Laid Up Systems (27, 37, 64, 71, 73, and 75) (Wet)

1.0. General

U1 systems 27, 37, 64, 71, 73, and 75 were not incorporated into the BFN lay-up program. Based on location, valve leakage, etc., the components within the scope of BFN license renewal for System 27 saw raw stagnant water for extended periods of time and the components within the scope of BFN license renewal for system 37 saw treated (condensate) water for extended periods of time. Systems 64, 71, 73, and 75 (torus and torus attached piping) saw treated (torus) water for extended periods of time.

2.0. NON-FERROUS METALS IN A TREATED WATER ENVIRONMENT

2.0. A. Aluminum and aluminum alloys

This section addresses Unit 1 Lay-up System components made of aluminum and aluminum alloys in a treated water environment.

2.1. A. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of aluminum and aluminum alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for aluminum and aluminum alloys in the Unit 1 Lay-up Systems.

2.2. A. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of aluminum and aluminum alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, aluminum and aluminum alloys are susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces or aluminum and aluminum alloys in the Unit 1 Lay-up Systems.

2.3. A. Galvanic Corrosion (Aging Management Required: Yes)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Anodic metals like aluminum will preferentially corrode when coupled with most metals (such as copper, stainless, and carbon steels) in an electrolytically conductive environment. The potential for galvanic corrosion exists in locations not particularly identified where aluminum and aluminum alloys are in contact with a more cathodic material.

2.4. A. Flow Accelerated Corrosion (FAC) (Aging Management Required: No)

High-energy piping systems are susceptible to the form of erosion/corrosion called flow accelerated corrosion (FAC). The evaluation of FAC is conservatively treated as a potential aging mechanism in the feed water, steam, and condensate systems of both PWRs and BWRs and for the HPCI and the RCIC systems in BWRs where the material chromium content is < 1% or the pH is < 9.5. FAC rates are greatest at temperatures of 212°F to 392°F and decreases rapidly above and below these temperatures. FAC is not an aging mechanism that must be managed for the period of extended operation in the wet U1 lay-up Systems.

2.5. A. Microbiologically influenced corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 Lay-up Systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

2.6. A. Selective Leaching (Aging Management Required: No)

Copper-zinc alloys containing greater than 15% zinc and aluminum bronze with greater than 8% aluminum, in a moist air environment that is susceptible to wetted environments, are susceptible to selective leaching, while copper alloys with a copper content in excess of 85% resist dezincification. Aluminum is not identified by the mechanical tools document as being susceptible to selective leaching.

2.7. A. Stress Corrosion Cracking (SCC) (Aging Management Required: Yes)

SCC of aluminum and aluminum alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, aluminum alloys are susceptible to SCC in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for SCC of the internal surfaces.

2.8. A. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 Lay-up Systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for aluminum for the period of extended operation for the Unit 1 Lay-up Systems.

2.9. A. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 Lay-up Systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where aluminum and aluminum alloys are used in the Unit 1 Lay-up Systems.

2.0. B. Copper and Copper Alloys

This section addresses Unit 1 Lay-up System components made of copper alloys in a treated water environment.

2.1. B. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of copper alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for copper alloys in the Unit 1 Lay-up Systems.

2.2. B. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of copper alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

For treated water environments, copper alloys are susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces or copper alloys in the Unit 1 Lay-up Systems.

2.3. B. Galvanic Corrosion (Aging Management Required: Yes)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Copper and copper alloys are in the middle of the galvanic series with steel, alloy steel and cast iron being more anodic (or active) and the stainless steels, nickel alloys, and titanium being more cathodic (or passive). When copper alloys are galvanically coupled to the more cathodic materials such as stainless steel, titanium or graphite, the copper alloys may demonstrate an increased susceptibility to corrosion. The potential for galvanic corrosion exists in locations not particularly identified where copper and copper alloys are in contact with a more cathodic material.

2.4. B. Flow Accelerated Corrosion (FAC) (Aging Management Required: No)

High-energy piping systems are susceptible to the form of erosion/corrosion called flow accelerated corrosion (FAC). The evaluation of FAC is conservatively treated as a potential aging mechanism in the feed water, steam, and condensate systems of both

PWRs and BWRs and for the HPCI and the RCIC systems in BWRs where the material chromium content is < 1% or the pH is < 9.5. FAC rates are greatest at temperatures of 212°F to 392°F and decreases rapidly above and below these temperatures. FAC is not an aging mechanism that must be managed for the period of extended operation in the wet U1 lay-up Systems.

2.5. B. Microbiologically influenced corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 Lay-up Systems contains treat water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

2.6. B. Selective Leaching (Aging Management Required: Yes)

Selective leaching of copper alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 Lay-up Systems.

Copper-zinc alloys containing greater than 15% zinc, in a treated water environment is susceptible to selective leaching, while copper alloys with a copper content in excess of 85% resist dezincification.

2.7. B. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

Ammonia and ammonium compounds are the corrosive substances most often associated with SCC of copper alloys. Both oxygen and moisture are necessary for ammonia and other contaminates to be corrosive to copper alloys. Carbon dioxide, sea water, chloride solutions, hydrogen sulfide, and sodium hydroxide are also thought to contribute to the process. All copper alloys (both brasses and bronzes) containing in excess of 15% Zn in a contaminated environment is considered susceptible to SCC regardless of any added inhibiting elements such a Sn or As. Ammonia and ammonium compounds are not injected into the Unit 1 Lay-up Systems. Therefore, SCC is no a concern for copper alloys within the Unit 1 Lay-up Systems.

2.8. B. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 Lay-up Systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for copper alloys for the period of extended operation for the Unit 1 Lay-up Systems.

2.9. B. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 Lay-up Systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where copper alloys are used in the Unit 1 Lay-up Systems.

3.0. CARBON AND LOW ALLOY STEEL IN TREATED WATER

This section addresses Unit 1 laid up system components made of carbon and low alloy steel in a treated water environment.

3.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

General corrosion has been identified as a potential aging mechanism for the internal surfaces of various carbon steel components of the Unit 1 laid up systems. General corrosion can be mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen eliminates the effect of general corrosion as an internal aging mechanism.

3.2. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of carbon and low alloy steel is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for carbon and low alloy steels in the Unit 1 laid up systems.

3.3. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of carbon and low alloy steel is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

For treated water environments, carbon and low alloy steel is susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces of carbon and low alloy steels in the Unit 1 laid up systems.

3.4. Galvanic Corrosion (Aging Management Required: Yes)

Galvanic corrosion of carbon and low alloy steel is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Carbon steels and low-alloy steels that are in contact with stainless, CASS, or nickel-based alloys and are subjected to treated water may be susceptible to galvanic corrosion. The potential for galvanic corrosion exists in several locations not specifically identified where carbon steel components are in contact with a more cathodic material.

3.5. Flow Accelerated Corrosion (FAC) (Aging Management Required: No)

High-energy piping systems are susceptible to the form of erosion/corrosion called flow accelerated corrosion (FAC). The evaluation of FAC is conservatively treated as a potential aging mechanism in the feed water, steam, and condensate systems of both PWRs and BWRs and for the HPCI and the RCIC systems in BWRs where the material chromium content is < 1% or the pH is < 9.5. FAC rates are greatest at temperatures of 212°F to 392°F and decreases rapidly above and below these temperatures. FAC is not an aging mechanism that must be managed for the period of extended operation in the wet U1 lay-up systems.

3.6. Microbiological Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 laid up systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

3.7. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 laid up systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for carbon and low alloy steel for the period of extended operation for the Unit 1 laid up systems.

3.8. Stress Relaxation (Aging Management Required: No)

Stress relaxation is a potential aging mechanism for bolting/fasteners. Mechanical closure bolting/fasteners are considered separately as a commodity group aging effect for external environments. The only internal mechanical closure bolting/fasteners with a potential aging mechanism are the bolting/fasteners included with the reactor vessel internals. Stress relaxation is not a concern for the Unit 1 laid up systems while in a laid up state.

3.9. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where carbon and low alloy steel is used in the Unit 1 laid up systems.

4.0. STAINLESS STEEL IN A TREATED WATER ENVIRONMENT

This section addresses Unit 1 laid up system components made of stainless steel in a treated water environment.

4.1. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of stainless steel in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for stainless steel in the Unit 1 laid up systems.

4.2. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of stainless steel in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

For treated water environments, stainless steel is susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces of stainless steel in the Unit 1 laid up systems.

4.3. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 laid up systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

4.4. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

For treated water environments, stainless steel is susceptible to SCC in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb at temperatures > 140°F. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for SCC of the internal surfaces. The normal temperature of the Unit 1 laid up systems is < 140°F while in a laid up state. Therefore, SCC is not a concern.

4.5. Thermal Aging (Aging Management Required: No)

Wrought austenitic stainless steel is not susceptible to thermal embrittlement when exposed to normal nuclear plant operating environments. However, cast austenitic stainless steel (CASS) materials are susceptible to thermal embrittlement depending upon material composition and time at high temperatures. CASS materials subjected to temperatures > 482°F are susceptible to thermal aging. The normal temperature of the Unit 1 laid up systems is < 482°F while in a laid up state. Therefore, thermal aging is not a concern for the period of extended operation for the applications where stainless steel is used in the Unit 1 laid up systems.

4.6. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 laid up systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for stainless steel for the period of extended operation for the Unit 1 laid up systems.

4.7. Stress Relaxation (Aging Management Required: No)

Stress relaxation is a potential aging mechanism for bolting/fasteners. Mechanical closure bolting/fasteners are considered separately as a commodity group aging effect for external environments. The only internal mechanical closure bolting/fasteners with a potential aging mechanism are the bolting/fasteners included with the reactor vessel internals. Stress relaxation is not a concern for the Unit 1 laid up systems while in a laid up state.

4.8. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where stainless steel is used in the Unit 1 laid up systems.

5.0. NICKEL-BASED ALLOYS IN A TREATED WATER ENVIRONMENT

This section addresses Unit 1 laid up system components made of nickel-based alloys in a treated water environment.

5.1. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of nickel based alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for nickel based alloys in the Unit 1 laid up systems.

5.2. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of nickel based alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

For treated water environments, nickel based alloys are susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chlorides and sulfates to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces of nickel based alloys in the Unit 1 laid up systems.

5.3. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 laid up systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

5.4. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

For treated water environments, nickel based alloys are susceptible to SCC in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb at temperatures > 500°F. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for SCC of the internal surfaces. The portion of the Unit 1 laid up systems that's within the scope of BFN license renewal containing nickel based alloys have a normal operating temperature < 500°F. Therefore, SCC is not a concern for nickel based alloys in treated water for the Unit 1 laid up systems.

5.5. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The portion of the Unit 1 laid up systems within the scope of BFN license renewal is not within the reactor vessel belt line region and is not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for nickel-based alloys for the period of extended operation for the Unit 1 laid up systems.

5.6. Stress Relaxation (Aging Management Required: No)

Stress relaxation is a potential aging mechanism for bolting/fasteners. Mechanical closure bolting/fasteners are considered separately as a commodity group aging effect for external environments. Stress relaxation is not a concern for the Unit 1 laid up systems while in a laid up state.

5.7. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate at the bottom of tanks or reservoirs. In treated water applications corrosion product particulates can accumulate in heat exchangers preventing its heat transfer intended function. There are no heat exchangers within the scope of BFN license renewal for the Unit 1 laid up systems with a heat transfer intended function while in a laid up state. Therefore, particulate fouling is not a concern for the Unit 1 laid up systems.

6.0. CAST IRON & CAST IRON ALLOYS IN A TREATED WATER ENVIRONMENT

This section addresses Unit 1 laid up system components made of cast iron in a treated water environment.

6.1. General Corrosion (Aging Management Required: Yes)

General corrosion of cast iron and cast iron alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

General corrosion has been identified as a potential aging mechanism for the internal surfaces of various cast iron components of the Unit 1 laid up systems. General corrosion can be mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen eliminates the effect of general corrosion as an internal aging mechanism.

6.2. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of cast iron and cast iron alloys is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. Crevice corrosion is mitigated by maintaining adequate chemistry controls. Minimizing the dissolved oxygen to < 100 ppb eliminates the effect of crevice corrosion as an internal aging mechanism for cast iron and cast iron alloys in the Unit 1 laid up systems.

6.3. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of cast iron and cast iron alloys is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

For treated water environments, cast iron and cast iron alloys are susceptible to pitting corrosion in the presence of chlorides or sulfates > 150 ppb when dissolved in oxygen > 100 ppb with stagnant or low flow conditions. Pitting corrosion is mitigated by maintaining adequate chemistry controls. Limiting the chloride and sulfate to < 150 ppb, and the dissolved oxygen to < 100 ppb eliminates the potential for pitting corrosion of the internal surfaces of cast iron and cast iron alloys in the Unit 1 laid up systems.

6.4. Galvanic Corrosion (Aging Management Required: Yes)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Cast iron and cast iron alloys that are in contact with stainless, CASS, or nickel-based alloys and are subjected to treated water may be susceptible to galvanic corrosion. Cast iron and carbon steel are grouped together in the galvanic series as similar metals. The potential for galvanic corrosion exists in several locations not specifically identified where cast iron components are in contact with a more cathodic material.

6.5. Flow Accelerated Corrosion (Aging Management Required: No)

High-energy piping systems are susceptible to the form of erosion/corrosion called flow accelerated corrosion (FAC). The evaluation of FAC is conservatively treated as a potential aging mechanism in the feed water, steam, and condensate systems of both PWRs and BWRs and for the HPCI and the RCIC systems in BWRs where the material chromium content is < 1% or the pH is < 9.5. FAC rates are greatest at temperatures of 212°F to 392°F and decreases rapidly above and below these temperatures. FAC is not an aging mechanism that must be managed for the period of extended operation in the wet U1 lay-up systems.

6.6. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: No)

MIC is not likely in treated water systems where sulfates are less than 150 ppb, and at temperatures greater than 210°F or pH greater than 10. However, contamination of treated water systems can lead to MIC. The Unit 1 laid up systems contains treated water with little or no contamination. A review of BFN PERs and WOs identified no instances where MIC was a failure mechanism for any components in the scope of license renewal for this system. Therefore, MIC is not a concern.

6.7. Selective Leaching (Aging Management Required: Yes)

Selective leaching of cast iron and cast iron alloys in treated water is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

The most common forms of leaching are graphitic corrosion with loss of the iron matrix from gray cast iron under harsh conditions (i.e., buried pipe). However, gray cast iron can also display the effects of selective leaching in relatively mild environments. Malleable (white) iron does not experience selective leaching. The exact composition of the cast iron components could not be determined. Therefore, selective leaching is a concern for these components.

6.8. Neutron/Radiation Embrittlement (Aging Management Required: No)

Neutron embrittlement is considered a potential aging mechanism requiring management only inside the reactor vessel. The components within the scope of BFN license renewal for the Unit 1 laid up systems are not within the reactor vessel belt line region and are not subjected to the neutron fluence required to embrittle these materials. Therefore, neutron/radiation embrittlement is not a concern for cast iron for the period of extended operation for the Unit 1 laid up systems.

6.9. Particulate Fouling (Aging Management Required: No)

In treated water applications corrosion product particulates can accumulate in heat exchangers. Corrosion product buildup may prevent the performance of intended functions as a result of flow restriction. There are no cast iron heat exchangers within the scope of BFN license renewal within the Unit 1 laid up systems. Therefore, particulate fouling is not an aging mechanism that must be managed for the period of extended operation for the applications where cast iron is used in the Unit 1 laid up systems.

7.0. GLASS IN A TREATED WATER ENVIRONMENT

This section addresses glass in a treated water environment.

7.1. Corrosion (Aging Management Required: No)

Glass fittings in a treated water environment are used the Unit 1 laid up systems. There are no aging mechanisms that must be managed for the period of extended operation for glass in a treated water environment.

8.0. CARBON AND LOW ALLOY STEEL IN RAW WATER

This section address carbon and low alloy steel system 27 components in a raw water environment.

8.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in raw water is an aging mechanism that must be managed for the period of extended operation for the CCW System.

General corrosion is in many cases predictable and can be accounted for by a corrosion allowance. Trending of observed corrosion rates can be used to estimate the remaining life of the carbon steel components. Because of the uncertainty involved in determining whether corrosion rates are with in the bounds of corrosion allowances, general corrosion is an applicable aging mechanism for carbon steel where oxygen and moisture is present.

8.2. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of carbon and low alloy steel is an aging mechanism that must be managed for the period of extended operation for the CCW System.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level greater than 100 ppb. It occurs most frequently in joints and connections, or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads.

8.3. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of carbon and low alloy steel is an aging mechanism that must be managed for the period of extended operation for the CCW System.

With stagnant or low flow conditions, impurities such as halides remain in the pit and dissolution of the metal continues. Pitting corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads where contaminants can concentrate.

8.4. Galvanic Corrosion (Aging Management Required: No)

Carbon and low alloy steels that are in contact with copper alloys, stainless, CASS, or nickel-based alloys and are subjected to raw water may be susceptible to galvanic corrosion. The source of galvanic corrosion is the difference in potential between the carbon steel components and more cathodic components. The carbon steel components are not in contact with more cathodic materials within the raw water portions of the CCW system that is in scope for BFN license renewal. Therefore, galvanic corrosion is not a concern.

8.5. Microbiological Influenced Corrosion (MIC) (Aging Management Required: Yes)

MIC of carbon and low alloy steel in raw water is an aging mechanism that must be managed for the period of extended operation for the CCW System.

MIC is facilitated by stagnant conditions, biofouling, internal crevices, and contact with untreated water from a natural source. Laid up lines, stagnant portions of systems containing raw water, and untreated connected systems are susceptible to MIC.

8.6. Biofouling (Aging Management Required: Yes)

Macroorganisms can potentially create crevices which provide locations that are conducive to crevice corrosion. The analysis of this aging effect is address under the crevice corrosion evaluation.

8.7. Biological Fouling (Aging Management Required: No)

Operating experience has shown that cases of biological fouling occur well before the end of the initial license period of 40 years. However, macro-organisms found in raw water can interfere with the heat transfer characteristics of heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the CCW System. Therefore biofouling fouling is not a concern for the CCW System.

8.8. Particulate Fouling (Aging Management Required: No)

Operating experience has shown that cases of particulate fouling occur well before the end of the initial license period of 40 years. However, particulates found in raw water can interfere with the heat transfer characteristics of heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the CCW System. Therefore particulate fouling is not a concern for the CCW System.

9.0. CAST IRON & CAST IRON ALLOYS IN A RAW WATER ENVIRONMENT

This section addresses system 27 cast iron components in a raw water environment.

9.1. General Corrosion (Aging Management Required: Yes)

General corrosion of cast iron in raw water is an aging mechanism that must be managed for the period of extended operation for the CCW System.

General corrosion is in many cases predictable and can be accounted for by a corrosion allowance. Trending of observed corrosion rates can be used to estimate the remaining life of the cast iron components. Because of the uncertainty involved in determining whether corrosion rates are with in the bounds of corrosion allowances, general corrosion is an applicable aging mechanism for cast iron where oxygen and moisture is present.

9.2. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of cast iron and cast iron alloys is an aging mechanism that must be managed for the period of extended operation for the CCW System.

Crevice Corrosion occurs in wetted, stagnant or low flow environments with a dissolved oxygen level > 100 ppb. It occurs most frequently in joints and connections, or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads.

9.3. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of cast iron and cast iron alloys is an aging mechanism that must be managed for the period of extended operation for the CCW System.

With stagnant or low flow conditions, impurities such as halides remain in the pit and dissolution of the metal continues. Pitting corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads where contaminants can concentrate. Pitting corrosion can be inhibited by maintaining an adequate flow rate, thus preventing impurities from adhering to the material surface.

9.4. Galvanic Corrosion (Aging Management Required: No)

Loss of material due to galvanic corrosion occurs when materials with different electrochemical potentials are in contact in the presence of a corrosive environment. Cast iron and cast iron alloys in contact with more cathodic materials such as copper alloys, stainless, CASS, or nickel-based alloys that are subjected to raw water may be susceptible to galvanic corrosion. The cast iron components are not in contact with more cathodic materials within the raw water portions of the CCW system that is in scope for BFN license renewal. Therefore, galvanic corrosion is not a concern.

9.5. Microbiologically Influenced Corrosion (MIC) (Aging Management Required: Yes)

MIC of cast iron and cast iron alloys in raw water is an aging mechanism that must be managed for the period of extended operation for the CCW System.

MIC is facilitated by stagnant conditions, biofouling, internal crevices, and contact with untreated water from a natural source. Laid up lines, stagnant portions of systems containing raw water, and untreated connected systems are susceptible to MIC.

9.6. Biofouling (Aging Management Required: Yes)

Macroorganisms can potentially create crevices which provide locations that are conducive to crevice corrosion. The analysis of this aging effect is address under the crevice corrosion evaluation.

9.7. Selective Leaching (Aging Management Required: Yes)

Selective leaching of cast iron and cast iron alloys in raw water is an aging mechanism that must be managed for the period of extended operation for the CCW System.

The most common forms of leaching are graphitic corrosion with loss of the iron matrix from gray cast iron under harsh conditions (i.e., buried pipe). However, gray cast iron can also display the effects of selective leaching in relatively mild environments.

9.8. Biological Fouling (Aging Management Required: No)

Operating experience has shown that cases of biological fouling occur well before the end of the initial license period of 40 years. However, macro-organisms found in raw water can interfere with the heat transfer characteristics of heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the CCW System. Therefore biofouling fouling is not a concern for the CCW System.

9.9. Particulate Fouling (Aging Management Required: No)

Operating experience has shown that cases of particulate fouling occur well before the end of the initial license period of 40 years. However, particulates found in raw water can interfere with the heat transfer characteristics of heat exchangers. There are no heat exchangers within the scope of BFN license renewal for the CCW System. Therefore particulate fouling is not a concern for the CCW System.

10.0. CARBON AND LOW ALLOY STEEL IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 laid up system components made of carbon and low alloy steel in an inside air environment.

10.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Carbon steel is considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for carbon and low alloy steels in an inside air environment where the temperature is greater than

212°F.

10.2. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

11.0. STAINLESS STEEL IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 laid up system components made of stainless steel in an inside air environment.

11.1. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

12.0. NON-FERROUS METALS IN A INSIDE AIR ENVIRONMENT

12.0. A. Copper Alloys

This section addresses Unit 1 laid up system components made of copper and copper alloys in an inside air environment.

12.1. A. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

12.0. B. Zinc alloys

This section addresses Unit 1 laid up system components made of zinc alloys in an inside air environment.

12.1. B. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

12.0. C. Aluminum and aluminum alloys

This section addresses Unit 1 laid up system components made of aluminum and aluminum alloys in an inside air environment.

12.1. C. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

13.0. CAST IRON & CAST IRON ALLOYS IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 laid up system components made of cast iron in an inside air environment.

13.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the Unit 1 laid up systems.

Cast iron and cast iron alloys are considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for cast iron and cast iron alloys in an inside air environment where the temperature is greater than 212°F.

13. 2. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interface supports, crane rails, and door hatch/hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

14.0. GLASS IN AN INSIDE AIR ENVIRONMENT (Aging Management Required: No)

Glass is used in the sight glasses as fittings within the Unit 1 laid up systems. There are no aging mechanisms that must be managed for the period of extended operation for glass in a lubricating oil environment.

15.0. NICKEL-BASED ALLOYS IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 laid up system components made of nickel-based alloys in an inside air environment.

15.1. Mechanical wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, and the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external stainless steel surfaces of mechanical systems.

16.0. ELASTOMERS IN AN INSIDE AIR ENVIRONMENT

This section addresses Unit 1 laid up rubber, neoprene, RTV 106, and silicon sealant components in an inside air environment.

16.1. Ultraviolet Radiation (Aging Management Required: Yes)

Rubber is decomposed by exposure to ultraviolet radiation. Ultraviolet radiation sources at nuclear plants include solar radiation and ultraviolet or fluorescent lamps. The deterioration of rubber is greatly accelerated in the presents of oxygen. Cracking and checking, which may occur when rubber is exposed to air and sunlight, are due mainly to reaction with ozone. Ultraviolet degradation may be prevented by means of and opaque covering.

16.2. Thermal Exposure (Aging Management Required: No)

Thermal exposure of elastomers can result in decreased tensile strength and ultimate elongation, cracking, chain scission, or cross-linking. Cross-linking makes the elastomers brittle, increases the modulus of elasticity, and promotes surface cracking. Elastomers are tested for short-term and long-term temperature durability. Maximum temperature ratings for elastomers are provided as follows: Butyl Rubber at 150°F, Rubber at 130°F, Neoprene at 160°F, Nitrile Rubber at 175°F, and Silicone at 275°F. In general, if the ambient temperature is less than 95°F, then thermal aging may be considered non-significant for the period of extended operation. Material property changes and cracking owing to thermal stresses is an applicable aging effect for rubber, neoprene, and silicone elastomers in environments where the temperatures exceed the limits defined above. During the normal operation, the temperature of the elastomers within the Unit 1 laid up systems does not exceed 130°F. Therefore thermal aging may be considered non-significant for the period of extended operation.

16.3. Ionizing Radiation (Aging Management Required: No)

Ionizing radiation can profoundly alter the molecular structure and macroscopic properties of elastomers. The effects of radiation-induced degradation of elastomers may include embrittlement, cracking or crazing, swelling, discoloration and melting. Rubber, neoprene, and silicone elastomers ultimately become harder, stiffer and eventually brittle when exposed to radiation. The lowest reported dose thresholds for radiation degradation of elastomers common in nuclear power plants are as follows: Butyl Rubber at 10E6 rads, Rubber at 10E7 rads, Neoprene at 10E6 rads, Nitrile Rubber at 10E7 rads, and Silicone at 10E6 rads. Material property changes and cracking owing to radiation is an applicable aging effect for rubber, neoprene, and silicone elastomers in environments where the radiation exceeds the limits defined above. The radiation levels in duct work within the scope of BFN license renewal for the Unit 1 laid up systems are well below the limits addressed for the propagation of ionizing radiation.

17.0. POLYMER IN AN INSIDE AIR ENVIRONMENT

This section addresses tygon tubing in an inside air environment.

17.1. Corrosion (Aging Management Required: No)

This section addresses tygon tubing in an inside air environment. There are no aging mechanisms that must be managed for the period of extended operation for polymer in an inside air environment for the U1 laid up systems.

18.0. CARBON AND LOW ALLOY STEEL IN AN OUTSIDE AIR ENVIRONMENT

This section addresses carbon steel components in an outside air environment.

18.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in an outside air environment is an aging mechanism that must be managed for the period of extended operation for the CCW System.

Carbon steel is considered susceptible to general corrosion in periodically wetted and continuously moist environments. General corrosion is not a concern for carbon and low alloy steels in an outside air environment where the temperature is greater than 212°F.

18.2. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

19.0. ELASTOMERS IN AN OUTSIDE AIR ENVIRONMENT

This section addresses Unit 1 laid up systems rubber, neoprene, RTV 106, and silicon sealant components in an outside air environment.

19.1. Ultraviolet Radiation (Aging Management Required: Yes)

Rubber is decomposed by exposure to ultraviolet radiation. Ultraviolet radiation sources at nuclear plants include solar radiation and ultraviolet or fluorescent lamps. The deterioration of rubber is greatly accelerated in the presents of oxygen. Cracking and checking, which may occur when rubber is exposed to air and sunlight, are due mainly to reaction with ozone. Rubber may crack when exposed to sunlight and ozone.

19.2. Thermal Exposure (Aging Management Required: No)

Thermal exposure of elastomers can result in decreased tensile strength and ultimate elongation, cracking, chain scission, or cross-linking. Cross-linking makes the elastomers brittle, increases the modulus of elasticity, and promotes surface cracking. Elastomers are tested for short-term and long-term temperature durability. Maximum temperature ratings for elastomers are provided as follows: Butyl Rubber at 150°F, Rubber at 130°F, Neoprene at 160°F, Nitrile Rubber at 175°F, and Silicone at 275°F. In general, if the ambient temperature is less than 95°F, then thermal aging may be considered non-significant for the period of extended operation. Material property changes and cracking owing to thermal stresses is an applicable aging effect for rubber, neoprene, and silicone elastomers in environments where the temperatures exceed the limits defined above. During the normal operation, the temperature of the elastomers within the Unit 1 laid up systems does not exceed 130°F. Therefore thermal aging may be considered non-significant for the period of extended operation.

19.3. Ionizing Radiation (Aging Management Required: No)

Ionizing radiation can profoundly alter the molecular structure and macroscopic properties of elastomers. The effects of radiation-induced degradation of elastomers may include embrittlement, cracking or crazing, swelling, discoloration and melting. Rubber, neoprene, and silicone elastomers ultimately become harder, stiffer and eventually brittle when exposed to radiation. The lowest reported dose thresholds for radiation degradation of elastomers common in nuclear power plants are as follows: Butyl Rubber at 10E6 rads, Rubber at 10E7 rads, Neoprene at 10E6 rads, Nitrile Rubber at 10E7 rads, and Silicone at 10E6 rads. Material property changes and cracking owing to radiation is an applicable aging effect for rubber, neoprene, and silicone elastomers in environments where the radiation exceeds the limits defined above. The radiation levels in duct work within the scope of BFN license renewal for the Unit 1 laid up systems are well below the limits addressed for the propagation of ionizing radiation.

20.0. NON-FERROUS METALS IN AN OUTSIDE AIR ENVIRONMENT

This section addresses aluminum and aluminum alloy Unit 1 laid up systems components in an outside air environment.

20.1. Pitting Corrosion (Aging Management Required: No)

Periodic or continuously wetted surfaces are necessary for the onset of pitting corrosion. Aluminum and aluminum alloys are considered susceptible to pitting corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, pitting corrosion is not a concern in an outside air environment.

20.2. Crevice Corrosion (Aging Management Required: No)

Crevice corrosion occurs most frequently in joints and connections or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads. Periodic or continuously wetted surfaces cause loss of material degradation due to crevice corrosion. Alternate wetting and drying is particularly harmful as this leads to a concentration of atmospheric pollutants and contaminants. Aluminum and aluminum alloys are considered susceptible to crevice corrosion when exposed an aggressive atmosphere/weather environment, exposure to fluid environments, and exposure to soil/ground water. Outside air is not considered an aggressive environment. Therefore, crevice corrosion is not a concern in an outside air environment.

20.3. Mechanical Wear (Aging Management Required: No)

Wear may occur by equipment movement on access surfaces and crane rails, the relative movement at the interfaces supports, crane rails, and door/hatch hinges. This aging mechanism is not applicable to external surfaces of mechanical systems.

20.4. Stress Corrosion Cracking (SCC) (Aging Management Required: No)

Stress corrosion cracking (SCC) is a type of corrosive attack that occurs through the combined actions of stress, a corrosive environment, and a susceptible material. One method of preventing SCC is through the use of low yield strength materials. Copper alloys are low yield strength metals, therefore SCC is not considered plausible. Aluminum is also a low yield strength material; however aluminum alloys containing appreciable amounts of copper, magnesium, silicon, and zinc may be susceptible to SCC. Outside air is not considered a corrosive environment. Therefore, SCC is not a concern in an outside air environment.

21.0. CARBON AND LOW ALLOY STEEL IN A BURIED ENVIRONMENT

This section addresses carbon steel components in a buried environment.

21.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel in a buried environment is an aging mechanism that must be managed for the period of extended operation for the CCW System.

For the purposes of this evaluation, buried components are assumed susceptible to corrosion because of the potential for oxygen levels, moisture content, biological organisms, and containments. Therefore, general corrosion of carbon and low alloy steel in a buried or groundwater environment could result in loss of material and requires ageing management for the period of extended operation.

21.2. Pitting Corrosion (Aging Management Required: Yes)

Pitting corrosion of carbon and low alloy steel in a buried environment is an aging mechanism that must be managed for the period of extended operation for the CCW System.

With stagnant or low flow conditions, impurities such as halides remain in the pit and dissolution of the metal continues. Pitting corrosion occurs most frequently in joints and connections, or points of contact between metals and nonmetals, such as gasket surfaces, lap joints, and under bolt heads where contaminants can concentrate. Components that are buried in wet soils may exhibit damage due to pitting corrosion.

21.3. Crevice Corrosion (Aging Management Required: Yes)

Crevice corrosion of carbon and low alloy steel in a buried environment is an aging mechanism that must be managed for the period of extended operation for the CCW System.

Crevice Corrosion occurs in wetted, stagnant or low flow environments. It occurs most frequently in joints and connections, or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads. Crevice corrosion of carbon and low alloy steel material in a buried or groundwater environment could result in loss of material.

21.4. Microbiological Influenced Corrosion (MIC) (Aging Management Required: Yes)

MIC of carbon and low alloy steel in a buried environment is an aging mechanism that must be managed for the period of extended operation for the CCW System.

MIC is facilitated by stagnant conditions, biofouling, internal crevices, and contact with untreated water from a natural source. MIC is a concern for carbon and low alloy steels buried or subject to wetting or aggressive environments and fluid environments.

22.0. CARBON AND LOW ALLOY STEEL IN AN EMBEDDED/ENCASED ENVIRONMENT

This section addresses carbon steel components in an embedded/encased environment.

22.1. Corrosion (Aging Management Required: No)

For the purposes of this evaluation, embedded or encased components are not assumed susceptible to corrosion unless the encased components are located in fluid environments, wetted conditions, or located in splash zones. The concrete enclosures prohibit exposure of the embedded components to an aggressive environment.

23.0. CARBON AND LOW ALLOY STEEL BOLTING IN AN INSIDE AIR ENVIRONMENT

This section addresses carbon steel bolting in an inside air environment.

23.1. General Corrosion (Aging Management Required: Yes)

General corrosion of carbon and low alloy steel bolting in an inside air environment is an aging mechanism that must be managed for the period of extended operation for the

Unit 1 laid up systems.

Loss of material degradation due to general corrosion of carbon and low alloy steel bolted joints and cast iron and iron alloy bolted joints are generally attributed to joint leakage or exposure to high-moisture ambient environments. General corrosion is not a concern for carbon and low alloy steels in an inside air environment where the temperature is greater than 212°F.

23.2. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves. Wear is not a concern for bolting while in a laid up state.

24.0. STAINLESS STEEL BOLTING IN AN INSIDE AIR ENVIRONMENT

This section addresses stainless steel bolting in an inside air environment

24.1. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves. Wear is not a concern for the reactor water recirculation pump and valve bolting while in a laid up state.

25.0. STAINLESS STEEL BOLTING IN AN OUTSIDE AIR ENVIRONMENT

This section addresses stainless steel bolting in an outside air environment.

25.1. Wear (Aging Management Required: No)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. Wear is not a concern for the U1 lay-up systems while in a laid up state.

26.0. NICKEL-BASE ALLOY BOLING IN AN INSIDE AIR ENVIRONMENT

This section addresses nickel-base alloy bolting in an inside air environment

26.1. Wear (Aging Management Required: Yes)

Bolting degradation due to wear could potentially occur at locations of repeated relative motion of mechanical component bolted joints. Wear of bolted joint components is generally not a concern, however for License Renewal purposes, wear is being assumed as a potential mechanism for ‘critical bolting applications’. ‘Critical bolting applications’ constitute reactor coolant pressure boundary (RCPB) components where closure bolting failure could result in loss of reactor coolant and jeopardize safe operation of the plant. These locations include bolted joints on the recirculation pumps and reactor coolant pressure boundary valves.

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Revised to update aging effects

Aging Management Comparison of the Evaluation of the Unit 1 Lay-up Systems and Operating Systems

TABLE 1: Systems Standby Liquid Control System (63), Off-Gas System (66), Reactor Core Isolation Cooling System (71), High Pressure Coolant Injection System (73), and Core Spray System (75)

The internal environment for the portions of systems 63, 66, 71, 73, and 75 within the boundary of the BFN Lay-up Program and within the scope of BFN license renewal is maintained at < 60% de-humidified air.

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
063	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Treated Water Borated (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion	No
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Stress	N/A	N/A	N/A

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
				Corrosion Cracking Program			
		Treated Water Borated (internal)	Loss of material due to crevice corrosion and pitting corrosion	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Aluminum Alloy	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to stress corrosion cracking	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Air/gas (internal)	N/A	N/A	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Polymer - Delrin	Treated Water (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	N/A	N/A	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
066	Carbon and Low Alloy Steel	Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion	No
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air	None	None	Inside Air	None	No

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
		(external)			(external)		
	Copper Alloy	Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
71	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to flow accelerated corrosion, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading and fatigue	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	N/A	N/A	N/A
		Treated Water (external)	Loss of material due to flow accelerated corrosion, general corrosion, crevice corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion	No
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB,	N/A	N/A	N/A

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
				IWC and IWD Inspection Program BWR Stress Corrosion Cracking Program			
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Aluminum Alloy	Treated Water (internal)	Loss of material due to crevice corrosion, galvanic corrosion, and pitting corrosion Crack initiation/growth due to stress corrosion cracking and cyclic loading	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Air/gas (internal)	N/A	N/A	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Copper Alloy	Treated Water (internal)	Loss of material due to selective leaching, flow accelerated corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Fouling product buildup due to particulates	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program Selective Leaching of Materials Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air	None	None	Inside Air	None	No

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
		(external)			(external)		
	Cast Iron and Cast Iron Alloy	Treated Water (internal)	Loss of material due to selective leaching, flow accelerated corrosion, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program Selective Leaching of Materials Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion	No
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Glass	Treated Water (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
073	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to flow accelerated corrosion, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading and fatigue	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	N/A	N/A	N/A

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
		Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion	No
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Stress Corrosion Cracking Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Nickel Alloy	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Air/gas	N/A	N/A	Air/gas	None	No

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
		(internal)			(internal)		
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Copper Alloy	Treated Water (internal)	Loss of material due to selective leaching, crevice corrosion, pitting corrosion, and galvanic corrosion Fouling product buildup due to particulates	Chemistry Control Program One-Time Inspection Program Selective Leaching of Materials Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program Selective Leaching of Materials Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion	No
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Elastomer	Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air (external)	Hardening and loss of strength due to elastomer degradation (ultraviolet radiation)	System Monitoring Program	Inside Air (external)	Hardening and loss of strength due to elastomer degradation	No

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
						(ultraviolet radiation)	
	Glass	Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
075	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading and fatigue	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	N/A	N/A	N/A
		Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion	No
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading Change in material properties/reduction in fracture toughness due to thermal aging	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	N/A	N/A	N/A

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
		Treated Water (external)	Loss of material due to crevice corrosion and pitting corrosion	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Air/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Aluminum Alloy	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to stress corrosion cracking	Chemistry Control Program One-Time Inspection Program	N/A	N/A	N/A
		Air/gas (internal)	N/A	N/A	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program Selective Leaching of Materials Program	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion	No
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Polymer	Ai/gas (internal)	None	None	Air/gas (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No

TABLE 2: Systems Reactor Vessel and Internals System (RVI), Feedwater System (03), Boiler Drains and Vents System (10), Recirculation System (68), Reactor Water Cleanup System (69), and Control Rod Drive System (85)

Portions of U1 system 03 are within the boundary of the BFN Lay-up program. However, the portions of U1system 03 within the scope of BFN license renewal sees the same water as the portions of U1 systems RVI, 10, 68, 69, and 85. BFN maintains the internal environment of these systems with flowing, air-saturated, demineralized water per the Chemistry Program (CI-13.1). Due to drainage and system isolation, portions of these systems saw a moist air environment for extended periods of time. However, the evaluation for treated water encompasses the aging effects for a moist air environment in these systems.

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
RVI	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, and pitting corrosion Crack initiation/growth due to cyclic loading and fatigue Change in material properties/reduction in fracture toughness due to neutron irradiation embrittle	Chemistry Control Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Vessel ID Attachment Welds Program Reactor Vessel Surveillance Program BWR Feedwater Nozzle Program BWR Control Rod Drive Return Line Nozzle Program BWR Penetrations Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to general corrosion, crevice corrosion, and pitting corrosion Crack initiation/growth due	Reactor Head Closure Studs Program One-Time Inspection Program	N/A	N/A	N/A

			to stress corrosion cracking and cyclic loading				
		Inside Air (external)	Loss of material due to general corrosion and mechanical wear Distortion/plastic deformation due to stress relaxation Crack initiation/growth due to fatigue	Reactor Head Closure Studs Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading	Chemistry Control Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Vessel ID Attachment Welds Program BWR Control Rod Drive Return Line Nozzle Program BWR Stress Corrosion Cracking Program BWR Penetrations Program	Treated Water (internal)	Loss of material due to crevice and pitting corrosion	No
		Air/gas (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to stress corrosion cracking	ASME Section XI Subsections IWB, IWC and IWD Inspection Program	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Nickel Alloy	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading	Chemistry Control Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Vessel ID	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	No

				Attachment Welds Program BWR Penetrations Program			
		Air/gas (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to stress corrosion cracking	ASME Section XI Subsections IWB, IWC and IWD Inspection Program	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
03	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to flow accelerated corrosion, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading and fatigue	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	No
		Air/gas (internal) – moist air	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading	One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	Loss of material due to general corrosion	Yes[1]
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	No
		Air/gas (internal) – moist air	Loss of material due to crevice corrosion and pitting corrosion	One-Time Inspection Program ASME Section XI	N/A	N/A	N/A

			Crack initiation/growth due to stress corrosion cracking and cyclic loading Change in material properties/reduction in fracture toughness due to thermal aging	Subsections IWB, IWC and IWD Inspection Program			
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Copper Alloy	Air/gas (internal)	None	None	Air/gas (internal) Moist air	Loss of material due to selective leaching, crevice corrosion galvanic corrosion, and pitting corrosion	Yes[2]
		Inside Air (external)	None	None	Inside Air (external)	None	No
010	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to flow accelerated corrosion, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	No
		Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general	No

						corrosion	
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading Change in material properties/reduction in fracture toughness due to thermal aging	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Stress Corrosion Cracking Program	Treated Water (internal)	Loss of material due to crevice and pitting corrosion	No
		Treated Water (external)	Loss of material due to crevice corrosion and pitting corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (external)	Loss of material due to crevice and pitting corrosion	No
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
068	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	No
		Raw Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, biofouling, MIC, and galvanic corrosion	Open-Cycle Cooling Water System Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No

	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading Change in material properties/reduction in fracture toughness due to thermal aging	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Stress Corrosion Cracking Program	Treated Water (internal)	Loss of material due to crevice and pitting corrosion	No
		Raw Water (internal)	Loss of material due to crevice corrosion, biofouling, MIC, and pitting corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Copper Alloy	Treated Water (internal)	Loss of material due to selective leaching, crevice corrosion, and pitting corrosion	One-Time Inspection Program Selective Leaching of Materials Program	Treated Water (internal)	Loss of material due to selective leaching, crevice corrosion and pitting corrosion	No
		Raw Water (internal)	Loss of material due to selective leaching, biofouling, MIC, crevice corrosion, and pitting corrosion	One-Time Inspection Program Selective Leaching of Materials Program	N/A	N/A	N/A
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Lubricating Oil	None	None	N/A	N/A	N/A

		(internal)					
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Glass	Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
069	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading and fatigue	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program Closed-Cycle Cooling Water System Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading Change in material properties/reduction in fracture toughness due to thermal aging	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Stress Corrosion Cracking Program	Treated Water (internal)	Loss of material due to crevice and pitting corrosion	No
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Copper Alloy	Treated Water	Loss of material due to	Chemistry Control	Treated	Loss of material	No

		(internal)	selective leaching, crevice corrosion, and pitting corrosion	Program One-Time Inspection Program Selective Leaching of Materials Program	Water (internal)	due to selective leaching, crevice corrosion and pitting corrosion	
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program Selective Leaching of Materials Program Closed-Cycle Cooling Water System Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, selective leaching, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	One-Time Inspection Program Selective Leaching of Materials Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Glass	Treated Water (internal)	None	None	Treated Water (internal)	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
085	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	No
		Raw Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, biofouling, MIC, and	Open-Cycle Cooling Water System Program	N/A	N/A	N/A

			galvanic corrosion				
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to stress corrosion cracking	Chemistry Control Program One-Time Inspection Program BWR Stress Corrosion Cracking Program	Treated Water (internal)	Loss of material due to crevice and pitting corrosion	No
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Copper Alloy	Raw Water (internal)	Loss of material due to selective leaching, biofouling, MIC, crevice corrosion, and pitting corrosion	Open-Cycle Cooling Water System Program Selective Leaching of Materials Program	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Aluminum Alloy	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to stress corrosion cracking	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Raw Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, pitting corrosion, biofouling, MIC, and galvanic corrosion	Open-Cycle Cooling Water System Program Selective Leaching of Materials Program	N/A	N/A	N/A

		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No

Note 1: The AMR for the operating condition did not consider general corrosion as an aging mechanism on external surfaces of carbon steel when the operating temperature is greater than 212 °F. The AMR for the lay up period did consider general corrosion as an aging mechanism because the surface is less than 212 °F during the extended outage of Unit 1. The piping and components will be inspected for external corrosion prior to Unit 1 restart. If necessary, unacceptable external corrosion effects will be corrected prior to Unit 1 restart. These piping and components will not require additional aging management during the period of extended operation.

Note 2: The internal operating environment for these systems is air/gas without a significant amount of moisture present. During lay up there were no moisture controls on the non-operating Unit 1 portions of these systems. Without moisture controls the possibility of moisture collecting at system low points exists. The piping components will be inspected for the potential aging effects prior to Unit 1 restart. If necessary, unacceptable internal corrosion effects will be corrected prior to Unit 1 restart. These piping and components will not require additional aging management during the period of extended operation.

TABLE 3: Systems Condenser Circulation Water System (27), Gland Seal Water System (37), Containment (64), Reactor Core Isolation Cooling System (71), High Pressure Coolant Injection System (73), and Core Spray System (75)

The portions of U1 systems 27, 37, 64, 71, 73, and 75 within the scope of BFN license renewal were not incorporated into the BFN lay-up program. Based on location, valve leakage, etc., the components within the scope of BFN license renewal for System 27 saw raw stagnant water for extended periods of time and the components within the scope of BFN license renewal for system 37 saw treated (condensate) water for extended periods of time. Systems 64, 71, 73, and 75 (torus and torus attached piping) saw treated (torus) water maintained by the Chemistry Program (CI-13.1) for extended periods of time. Due to drainage and system isolation, portions of these systems saw a moist air environment for extended periods of time. However, the evaluation for raw and treated water encompasses the aging effects for a moist air environment in these systems.

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
027	Carbon and Low Alloy Steel	Raw Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, biofouling, and MIC	One-Time Inspection Program	Raw Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, biofouling, and MIC	No
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
		Outside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Outside Air (external)	Loss of material due to general corrosion	No
		Buried (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion,	Buried Piping and Tanks Inspection Program	Buried (external)	Loss of material due to general corrosion,	No

			and MIC			crevice corrosion, pitting corrosion, and MIC	
		Embedded/Encased (external)	None	None	Embedded/Encased (external)	None	No
	Stainless Steel	Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Copper Alloy	Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Raw Water (internal)	Loss of material due to biofouling, MIC, general corrosion, crevice corrosion, and pitting corrosion	One-Time Inspection Program	Raw Water (internal)	Loss of material due to biofouling, MIC, general corrosion, crevice corrosion, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
037	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Copper Alloy	Treated Water (internal)	Loss of material due to selective leaching, crevice corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to selective leaching, crevice corrosion and	No

				Selective Leaching of Materials Program		pitting corrosion	
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program Selective Leaching of Materials Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, selective leaching, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Glass	Treated Water (internal)	None	None	Treated Water (internal)	None	No
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Treated Water (internal)	None	No
064	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	No
		Raw Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, biofouling, galvanic corrosion, and MIC	Open-Cycle Cooling Water System Program	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general	No

						corrosion	
		Outside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Outside Air (external)	Loss of material due to general corrosion	No
		Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	No
		Buried (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and MIC	Buried Piping and Tanks Inspection Program	Buried (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and MIC	No
		Embedded/Encased (external)	None	None	Embedded/Encased (external)	None	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to crevice and pitting corrosion	No
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Nickel Alloy	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	No
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Copper Alloy	Raw Water (internal)	Fouling due to biological and particulate build up Loss of material due to selective leaching, biofouling, MIC, crevice corrosion, and pitting	Open-Cycle Cooling Water System Program Selective Leaching of Materials Program	N/A	N/A	N/A

			corrosion				
		Air/gas (internal)	Fouling due to particulate buildup	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Aluminum Alloy	Air/gas (internal)	Fouling due to particulate buildup	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
		Outside Air (external)	None	None	Outside Air (external)	None	No
	Zinc Alloy	Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Glass	Treated Water (internal)	None	None	Treated Water (internal)	None	No
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (internal)	None	No
	Elastomer	Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	Hardening and loss of strength due to elastomer degradation (ultraviolet radiation)	System Monitoring Program	Inside Air (external)	Hardening and loss of strength due to elastomer degradation (ultraviolet radiation)	No
		Outside Air (external)	Hardening and loss of strength due to elastomer degradation (ultraviolet radiation)	System Monitoring Program	Outside Air (external)	Hardening and loss of strength due to elastomer degradation (ultraviolet radiation)	No
71	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to flow accelerated corrosion, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading and fatigue	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	No
		Treated Water (external)	Loss of material due to flow accelerated corrosion,	Chemistry Control Program	Treated Water (external)	Loss of material due to general	No

			general corrosion, crevice corrosion, and pitting corrosion	One-Time Inspection Program		corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Stress Corrosion Cracking Program	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	No
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Aluminum Alloy	Treated Water (internal)	Loss of material due to crevice corrosion, galvanic corrosion, and pitting corrosion Crack initiation/growth due to stress corrosion cracking and cyclic loading	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to crevice corrosion, galvanic corrosion, and pitting corrosion Crack initiation/growth due to stress corrosion cracking	No
		Inside Air (external)	None	None	Inside Air (external)	None	No

	Copper Alloy	Treated Water (internal)	Loss of material due to selective leaching, flow accelerated corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Fouling product buildup due to particulates	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program Selective Leaching of Materials Program	Treated Water (internal)	Loss of material due to selective leaching, crevice corrosion, pitting corrosion, and galvanic corrosion	No
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Treated Water (internal)	Loss of material due to selective leaching, flow accelerated corrosion, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program Selective Leaching of Materials Program	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	No
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Glass	Treated Water (internal)	None	None	Treated Water (internal)	None	No
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
073	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to flow accelerated corrosion, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and	No

			to cyclic loading and fatigue	ASME Section XI Subsections IWB, IWC and IWD Inspection Program		galvanic corrosion	
		Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	No
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Stress Corrosion Cracking Program	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	No
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Nickel Alloy	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	No
		Air/gas (internal)	N/A	N/A	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No

	Copper Alloy	Treated Water (internal)	Loss of material due to selective leaching, crevice corrosion, pitting corrosion, and galvanic corrosion Fouling product buildup due to particulates	Chemistry Control Program One-Time Inspection Program Selective Leaching of Materials Program	Treated Water (internal)	Loss of material due to selective leaching, crevice corrosion, pitting corrosion, and galvanic corrosion	No
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program Selective Leaching of Materials Program	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	No
		Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Elastomer	Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	Elastomer degradation due to ultraviolet radiation	System Monitoring Program	Inside Air (external)	Elastomer degradation due to ultraviolet radiation	No
	Glass	Lubricating Oil (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
075	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion Crack initiation/growth due to cyclic loading and fatigue	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic	No

				Inspection Program		corrosion	
		Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (external)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	No
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading Change in material properties/reduction in fracture toughness due to thermal aging	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	No
		Treated Water (external)	Loss of material due to crevice corrosion and pitting corrosion	Chemistry Control Program One-Time Inspection Program	Treated Water (external)	Loss of material due to crevice corrosion and pitting corrosion	No
		Air/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Aluminum Alloy	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to stress corrosion cracking	Chemistry Control Program One-Time Inspection Program	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to stress corrosion cracking	No
		Inside Air (external)	None	None	Inside Air (external)	None	No

	Cast Iron and Cast Iron Alloy	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program Selective Leaching of Materials Program	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	N/A	N/A	N/A
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Polymer	Ai/gas (internal)	None	None	N/A	N/A	N/A
		Inside Air (external)	None	None	Inside Air (external)	None	No

TABLE 4: Systems Main Steam System (01), Condensate System (02), Heater Drains & Vents System (06), Containment Inerting System (76), and Containment Atmosphere Dilution System (84)

Portions of U1 systems 01, 02, and 06 are within the boundary of the BFN Lay-up program. However, the portions of these systems within the scope of BFN license renewal lacked moisture controls and is considered moist air. U1 systems 76 and 84 were not incorporated into the BFN lay-up program. There were no moisture controls for the portions of these systems within the scope of BFN license renewal, and the environment is considered moist air.

		Operating U1, U2, and U3			Lay-Up U1		
System	Material	Environment	Aging Effect Requiring Management	Aging Management Program	Environment	Aging Effect Requiring Management	Additional Aging Effects Identified (Yes/No)
01	Aluminum Alloy	Air/gas (internal)	None	None	Air/gas (internal) Moist air	Loss of material due to crevice corrosion, galvanic corrosion, and pitting corrosion Crack initiation/growth due to stress corrosion cracking	Yes[2]
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, galvanic corrosion, and flow accelerated corrosion Crack initiation/growth due to cyclic loading and fatigue	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program	Air/gas (internal) Moist air	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to	One-Time Inspection			

			general corrosion	Program			
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion Crack initiation/growth due to fatigue, stress corrosion cracking, and cyclic loading	Chemistry Control Program One-Time Inspection Program ASME Section XI Subsections IWB, IWC and IWD Inspection Program BWR Stress Corrosion Cracking Program	Air/gas (internal) Moist air	Loss of material due to crevice corrosion and pitting corrosion	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
02	Copper Alloy	Treated Water (internal)	Loss of material due to selective leaching, crevice and pitting corrosion	Selective Leaching of Materials Program Chemistry Control Program One-Time Inspection Program	Air/gas (internal) Moist air	Loss of material due to selective leaching, crevice corrosion, and pitting corrosion	No
		Air/gas (internal)	None	None			
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Aluminum Alloy	Treated Water (internal)	Loss of material due to crevice, pitting, and galvanic corrosion Crack initiation/growth due to SCC	Chemistry Control Program One-Time Inspection Program	Air/gas (internal) Moist air	Loss of material due to crevice corrosion, galvanic corrosion, and pitting corrosion Crack initiation/growth due to stress	No
		Air/gas (internal)	None	None			
		Inside Air (external)	None	None	Inside Air (external)	None	No
		Outside Air (external)	None	None	Outside Air (external)	None	No
	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program	Air/gas (internal) Moist air	Loss of material due to general corrosion, crevice corrosion, and	No
		Air/gas (internal)	Loss of material due to	One-Time Inspection			

			general corrosion	Program		pitting corrosion	
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
		Outside Air (external)	Loss of material due to general corrosion	System Monitoring Program Aboveground Carbon Steel Tanks Program	Outside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Treated Water (internal)	Loss of material due to crevice corrosion and pitting corrosion	Chemistry Control Program One-Time Inspection Program	Air/gas (internal) Moist air	Loss of material due to crevice corrosion and pitting corrosion	No
		Air/gas (internal)	None	None			
		Inside Air (external)	None	None	Inside Air (external)	None	No
		Outside Air (external)	None	None	Outside Air (external)	None	No
	Cast Iron and Cast Iron Alloys	Treated Water (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, and pitting corrosion	Chemistry Control Program One-Time Inspection Program Selective Leaching of Materials Program	Air/gas (internal) Moist air	Loss of material due to selective leaching, galvanic corrosion, general corrosion, crevice corrosion, and pitting corrosion	No
		Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program			
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
		Outside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Outside Air (external)	Loss of material due to general corrosion	No
	Polymer	Treated Water (internal)	None	None	Air/gas (internal) Moist air	None	No
		Inside Air (external)	None	None	Inside Air (external)	None	No
06	Carbon and Low Alloy Steel	Treated Water (internal)	Loss of material due to flow accelerated corrosion, general corrosion, crevice corrosion, pitting corrosion, and galvanic corrosion	Chemistry Control Program One-Time Inspection Program Flow-Accelerated Corrosion Program	Air/gas (internal) Moist air	Loss of material due to general corrosion, crevice corrosion, galvanic	No

						corrosion, and pitting corrosion	
		Inside Air (external)	None	None	Inside Air (external)	Loss of material due to general corrosion	Yes[1]
076	Carbon and Low Alloy Steel	Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	Yes[2]
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Raw Water (internal)	Loss of material due to biofouling, MIC, crevice corrosion, and pitting corrosion	Open-Cycle Cooling Water System Program	N/A	N/A	N/A
		Air/gas (internal)	None	None	Air/gas (internal)	Loss of material due to crevice corrosion and pitting corrosion	Yes[2]
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Nickel Alloy	Air/gas (internal)	None	None	Air/gas (internal)	Loss of material due to crevice corrosion and pitting corrosion	Yes[2]
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Copper Alloy	Air/gas (internal)	None	None	Air/gas (internal)	Loss of material due to selective leaching, crevice corrosion, galvanic corrosion, and pitting corrosion	Yes[2]
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Aluminum Alloy	Air/gas (internal)	None	None	Air/gas (internal)	Loss of material due to crevice	Yes[2]

						corrosion, galvanic corrosion, and pitting corrosion Crack initiation/growth due to stress	
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	Yes[2]
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
084	Carbon and Low Alloy Steel	Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	Yes[2]
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No
		Outside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Outside Air (external)	Loss of material due to general corrosion	No
	Stainless Steel	Air/gas (internal)	Fouling product buildup due to particulate	One-Time Inspection	Air/gas (internal)	Loss of material due to crevice corrosion and pitting corrosion	Yes[2]
		Inside Air (external)	None	None	Inside Air (external)	None	No
		Outside Air (external)	None	None	Outside Air (external)	None	No

		Buried (external)	Crack initiation/growth due to SCC Loss of material due to MIC, crevice corrosion, and pitting corrosion	Buried Piping and Tanks Inspection Program	Buried (external)	Loss of material due to MIC, crevice corrosion, and pitting corrosion	No
	Copper Alloy	Air/gas (internal)	None	None	Air/gas (internal)	Loss of material due to selective leaching, crevice corrosion, galvanic corrosion, and pitting corrosion	Yes[2]
		Inside Air (external)	None	None	Inside Air (external)	None	No
		Outside Air (external)	None	None	Outside Air (external)	None	No
	Aluminum Alloy	Air/gas (internal)	None	None	Air/gas (internal)	Loss of material due to crevice corrosion, galvanic corrosion, and pitting corrosion Crack initiation/growth due to stress	Yes[2]
		Inside Air (external)	None	None	Inside Air (external)	None	No
	Cast Iron and Cast Iron Alloy	Air/gas (internal)	Loss of material due to general corrosion	One-Time Inspection Program	Air/gas (internal)	Loss of material due to selective leaching, general corrosion, crevice corrosion, galvanic corrosion, and pitting corrosion	Yes[2]
		Inside Air (external)	Loss of material due to general corrosion	System Monitoring Program	Inside Air (external)	Loss of material due to general corrosion	No

Note 1: The AMR for the operating condition did not consider general corrosion as an aging mechanism on external surfaces of carbon steel when the operating temperature is greater than 212 °F. The AMR for the lay up period did consider general corrosion as

an aging mechanism because the surface is less than 212 °F during the extended outage of Unit 1. The piping and components will be inspected for external corrosion prior to Unit 1 restart. If necessary, unacceptable external corrosion effects will be corrected prior to Unit 1 restart. These piping and components will not require additional aging management during the period of extended operation.

Note 2: The internal operating environment for these systems is air/gas without a significant amount of moisture present. During lay up there were no moisture controls on the non-operating Unit 1 portions of these systems. Without moisture controls the possibility of moisture collecting at system low points exists. The piping components will be inspected for the potential aging effects prior to Unit 1 restart. If necessary, unacceptable internal corrosion effects will be corrected prior to Unit 1 restart. These piping and components will not require additional aging management during the period of extended operation.

Operating Experience during the Extended Outage

Evaluation Methodology

Review and evaluation of NRC docketed correspondence, Problem Evaluation Reports (PERs) and Work Orders (WOs) were selected by the use of keywords "Layup Program" and "Lay-up Program" which gave the following results:

11 TVA Letters and NRC docketed correspondence documents
57 Problem Evaluation Reports (PERs)
303 Work Orders (WOs)

The Problem Evaluation Reports (PERs) and Work Orders (WOs) were searched from 1995 through 2003

The review and evaluation of each set of documents provided the following results.

NRC Docketed Correspondence

The following NRC docketed correspondence was identified as Unit 1 Layup Program related:

1. NRC Inspection Report Nos. 50-259/87-14, 50-260/87-14, and 50-296/87-14, - Commitment Date Revision for Violation Corrective Action, Dated April 5, 1988.

2. NRC Inspection Report Nos. 50-259/87-45, 50-260/87-45, and 50-296/87-45, Dated March 15, 1988.

3. Letter from TVA to NRC, Dated October 24, 1988, Browns Ferry Nuclear Plant (BFN) - Nuclear Performance Plan, Revision 2.

4. NRC Inspection Report Nos. 50-259/91-02, 50-260/91-02, and 50-296/91-02, Dated March 18, 1991.

5. NRC Inspection Report Nos. 50-259/94-09, 50-260/94-09, and 50-296/94-09, Notice of Violation, Dated June 6, 1994.

6. NRC Integrated Inspection Report 50-259/96-12, 50-260/96-12, and 50-296/96-12, Notice of Violation, Dated December 20, 1996.

7. Browns Ferry, Unit 1, NRC Summary of Meeting with Tennessee Valley Authority of Implementation of 10 CFR 50.65 - Meeting of January 26, 1998, Dated February 6, 1998.

8. TVA Letter to NRC, Browns Ferry Nuclear Plant (BFN) - Unit 1 - Request for a Temporary Exemption from the Requirements of 10 CFR 50.65, Maintenance Rule, Dated February 4, 1999.

9. Browns Ferry Nuclear Plant - NRC Inspection Report 50-259/00-04, 50-260/00-04, and 50-296/00-04, Dated October 23, 2000.

10. Browns Ferry Nuclear Plant - NRC Integrated Inspection Report 50-259/01-03, 50-260/01-03, and 50-296/01-03, Dated October 22, 2001.

11. Browns Ferry Nuclear Plant - NRC Integrated Inspection Report 50-259/2002-04, 50-260/2002-04, and 50-296/2002-04, Dated January 27, 2003.

NRC Docketed Correspondence Summary:

During the late 1980's the BFN Unit 1 Layup program was reviewed and evaluated by TVA and the NRC. A Layup program was developed to reduce the potential for corrosion damage of equipment and systems during the extended outage. The NRC identified program inadequacies in the program procedures, implementation, and quality assurance overview of the layup program. The layup program inadequacies were corrected and corrective actions were completed. NRC reviewed the corrective actions and closed the issue. Additional NRC inspection reports through the 1990s up to 2003 found the Unit 1 Layup and Equipment Preservation Program to be adequately controlled and consistent with long term storage requirements.

Based on review and evaluation of Browns Ferry Nuclear Plant Docketed Letters and NRC Inspection Reports of the Unit 1 Layup and Equipment Preservation Program, the program is adequately controlled and consistent with the long term storage requirements and will provide reasonable assurance that the layup of equipment and systems are being maintained to prevent corrosion damage during the period of BFN Unit 1's extended outage. No new aging effects for License Renewal were identified during this review and evaluation.

Problem Evaluation Report (PER) Summary:

The evaluation results of PERs found that the Unit 1 Layup and Equipment Preservation Program has experienced program inadequacies (i.e., procedural compliance and configuration control issues, missed preventive maintenance schedules, and failure to meet relative humidity acceptance criteria due to dehumidifier failures). These program inadequacies were corrected and system equipment was restored in accordance with the program requirements.

PER 01-005782-000 identified a material condition issue with the Raw Service Water (RSW) header supplying the Units 1, 2, and 3 Offgas Glycol Chillers. In addition, the Raw Service

Water inside the RSW cooling return piping to the 1B Glycol Chiller is in a stalled condition due to the chiller remaining out of service according to U1 Layup requirements per 1-GOI-100-13.7. The corrective action of this PER are to replace the RSW header that supplies cooling water to the Unit 1, 2, and 3 Offgas Glycol Chillers (WO 01-005040-000) has been initiated to replace the header. In addition, since 1B Offgas Glycol Chiller is out of service, remove the flow control valve 1-FCV-066-102B and replace with a spool to provide continuous flow of water inside the piping.

The Unit 1 Layup and Equipment Preservation Program are being monitored, tested, and program inadequacies identified and corrective actions taken as required per the Corrective Action Program.

Based on review and evaluation of Browns Ferry Nuclear Plant Problem Evaluation Reports (PERs) of the Unit 1 Layup and Equipment Preservation Program, the program is adequately controlled and consistent with the long term storage requirements and corrective actions taken as required and will provide reasonable assurance that the layup of equipment and systems are being maintained to prevent corrosion damage during the period of BFN Unit 1's extended outage. No new aging effects for License Renewal were identified during this review and evaluation.

Work Order (WO) Summary:

The evaluation results of WOs found that the Unit 1 Layup and Equipment Preservation Program is being inspected, tested and monitored per Preventive Maintenance Work Orders. The program inspection and monitoring Work Orders include inspection of layup boxes for signs of moisture, inspection of hoses and connections of layup equipment, inspection and change out of HEPA filters, equipment material condition (inspections for corrosion), layup deficiencies, and inspection and replacement of desiccant as required.
The program testing Work Orders include annual testing of the layup of HEPA filters, oil samples, heaters, and dehumidifiers.

Based on review and evaluation of Browns Ferry Nuclear Plant Work Orders (WOs) of the Unit 1 Layup and Equipment Preservation Program, the program is adequately inspected and tested and consistent with the long term storage requirements and will provide reasonable assurance that the layup of equipment and systems are being maintained to prevent corrosion damage during the period of BFN Unit 1's extended outage. No new aging effects for License Renewal were identified during this review and evaluation.

Unit 1 Layup and Equipment Preservation Program Summary:

Based on review and evaluation of NRC docketed correspondence, Problem Evaluation Reports (PERs) and Work Orders (WOs) of the Unit 1 Layup and Equipment Preservation Program, the program is adequately monitored, inspected and tested consistent with the long term storage requirements and will provide reasonable assurance that the layup of equipment and systems are being maintained to prevent corrosion damage during the period of BFN Unit 1's extended outage. No new aging effects for License Renewal were identified during this review and evaluation.