APPENDIX B

AGING MANAGEMENT PROGRAMS AND ACTIVITIES

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APPENDIX B
AGING MANAGEMENT PROGRAMS AND ACTIVITIES

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B.0 AGING MANAGEMENT PROGRAMS AND ACTIVITIES

B.1 INTRODUCTION

B.1.1 OVERVIEW

The aging management review results for the integrated plant assessment of Beaver Valley Power Station (BVPS) are presented in Sections 3.1 through 3.6 of this application. The programs credited in the integrated plant assessment for managing aging effects are described in this appendix.

Each aging management program described in this appendix has ten elements in accordance with the guidance in NUREG-1800 [Reference 1.3-4], Appendix A.1, *Aging Management Review - Generic*, Table A.1-1, *Elements of an Aging Management Program for License Renewal*. For aging management programs that are comparable to the programs described in Sections X and XI of NUREG-1801, *Generic Aging Lessons Learned (GALL) Report* [Reference 1.3-5], the ten elements have been compared to the elements of the NUREG-1801 program. For plant-specific programs which do not correlate with NUREG-1801, the ten elements are addressed in the program discussion.

Design differences exist between BVPS Unit 1 and Unit 2 due to the fact that the two units were constructed eleven years apart as evidenced by the license expiration dates for each unit. Those design differences that impact aging management for each unit are identified by a unit-specific designator ((Unit 1 only); (Unit 2 only); (Common)) in the appropriate section of this application.

B.1.2 FORMAT OF PRESENTATION

For those aging management programs that are comparable to the programs described in Sections X and XI of NUREG-1801, the program discussion is presented in the following format:

- **Program Description** — abstract of the overall program.
- **NUREG-1801 Consistency** — summary of the degree of consistency between the BVPS program and the corresponding NUREG-1801 program, when applicable (i.e., degree of similarity, etc.).
- **Exceptions to NUREG-1801** — exceptions to the NUREG-1801 program, including a justification for the exceptions (when applicable).

- **Enhancements** — future program enhancements with a proposed schedule for their completion (when applicable), including additional program features to manage aging effects not addressed by the NUREG-1801 program.
- **Operating Experience** — discussion of operating experience information specific to the program.
- **Conclusion** — statement of reasonable assurance that the program is effective, or will be effective, once implemented with necessary enhancements.

For plant-specific programs and new programs, the above format is generally followed, with additional discussion of each of the ten elements.

B.1.3 QUALITY ASSURANCE PROGRAM AND ADMINISTRATIVE CONTROLS

Three elements common to all aging management programs (AMPs) are corrective actions, confirmation process and administrative controls. These elements are included in the BVPS Quality Assurance (QA) Program, which implements the requirements of 10 CFR Part 50 [Reference 1.3-1], Appendix B. A description of the QA Program is provided in Unit 1 UFSAR, Appendix A, and Unit 2 UFSAR, Chapter 17.

Discussion of the three elements is presented in the following paragraphs. Corrective actions have program-specific details which are included in the descriptions of the individual programs in this report, but further discussion of the confirmation process and administrative controls is not necessary and is not included in the descriptions of the individual programs.

Corrective Actions

BVPS quality assurance procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. Adverse conditions, such as failures, malfunctions, deficiencies, deviations, defective hardware and non-conformances, or human performance, programmatic, organizational, or management weaknesses, are identified and corrected in a timely manner. Using the BVPS Corrective Action Program, adverse conditions are identified and categorized as conditions adverse to quality or significant conditions adverse to quality based on the significance and consequences of the specific problem identified. In the case of significant conditions adverse to quality, measures are implemented to ensure that the cause of the nonconformance is determined and that corrective action is taken to preclude recurrence. In addition, the root cause of the significant condition adverse to quality and the corrective action implemented are documented and reported to appropriate levels of management. BVPS corrective actions are consistent with NUREG-1801.

Confirmation Process

BVPS quality assurance procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B. The First Energy Nuclear Operating Company (FENOC) Quality Assurance Program applies to BVPS safety-related structures and components. Corrective actions and administrative (document) control for both safety-related and nonsafety-related structures and components are accomplished per the existing BVPS Corrective Action Program and document control program. The confirmation process is part of the Corrective Action Program and includes:

- Reviews to assure that proposed actions are adequate,
- Tracking and reporting of open corrective actions, and
- Review of corrective action effectiveness based on the significance category of the identified condition or management discretion.

Any follow-up inspection required by the confirmation process is documented in accordance with the Corrective Action Program. The Corrective Action Program constitutes the confirmation process for aging management programs and activities. The BVPS confirmation process is consistent with NUREG-1801.

Administrative Controls

BVPS quality assurance procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B. The FENOC Quality Assurance Program applies to BVPS safety-related structures and components. Administrative (document) control for both safety-related and nonsafety-related structures and components is accomplished per the existing document control program. The BVPS administrative controls are consistent with NUREG-1801.

B.1.4 OPERATING EXPERIENCE

Industry operating experience was incorporated into the license renewal process through the use of license renewal guidance documents that incorporated operating experience regarding aging effects requiring management. Industry operating experience applicable to BVPS since issuance of the industry guidance documents was reviewed and evaluated. The industry operating experience review included a broad list of industry documents and databases, such as generic NRC communications, Regulatory Issue Summaries, Institute for Nuclear Power Operations (INPO) operating experience database and the Licensee Event Report (LER) database, and the World Association of Nuclear Operators (WANO) operating experience database. These information sources were reviewed through directed system and component searches to identify examples of industry age-related degradation applicable to BVPS.

Review of plant-specific operating experience was performed to identify aging effects experienced at BVPS, and to demonstrate that existing BVPS aging management programs

(AMPs) credited for license renewal are effective for the management of aging effects. The review of plant-specific operating experience included review of site documents and electronic database searches, such as the BVPS LER database, the Condition Report Evaluation and Status Tracking database (a major component of the station Corrective Action Program), recent System and Program Health Reports, self-assessments, Quality Assurance audits, and NRC reviews. In addition, interviews with BVPS program owners and system engineers were conducted using interview forms with a list of questions pertaining to aging effects on plant systems and structures.

The operating experience evaluations demonstrate that the existing AMPs will continue to effectively manage aging effects during the period of extended operation. Site procedures require reviews of site and relevant industry operating experience as the site continues operation through the period of extended operation.

B.1.5 LIST OF BVPS AGING MANAGEMENT PROGRAMS

The following BVPS aging management programs are described in the sections listed in Table B.1-1. Programs in this table are identified as either “existing” or “new”. Additionally, the programs are either comparable to programs described in NUREG-1801, or are plant-specific. The correlation between NUREG-1801 programs and BVPS programs is shown in Table B.1-2.

Table B.1-1
BVPS Aging Management Programs

Aging Management Program Title	LRA Section	Status
10 CFR Part 50, Appendix J	B.2.1	Existing
ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	B.2.2	Existing
ASME Section XI, Subsection IWE	B.2.3	Existing
ASME Section XI, Subsection IWF	B.2.4	Existing
ASME Section XI, Subsection IWL	B.2.5	Existing
Bolting Integrity	B.2.6	Existing
Boric Acid Corrosion	B.2.7	Existing
Buried Piping and Tanks Inspection	B.2.8	New
Closed-Cycle Cooling Water System	B.2.9	Existing
Electrical Cable Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements One-Time Inspection	B.2.10	New
Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements	B.2.11	New
Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	B.2.12	New
Electrical Wooden Poles/Structures Inspection (Unit 2 only)	B.2.13	New

Table B.1-1
BVPS Aging Management Programs
(continued)

Aging Management Program Title	LRA Section	Status
Environmental Qualification (EQ) of Electrical Components	B.2.14	Existing
External Surfaces Monitoring	B.2.15	New
Fire Protection	B.2.16	Existing
Fire Water System	B.2.17	Existing
Flow-Accelerated Corrosion	B.2.18	Existing
Flux Thimble Tube Inspection	B.2.19	Existing
Fuel Oil Chemistry	B.2.20	Existing
Inaccessible Medium-Voltage Cables Not Subject to 10CFR50.49 Environmental Qualification Requirements	B.2.21	New
Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	B.2.22	New
Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	B.2.23	Existing
Lubricating Oil Analysis	B.2.24	Existing
Masonry Wall	B.2.25	Existing
Metal Enclosed Bus (Unit 2 only)	B.2.26	New
Metal Fatigue of Reactor Coolant Pressure Boundary	B.2.27	Existing
Nickel-Alloy Nozzles and Penetrations	B.2.28	New
Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Head	B.2.29	Existing
One-Time Inspection	B.2.30	New
One-Time Inspection of ASME Code Class 1 Small Bore Piping	B.2.31	New
Open-Cycle Cooling Water System	B.2.32	Existing

Table B.1-1
BVPS Aging Management Programs
(continued)

Aging Management Program Title	LRA Section	Status
PWR Vessel Internals	B.2.33	New
Reactor Head Closure Studs	B.2.34	Existing
Reactor Vessel Integrity	B.2.35	Existing
Selective Leaching of Materials	B.2.36	New
Settlement Monitoring (Unit 2 only)	B.2.37	Existing
Steam Generator Tube Integrity	B.2.38	Existing
Structures Monitoring	B.2.39	Existing
Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	B.2.40	New
Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	B.2.41	New
Water Chemistry	B.2.42	Existing

B.1.6 BVPS AGING MANAGEMENT PROGRAM CORRELATION TO NUREG-1801 AGING MANAGEMENT PROGRAMS

The correlation between NUREG-1801 Aging Management Programs and BVPS Aging Management Programs is shown in Table B.1-2. Links are provided to the BVPS program discussions, and plant-specific programs are listed at the end of the table.

Table B.1-2
BVPS Aging Management Program Correlation to NUREG-1801 Aging Management Programs

NUREG-1801 Number	NUREG-1801 Program	BVPS Program	LRA Section
NUREG-1801 Vol. 2 - Chapter X: Time-Limited Aging Analyses Programs			
X.M1	Metal Fatigue of Reactor Coolant Pressure Boundary	Metal Fatigue of Reactor Coolant Pressure Boundary	B.2.27
X.S1	Concrete Containment Tendon Prestress	BVPS does not have pre-stressed tendons in the Containment Building	--
X.E1	Environmental Qualification (EQ) of Electrical Components	Environmental Qualification (EQ) of Electrical Components	B.2.14
NUREG-1801 Vol. 2 - Chapter XI: Aging Management Programs			
XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	B.2.2
XI.M2	Water Chemistry	Water Chemistry	B.2.42
XI.M3	Reactor Head Closure Studs	Reactor Head Closure Studs	B.2.34
XI.M4	BWR Vessel ID Attachment Welds	Not applicable to PWRs	--
XI.M5	BWR Feedwater Nozzle	Not applicable to PWRs	--
XI.M6	BWR Control Rod Drive Return Line Nozzle	Not applicable to PWRs	--
XI.M7	BWR Stress Corrosion Cracking	Not applicable to PWRs	--

Table B.1-2
BVPS Aging Management Program Correlation to NUREG-1801 Aging Management Programs (continued)

NUREG-1801 Number	NUREG-1801 Program	BVPS Program	LRA Section
XI.M8	BWR Penetrations	Not applicable to PWRs	--
XI.M9	BWR Vessel Internals	Not applicable to PWRs	--
XI.M10	Boric Acid Corrosion	Boric Acid Corrosion	B.2.7
XI.M11	Nickel-Alloy Nozzles and Penetrations	Nickel Alloy Nozzles and Penetrations	B.2.28
XI.M11A	Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Head	B.2.29
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	B.2.41
XI.M13	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	B.2.40
XI.M14	Loose Part Monitoring	Not credited for aging management	--
XI.M15	Neutron Noise Monitoring	Not credited for aging management	--
XI.M16	PWR Vessel Internals	PWR Vessel Internals	B.2.33
XI.M17	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion	B.2.18
XI.M18	Bolting Integrity	Bolting Integrity	B.2.6
XI.M19	Steam Generator Tube Integrity	Steam Generator Tube Integrity	B.2.38
XI.M20	Open-Cycle Cooling Water System	Open-Cycle Cooling Water System	B.2.32
XI.M21	Closed-Cycle Cooling Water System	Closed-Cycle Cooling Water System	B.2.9
XI.M22	Boraflex Monitoring	Not credited for aging management	--

Table B.1-2
BVPS Aging Management Program Correlation to NUREG-1801 Aging Management Programs (continued)

NUREG-1801 Number	NUREG-1801 Program	BVPS Program	LRA Section
XI.M23	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	B.2.23
XI.M24	Compressed Air Monitoring	Not credited for aging management	--
XI.M25	BWR Reactor Water Cleanup System	Not applicable to PWRs	--
XI.M26	Fire Protection	Fire Protection	B.2.16
XI.M27	Fire Water System	Fire Water System	B.2.17
XI.M28	Buried Piping and Tanks Surveillance	Not credited for aging management	--
XI.M29	Aboveground Steel Tanks	Not credited for aging management	--
XI.M30	Fuel Oil Chemistry	Fuel Oil Chemistry	B.2.20
XI.M31	Reactor Vessel Surveillance	Not credited for aging management. The Reactor Vessel Integrity Program (B.2.35) manages aging of Reactor Vessel materials.	--
XI.M32	One-Time Inspection	One-Time Inspection	B.2.30
XI.M33	Selective Leaching of Materials	Selective Leaching of Materials	B.2.36
XI.M34	Buried Piping and Tanks Inspection	Buried Piping and Tanks Inspection	B.2.8
XI.M35	One-Time Inspection of ASME Code Class 1 Small Bore Piping	One-Time Inspection of ASME Code Class 1 Small Bore Piping	B.2.31
XI.M36	External Surfaces Monitoring	External Surfaces Monitoring	B.2.15
XI.M37	Flux Thimble Tube Inspection	Flux Thimble Tube Inspection	B.2.19

Table B.1-2
BVPS Aging Management Program Correlation to NUREG-1801 Aging Management Programs
(continued)

NUREG-1801 Number	NUREG-1801 Program	BVPS Program	LRA Section
XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	B.2.22
XI.M39	Lubricating Oil Analysis	Lubricating Oil Analysis	B.2.24
XI.S1	ASME Section XI, Subsection IWE	ASME Section XI, Subsection IWE	B.2.3
XI.S2	ASME Section XI, Subsection IWL	ASME Section XI, Subsection IWL	B.2.5
XI.S3	ASME Section XI, Subsection IWF	ASME Section XI, Subsection IWF	B.2.4
XI.S4	10 CFR Part 50, Appendix J	10 CFR Part 50, Appendix J	B.2.1
XI.S5	Masonry Wall Program	Masonry Wall	B.2.25
XI.S6	Structures Monitoring Program	Structures Monitoring	B.2.39
XI.S7	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	Not credited for aging management. However, the Structures Monitoring Program (B.2.39) includes elements of the RG 1.127 program for BVPS structures.	--
XI.S8	Protective Coating Monitoring and Maintenance Program	Not credited for aging management. Protective coatings are not relied upon to manage the effects of aging	--
XI.E1	Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements	Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements	B.2.11
XI.E2	Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	B.2.12

Table B.1-2
BVPS Aging Management Program Correlation to NUREG-1801 Aging Management Programs (continued)

NUREG-1801 Number	NUREG-1801 Program	BVPS Program	LRA Section
XI.E3	Inaccessible Medium-Voltage Cables Not Subject to 10CFR50.49 Environmental Qualification Requirements	Inaccessible Medium-Voltage Cables Not Subject to 10CFR50.49 Environmental Qualification Requirements	B.2.21
XI.E4	Metal Enclosed Bus	Metal Enclosed Bus (Unit 2 only). There is no in-scope metal enclosed bus at Unit 1.	B.2.26
XI.E5	Fuse Holders	Not credited for aging management. Insulation for fuse holders is addressed by the Electrical Cables and Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements Program (B.2.11).	--
XI.E6	Electrical Cable Connections Not Subject to 10CFR50.49 Environmental Qualification Requirements	Not credited for aging management. See plant-specific Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements One-Time Inspection Program (B.2.10).	--
Plant-Specific Programs			
NA	Plant-specific Program	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements One-Time Inspection	B.2.10
NA	Plant-specific Program	Electric Wooden Poles/Structures Inspection (Unit 2 only)	B.2.13
NA	Plant-specific Program	Reactor Vessel Integrity	B.2.35
NA	Plant-specific Program	Settlement Monitoring (Unit 2 only)	B.2.37

B.1.7 BVPS Aging Management Program Consistency with NUREG-1801 Aging Management Programs

BVPS Aging Management Programs were compared to NUREG-1801 Aging Management Programs for consistency. The results of the comparison are shown in Table B.1-3, and fall into one of four categories:

- Plant-specific [not comparable to a NUREG-1801 Aging Management Program];
- Program consistent with NUREG-1801;
- Program with enhancement(s) [to align with NUREG-1801]; or,
- Program with exception(s) to NUREG-1801.

Table B.1-3
BVPS Aging Management Program Consistency with NUREG-1801 Aging Management Programs

Program Name	Plant Specific	NUREG-1801 Comparison		
		Programs Consistent with NUREG-1801	Programs with Enhancement(s)	Programs with Exception(s) to NUREG-1801
10 CFR Part 50, Appendix J	--	Yes	--	--
ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	--	--	--	Yes
ASME Section XI, Subsection IWE	--	--	--	Yes
ASME Section XI, Subsection IWF	--	--	--	Yes
ASME Section XI, Subsection IWL	--	Yes	--	--
Bolting Integrity	--	Yes	--	--
Boric Acid Corrosion	--	Yes	--	--
Buried Piping and Tanks Inspection	--	Yes	--	--

Table B.1-3
BVPS Aging Management Program Consistency with NUREG-1801 Aging Management Programs (continued)

Program Name	Plant Specific	NUREG-1801 Comparison		
		Programs Consistent with NUREG-1801	Programs with Enhancement(s)	Programs with Exception(s) to NUREG-1801
Closed-Cycle Cooling Water System	--	Yes	Yes	--
Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements One-Time Inspection	Yes	--	--	--
Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	--	Yes	--	--
Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	--	Yes	--	--
Electrical Wooden Poles/ Structures Inspection (Unit 2 only)	Yes	--	--	--
Environmental Qualification (EQ) of Electrical Components	--	Yes	--	--
External Surfaces Monitoring	--	Yes	--	--
Fire Protection	--	--	Yes	Yes
Fire Water System	--	Yes	Yes	--
Flow-Accelerated Corrosion	--	Yes	--	--
Flux Thimble Tube Inspection	--	Yes	Yes	--

Table B.1-3
BVPS Aging Management Program Consistency with NUREG-1801 Aging Management Programs (continued)

Program Name	Plant Specific	NUREG-1801 Comparison		
		Programs Consistent with NUREG-1801	Programs with Enhancement(s)	Programs with Exception(s) to NUREG-1801
Fuel Oil Chemistry	--	--	Yes	Yes
Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	--	Yes	--	--
Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	--	Yes	--	--
Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	--	Yes	Yes	--
Lubricating Oil Analysis	--	Yes	--	--
Masonry Wall	--	Yes	Yes	--
Metal Enclosed Bus (Unit 2 only)	--	Yes	--	--
Metal Fatigue of Reactor Coolant Pressure Boundary	--	Yes	--	--
Nickel-Alloy Nozzles and Penetrations	--	Yes	--	--
Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Head	--	Yes	--	--
One-Time Inspection	--	Yes	--	--
One-Time Inspection of ASME Code Class 1 Small Bore Piping	--	Yes	--	--

Table B.1-3
BVPS Aging Management Program Consistency with NUREG-1801 Aging Management Programs (continued)

Program Name	Plant Specific	NUREG-1801 Comparison		
		Programs Consistent with NUREG-1801	Programs with Enhancement(s)	Programs with Exception(s) to NUREG-1801
Open-Cycle Cooling Water System	--	Yes	--	--
PWR Vessel Internals	--	Yes	--	--
Reactor Head Closure Studs	--	--	--	Yes
Reactor Vessel Integrity	Yes	--	--	--
Selective Leaching of Materials Inspection	--	--	--	Yes
Settlement Monitoring (Unit 2 only)	Yes	--	--	--
Steam Generator Tube Integrity	--	Yes	--	--
Structures Monitoring	--	Yes	Yes	--
Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	--	Yes	--	--
Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	--	Yes	--	--
Water Chemistry	--	Yes	Yes	--

B.2 AGING MANAGEMENT PROGRAMS

B.2.1 10 CFR PART 50, APPENDIX J

Program Description

The BVPS 10 CFR Part 50, Appendix J Program monitors Containment leak rate. Containment leak rate tests are required to assure that: (a) leakage through primary Reactor Containment and systems and components penetrating primary Containment will not exceed allowable values specified in technical specifications or associated bases, and (b) periodic surveillance of Reactor Containment penetrations and isolation valves is performed so that proper maintenance and repairs are made during the service life of Containment, and systems and components penetrating primary Containment.

Appendix J provides two options, A and B, either of which can be chosen to meet the requirements of a Containment leak rate test program. BVPS uses option B, the performance-based approach. The Containment leak rate tests are performed in accordance with the guidelines contained in NRC Regulatory Guide 1.163, *Performance-Based Containment Leak-Testing Program* [Reference B.3-1] and NEI 94-01, *Industry Guidance for Implementing Performance-Based Options of 10 CFR Part 50 Appendix J* [Reference B.3-2].

NUREG-1801 Consistency

The 10 CFR Part 50, Appendix J Program is an existing program that is consistent with NUREG-1801 [Reference 1.3-5], Section XI.S4, *10 CFR Part 50, Appendix J*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

As stated in NUREG-1801, Section XI.S4, *10 CFR Part 50, Appendix J*, "To date, the 10 CFR Part 50, Appendix J, LRT program has been effective in preventing unacceptable leakage through the Containment pressure boundary. Implementation of Option B for testing frequency must be consistent with plant-specific operating experience." BVPS uses the Option B program. The program strategy and frequency are directly driven by program operating experience. The results of previous inspections are used to establish inspection parameters and formulate corrective actions.

When a penetration is found to be outside the established administrative leakage limits, evaluations are performed and corrective actions taken to restore it to within the limits. Some site-specific examples follow.

The most recent Unit 1 Type A test, conducted on April 14, 2006, showed a leakage rate (including the Type B and Type C Penalty Additions and Tank Change Volume Corrections) within the limits of the Acceptance Criteria. The most recent Unit 2 Type A test, conducted on November 10, 1993, showed a leakage rate within the limits of the Acceptance Criteria.

During the most recent Type C tests, the Unit 1 inside Containment purge exhaust valve and the Unit 2 inside Containment radiation monitor return check valve had leak rates that exceeded their administrative limits. The Unit 1 inside Containment purge exhaust valve was cleaned and retested, resulting in an acceptable leak rate. The Unit 2 inside Containment radiation monitor return check valve was repaired and re-tested, resulting in an acceptable leak rate.

A self-assessment of the BVPS Appendix J Program was conducted in 2005 to identify areas to optimize Type-C testing activities performed during scheduled refueling outages (specifically, scope selection). Four Strengths, seven Noteworthy Items, and one Area For Improvement were identified. The assessment team concluded that the program is effective in satisfying the requirements of 10 CFR 50.54(o), 10 CFR 50, Appendix J, Option B, NEI 94-01, and Regulatory Guide 1.163.

Confirmation of Containment integrity, along with identification and resolution of program discrepancies, provides reasonable assurance that the program is effective for managing loss of material of components.

Conclusion

Continued implementation of the 10 CFR Part 50, Appendix J Program provides reasonable assurance that the aging effects will be managed so that the structures and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.2 ASME SECTION XI INSERVICE INSPECTION, SUBSECTIONS IWB, IWC, AND IWD

Program Description

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program is in accordance with ASME Section XI 1989 edition (with no Addenda) and is subject to the limitations and modifications of 10 CFR 50.55a [Reference 1.3-1]. The program provides for condition monitoring of Class 1, 2, and 3 pressure-retaining components, including welds, pump casings, valve bodies, integral attachments, and pressure-retaining bolting. The program is updated as required by 10 CFR 50.55a.

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program is augmented by the Water Chemistry Program (Section B.2.42) where applicable.

NUREG-1801 Consistency

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program is an existing program that is consistent with NUREG-1801, Section XI.M1, *ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD*, with exception.

Exceptions to NUREG-1801

Program Elements Affected:

- **Scope of Program**

  NUREG-1801, Section XI.M1, *ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD* specifies the use of ASME Section XI, 2001 edition through 2002 and 2003 Addenda. The applicable ASME Code for the third (Unit 1 only) and second (Unit 2 only) intervals of the BVPS ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program is ASME Section XI, 1989 edition (with no Addenda). The use of the 1989 edition of the ASME Code is consistent with provisions in 10 CFR 50.55a to use the Code in effect 12 months prior to the start of the inspection interval. BVPS will use the ASME Code edition consistent with the provisions of 10 CFR 50.55a during the period of extended operation.

- **Parameters Monitored or Inspected**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Detection of Aging Effects**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Monitoring and Trending**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Acceptance Criteria**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Corrective Actions**

  See the exception regarding differences in ASME Code edition under Scope of Program.

Enhancements

None

Operating Experience

The extent and schedule of the inspection and test techniques prescribed by the program are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of the component.

For Class 1, 2, or 3 components, the inspection schedule of IWB-2400, IWC-2400, or IWD-2400, respectively, and the extent and frequency of IWB-2500-1, IWC-2500-1, or IWD-2500-1, respectively, provides for timely detection of degradation. The BVPS Inservice Inspection (ISI) Program is an existing program that encompasses ASME Section XI, Subsections IWA, IWB, IWC, IWD and IWF requirements. The ISI Program is based on ASME Inspection Program B (IWA-2432), which has 10-year inspection intervals.

During the Unit 1 Cycle 17 Refueling Outage (February - April 2006), Inservice Inspection (ISI) examinations were performed on Class 1, 2, 3 and MC components. Class 1 examinations (welds, Class 1 bolting, VT-3 visual examinations, and ISI piping VT-2), Class 2 examinations (welds, bolting-UT, supports-visual, ISI piping VT-2), visual examinations of Class 3 supports, and Class MC examinations on the liner plate, new concrete patch, moisture barrier, and equipment hatch bolting were performed as part of this inspection. The Class 1 piping System Leakage Test was performed prior to plant start-up from the outage. Class 1 bolted connections were examined during the outage. Also, Class 2 and 3 system functional and system inservice tests were performed in accordance with 40-month pressure testing requirements. There were no recorded ISI non-destructive examination deficiencies in the Cycle 17 Refueling Outage.

During the Unit 2 Cycle 10 Refueling Outage (September - October 2003), Inservice Inspection (ISI) examinations were performed on Class 1, 2, and MC components. Class 1 examinations (pipe welds and RCP flywheel), and Class 2 examinations (welds, supports-visual) were performed. The Class 1 piping System Leakage Test was performed prior to plant start-up from the outage. Class 1 bolted connections were examined during the outage. Also, Class 2 and 3 system functional and system inservice tests were performed on various systems to fulfill the

current 40-month pressure testing requirement. There were no recorded ISI non-destructive examination deficiencies in the Cycle 10 Refueling Outage.

If results are found to be outside of acceptable limits, the affected components are either repaired, evaluated for acceptance as is, or replaced. Identification of degradation and corrective action prior to loss of intended function provide reasonable assurance that the program is effective for managing aging effects.

A self-assessment of the ISI program was completed in November 2004. The assessment team evaluated thirteen assessment areas. Also, the assessment included a review of industry operating experience related to ISI that identified a situation where UT examination volume was marginally acceptable. The BVPS program was reviewed and found to have incorporated the ISI extended examination volume requirement in their UT procedures. Overall the BVPS ISI program was evaluated to be implemented effectively. No technical issues were identified, and the identified items were limited to administrative issues that would clarify facets of the program and strengthen the overall ISI program. All of the identified items were resolved through the Corrective Action Program.

Quality Assurance surveillances in 2004 identified minor issues that, if corrected, would improve program performance and reduce human errors, but did not identify issues or findings that would impact the overall effectiveness of the program. The review of the ISI program identified items for improvement with the procedure references, format inconsistencies, and properly processing a Westinghouse evaluation. The Corrective Action Program was used to revise the program, and to process the evaluation in accordance with the required procedures.

NRC inspections of ISI were performed during the Unit 1 Cycle 17 Refueling Outage and the Unit 2 Cycle 12 Refueling Outage (October - November 2006). The NRC Integrated Inspection Reports (dated July 28, 2006 and January 24, 2007) state that no findings of significance were identified for this inspection. The inspectors assessed the ISI activities by reviewing documentation and interviewing personnel associated with these activities. The inspectors also reviewed a sample of Corrective Action Program documents to assess the licensee's effectiveness in problem identification and resolution. During the Unit 2 inspection, the inspectors also interviewed staff and reviewed evaluations for defects found during non-destructive examination that were to be left in service.

Because the ASME Code is a consensus document that has been widely used over a long period, it has been shown to be effective in managing aging effects in Class 1, 2, and 3 components and their integral attachments in light-water cooled power plants (see Chapter I of NUREG-1801, Volume 2).

Conclusion

Continued implementation of the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their

intended functions consistent with the current licensing basis for the period of extended operation.

B.2.3 ASME SECTION XI, SUBSECTION IWE

Program Description

The ASME Section XI, Subsection IWE Program is in accordance with ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWE, 1992 edition with the 1992 Addenda, within the limitations and modifications required by the Code of Federal Regulations in 10 CFR 50.55a.

This program is implemented through plant procedures, which provide for inservice inspection of Class MC and metallic liners of Class CC components.

NUREG-1801 Consistency

The ASME Section XI, Subsection IWE Program is an existing program that is consistent with NUREG-1801, Section XI.S1, *ASME Section XI, Subsection IWE*, with exception.

Exceptions to NUREG-1801

Program Elements Affected:

- **Scope of Program**

  NUREG-1801, Section XI.S1, *ASME Section XI, Subsection IWE* specifies the use of ASME Section XI, 2001 edition through 2002 and 2003 Addenda. The applicable ASME Code for the first inspection interval of the BVPS ASME Section XI, Subsection IWE Program is ASME Section XI, 1992 edition through the 1992 Addenda. The use of the 1992 edition through the 1992 Addenda of the ASME Code is consistent with provisions in 10 CFR 50.55a to use the Code in effect 12 months prior to the start of the inspection interval. BVPS will use the ASME Code edition consistent with the provisions of 10 CFR 50.55a during the period of extended operation.

- **Parameters Monitored or Inspected**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Detection of Aging Effects**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Monitoring and Trending**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Acceptance Criteria**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Corrective Actions**

  See the exception regarding differences in ASME Code edition under Scope of Program.

Enhancements

None

Operating Experience

The ASME Section XI, Subsection IWE program inspections, as recommended by NRC Information Notice IN 97-10 [Reference B.3-3], have identified containment liner plate deficiencies such as paint flaking, chipping, blistering, and other minor damage. The inspections have also identified a few instances of caulking deficiencies. The inspections have been effective in identifying minor irregularities on the inside surface of the liner plate before significant corrosion damage occurred.

The frequency and scope of examination specified in 10 CFR 50.55a and Subsection IWE ensure that aging effects would be detected before they would compromise the design-basis requirements. As indicated in IWE-2400, inservice examinations and pressure tests are performed in accordance with one of two inspection programs, A or B, on a specified schedule. IWE-3000 provides acceptance standards for components of steel containments and liners of concrete containments. ASME Section XI, Subsection IWE was incorporated into 10 CFR 50.55a in 1996. Prior to this time, operating experience pertaining to degradation of steel components of containment was gained through the inspections required by 10 CFR Part 50, Appendix J and ad hoc inspections conducted by licensees and the NRC.

BVPS performed Inservice Inspection (ISI) IWE examinations on the liner, penetrations, and welded attachments during the Unit 1 Cycle 17 Refueling Outage (February - April 2006) to meet the 2nd Period examination requirements of the initial IWE Interval. There were no recorded ISI non-destructive examination deficiencies in the outage.

A temporary construction opening was created for the Unit 1 steam generator and reactor head replacements during the Unit 1 Cycle 17 Refueling Outage (February - April 2006). Three areas of corrosion were identified on the Containment liner plate during initial visual inspection. These areas were located on the outside of the liner, which was on the side in contact with the concrete. Loss of material was identified for all three areas of corrosion. Ultrasonic testing (UT) measurements were performed at each location. Test results indicated spots below nominal wall thickness for the liner plate in two of three areas. The same two areas also contained evidence of pitting. The third area had evidence of minor material loss but remained at or above the nominal plate thickness with minimal pitting. The two areas found to have wall thickness below nominal were replaced. The third area was placed in service without repair or replacement, but was examined following re-painting to allow future examinations to monitor potential degradation. The probable cause for the liner plate corrosion is exposure to the elements during initial

construction. Once construction of the Containment structure was complete, exposure to water ceased and available oxygen was quickly depleted by the oxidation process itself.

BVPS documented the Containment liner corrosion issue in the Corrective Action Program. Corrective actions included follow-up inspections and repairs, and programmatic changes to more thoroughly evaluate the Containment liner plates to facilitate identification and repair of any corrosion on the steel liner. Specifically, corrosion area #3 will be ultrasonically thickness tested during each of the next three 40 month periods as part of the Inservice Inspection (ISI) 10-year plan.

Following the Unit 1 Cycle 17 Refueling Outage, test procedures for the evaluation of the Containment liner plates were modified at both units. Specifically, if the visual examination detects surface flaws on the liner plate or suspect areas on the liner plate that could potentially impact the leak tightness or structural integrity of the liner, then surface or volumetric examinations shall be performed to characterize the condition (i.e., depth, size, shape, orientation).

During the Unit 2 Cycle 10 Refueling Outage (September - October 2003) Inservice Inspection (ISI), the Unit 2 Containment Liner and associated components (penetrations, welded attachments, bolting) were examined in accordance with 10 CFR 50.55a(b)(2)(ix). The general visual examination found no conditions that affected either Containment structural integrity or leak tightness. Minor deficiencies were reported involving flaking paint and paint scratches. These areas did not impact structural integrity and were subsequently cleaned and re-painted. VT-3 examinations were also completed on the moisture barrier and on the bolting removed from the reactor cavity blind flange and the equipment hatch. The moisture barrier and bolting examinations found no unacceptable conditions. There were no ISI non-destructive examination deficiencies in the Unit 2 Cycle 10 Refueling Outage.

Identification of deficiencies and subsequent corrective actions, along with engineering evaluation of inspection results, provide reasonable assurance that the program will be effective for managing loss of material. In addition, the general lack of degradation, demonstrated through a regular program of inspections, provides reasonable assurance that the program is effective for managing aging effects for the Containment liner plate.

Conclusion

Continued implementation of the ASME Section XI, Subsection IWE Program provides reasonable assurance that the aging effects will be managed so that the structures and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.4 ASME SECTION XI, SUBSECTION IWF

Program Description

The ASME Section XI, Subsection IWF Program is in accordance with ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWF, 1989 edition (with no Addenda), within the limitations and modifications required by the Code of Federal Regulations in 10 CFR 50.55a.

This program is implemented through plant procedures, which provide for visual examination of inservice inspection Class 1, 2, and 3 supports in accordance with the requirements of ASME Code Case N-491, *Alternate Rules for Examination of Class 1, 2, 3, and MC Component Supports of Light-Water Cooled Power Plants* [Reference B.3-4].

NUREG-1801 Consistency

The ASME Section XI, Subsection IWF Program is an existing program that is consistent with NUREG-1801, Section XI.S3, *ASME Section XI, Subsection IWF*, with exception.

Exceptions to NUREG-1801

Program Elements Affected:

- **Scope of Program**

  NUREG-1801, Section XI.S3, *ASME Section XI, Subsection IWF* specifies the use of ASME Section XI, 2001 edition through 2002 and 2003 Addenda. The applicable ASME Code for the third (Unit 1 only) and second (Unit 2 only) intervals of the BVPS ASME Section XI, Subsection IWF Program is ASME Section XI, 1989 edition (with no Addenda). The use of the 1989 edition (with no Addenda) of the ASME Code is consistent with provisions in 10 CFR 50.55a to use the Code in effect 12 months prior to the start of the inspection interval. BVPS will use the ASME Code edition consistent with the provisions of 10 CFR 50.55a during the period of extended operation.

- **Parameters Monitored or Inspected**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Detection of Aging Effects**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Monitoring and Trending**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Acceptance Criteria**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Corrective Actions**

  See the exception regarding differences in ASME Code edition under Scope of Program.

Enhancements

None

Operating Experience

The VT-3 visual examination for supports is specified in Table IWF-2500-1. The complete inspection scope is repeated every 10-year inspection interval. Identification of unacceptable conditions triggers an expansion of the inspection scope in accordance with IWF-2430, and re-examination of the supports requiring corrective actions during the next inspection period in accordance with IWF-2420(b).

During the Unit 1 Cycle 17 Refueling Outage (February - April 2006), Inservice Inspection (ISI) examinations were performed on Class 1, 2, 3 and MC components. Class 1 examinations (VT-3 visual examinations for pipe and vessel supports), Class 2 examinations (supports-visual), and visual examinations of Class 3 supports were performed as part of this inspection. There were no recorded ISI non-destructive examination deficiencies in the outage.

During the Unit 2 Cycle 10 Refueling Outage (September - October 2003), Inservice Inspection (ISI) examinations were performed on Class 1, 2, and MC components. Class 2 examinations (supports-visual) were performed. There were no ISI non-destructive examination deficiencies in the outage.

QA surveillances in 2004 identified minor issues that would improve program performance and reduce human errors, but did not identify issues or findings that would impact the overall effectiveness of the program. The review of the ISI program identified items for improvement with the procedure references, format inconsistencies, and properly processing a Westinghouse evaluation. The Corrective Action Program was used to document and track all minor issues identified during the QA surveillance.

The ASME Section XI, Subsection IWF program at BVPS is updated to account for industry operating experience. ASME Section XI industry code is also revised every three years with addenda issued in the interim, which allows the code to be updated to reflect operating experience. The requirement to update the ASME Section XI, Subsection IWF program to reference more recent editions of ASME Section XI at the end of each inspection interval ensures the program reflects enhancements due to operating experience that have been incorporated into ASME Section XI. The ASME Section XI, Subsection IWF program has been effective in identifying, evaluating, and correcting component support deficiencies, including corrosion and misalignment.

Identification of minor deficiencies and non-conformities documented and resolved using the Corrective Action Program, along with engineering evaluation of inspection results, provides reasonable assurance that the program will remain effective for managing loss of material of components. In addition, the general lack of degradation, demonstrated through a regular program of inspections, provides reasonable assurance that the program is effective for managing aging effects for passive components. To date, IWF sampling inspections have been effective in managing aging effects for ASME Class 1, 2, 3, and MC supports. There is reasonable assurance that the Subsection IWF inspection program will be effective through the period of extended operation.

Conclusion

Continued implementation of the ASME Section XI, Subsection IWF Program provides reasonable assurance that the aging effects will be managed so that the structures and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.5 ASME SECTION XI, SUBSECTION IWL

Program Description

The ASME Section XI, Subsection IWL Program is in accordance with ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWL, 1992 edition with the 1992 Addenda, within the limitations and modifications required by the Code of Federal Regulations in 10 CFR 50.55a.

The program consists of periodic visual inspections of the reinforced concrete Containment structures. An additional commitment requires that the inspectors be trained and certified in accordance with ASME, Section IX, Subsection IWL (1992 edition with the 1992 Addenda) standards. The BVPS concrete Containment Buildings do not utilize a post-tensioning system; therefore, the IWL requirements associated with a post-tensioning system are not applicable.

NUREG-1801 Consistency

The ASME Section XI, Subsection IWL Program is an existing program that is consistent with NUREG-1801, Section XI.S2, *ASME Section XI, Subsection IWL*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

The ASME Section XI, Subsection IWL Program, by its nature, is sensitive to plant and industry operating experience. The program is based on guidelines established by the American Society of Mechanical Engineers (ASME) and the American Concrete Institute (ACI), which in part, are based on actual commercial operating experience. Program inspectors are tasked with identifying and addressing any unusual or unexpected appearance on the exposed, exterior surface of the Containment Buildings. Previous BVPS Containment Building inspections have identified minor issues such as mildew and rust stains, spalling, surface cracks, and loose foreign materials. Inspection findings and the resulting corrective actions were documented and tracked using the BVPS Corrective Action Program.

A regular program of Containment concrete (IWL) inspections has been established in which all accessible external surfaces of the Unit 1 and Unit 2 Containment Buildings are visually inspected every 5 years. The scope and level of detail of these inspections are procedurally defined. However, relevant industry operating experience also provides a contemporary basis for what to look for in the inspections. For example, an Institute of Nuclear Power Operations

operating experience message alerted all plants to look for embedded wood (from construction) and other articles when performing Containment concrete inspections. Subsequent inspections at BVPS identified a few small articles (form ties, small pieces of wood, etc.) embedded in the Containment Building exterior concrete. All identified articles were confined to the outer surface concrete and were successfully removed, and any remaining void was appropriately patched.

The most recent Containment structure IWL inspections were performed during the Unit 1 Cycle 17 Refueling Outage (February - April 2006) and the Unit 2 Cycle 10 Refueling Outage (October - November 2006). Inspection results confirmed the physical condition of the concrete for Unit 1 and Unit 2 Containment structures was satisfactory. There were no identified non-conformities, unusual wear, or damage observed on the exterior concrete at either unit. The Unit 1 IWL evaluation included inspection of the new concrete applied at the temporary construction opening used for steam generator and reactor head replacement access.

Identification of Containment structure non-conformities, along with appropriate corrective actions and engineering evaluation of inspection results, provide reasonable assurance that the IWL program will effectively manage Containment structure loss of material and cracking. The general lack of degradation, demonstrated through regular inspections, provides evidence that the program is effective in managing aging effects for the Containment structures.

BVPS Containment Buildings do not utilize prestressing or post-tensioning systems in their design and construction, therefore these systems are neither evaluated nor assessed.

Conclusion

Continued implementation of the ASME Section XI, Subsection IWL Program provides reasonable assurance that the aging effects will be managed so that the structures within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.6 BOLTING INTEGRITY

Program Description

The Bolting Integrity Program implements industry recommendations for a comprehensive bolting integrity program, as delineated in NUREG-1339, *Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants* [Reference B.3-5], and EPRI NP-5769, *Degradation and Failure of Bolting in Nuclear Power Plants* [Reference B.3-6]. Also, it implements industry recommendations for comprehensive bolting maintenance, as delineated in EPRI TR-104213, *Bolted Joint Maintenance & Application Guide* [Reference B.3-7], for pressure retaining bolting and structural bolting.

The program includes periodic inspection of closure bolting for indication of loss of preload, cracking, and loss of material due to corrosion, rust, etc. It also includes preventive measures to preclude or minimize loss of preload and cracking.

The program inspections are implemented through other aging management programs listed as follows:

- ASME Section XI, *Inservice Inspection, Subsections IWB, IWC, & IWD Program;*
- ASME Section XI, *Subsection IWE Program;*
- ASME Section XI, *Subsection IWF Program;*
- Structures Monitoring Program; and,
- External Surfaces Monitoring Program.

NUREG-1801 Consistency

The Bolting Integrity Program is an existing program that is consistent with NUREG-1801, Section XI.M18, *Bolting Integrity.*

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

The Bolting Integrity Program manages the effects of aging on bolting within the scope of license renewal. It includes periodic inspection of closure bolting for indication of loss of preload, cracking, and loss of material due to corrosion. It also includes preventive measures to preclude

or minimize loss of preload and cracking. The Bolting Integrity Program inspections are implemented through other aging management program inspections. Consequently, the frequency, acceptance criteria, and degree of inspection depends on factors including location, type of bolting, importance to safety, age, environmental conditions, and service requirements. The Corrective Action Program is used to document and correct degradation of bolting.

Visual inspections of bolted connections that have identified blistered coating and corrosion have been documented in the Corrective Action Program. Corrective actions were completed to ensure future integrity of the bolted connections. For example, in 2002, during a VT-1 visual inspection of reactor coolant pump flange bolts, the condition of a bolt was determined to be unsatisfactory. The specific condition observed was blistering of the bolt coating in the mid-shank area between the head and threads. The threads were also noted to be lightly rusted. The bolt was replaced.

Visual inspections of bolted connections that have identified inadequate thread engagement and loose or less than flush nuts have been documented in the Corrective Action Program. Corrective actions were completed to ensure future integrity of the bolted connections. For example, in 2003, during a refueling outage, an inspector noted a loose nut on one of the flange studs for the downstream flange of a strainer. The strainer flange nuts were re-torqued.

The program has evaluated industry operating experience for applicability, as documented in the Corrective Action Program. For example, in 2003, an industry operating experience notice was issued. It described a condition in which Emergency Diesel Generator temperature control valve internal poppet cap screw heads were found broken. The cause was determined to be intergranular stress corrosion cracking on the brass bolts that were in tension in the sodium-nitrite treated jacket water system. This condition was determined to be applicable to the BVPS Unit 2 Emergency Diesel Generators, because the same temperature control valves are used on the jacket water and intercooler systems. A review of inspections, configuration, and chemistry parameters determined that BVPS Emergency Diesel Generator operability was not challenged by the issues raised in the industry operating experience.

The Bolting Integrity Program has identified and resolved bolting aging issues through the Corrective Action Program. The Bolting Integrity Program has been evaluated against industry operating experience as appropriate. Identification of degradation and resolution of corrective actions prior to loss of intended function, along with reviews of program effectiveness, provide reasonable assurance that the program is effective for managing aging effects for passive components.

Conclusion

Continued implementation of the Bolting Integrity Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.7 BORIC ACID CORROSION

Program Description

The Boric Acid Corrosion Program manages loss of material due to borated water leakage through periodic visual inspections. The program relies in part on implementation of recommendations of NRC Generic Letter 88-05, *Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants* [Reference B.3-8].

The scope of the program inspections includes all systems that contain borated water, as well as components and systems that may be potentially impacted by borated water leakage. The program includes provisions for (a) determination of the principal location of leakage, (b) examination requirements and procedures for locating small leaks, and (c) engineering evaluations and corrective actions. If borated water leakage is discovered, either by program inspections or by other activities, it is evaluated and resolved using the Corrective Action Program.

NUREG-1801 Consistency

The Boric Acid Corrosion Program is an existing program that is consistent with NUREG-1801, Section XI.M10, *Boric Acid Corrosion*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

Frequent monitoring of locations where potential boric acid leakage could occur, and timely repair if leakage is detected, prevents or mitigates boric acid corrosion by minimizing reactor coolant leakage. NRC Generic Letter 88-05 recommends that corrective actions to prevent recurrences of degradation caused by borated water leakage be included in the program inspection.

Minor boric acid leakage detected during inspections of the BVPS Containment and Auxiliary Buildings was documented and evaluated as required by the boric acid corrosion control process, which included the use of the corrective action process. Identification of degradation and corrective action prior to loss of intended function provide reasonable assurance that the program is effective for managing aging effects for passive components.

Fleet and site procedures provide a structured approach for the evaluation and mitigation of borated water leakage which has the potential to affect structures and components within the scope of license renewal.

A self-assessment conducted in July of 2006 determined that the Boric Acid Corrosion Program was effective. The assessment generated several minor items for program enhancement:

- The BAC program tracks RCS inventory as recommended in WCAP-15988-NP, *Generic Guidance to Best Practice 88-05 Boric Acid Inspection Program* [Reference B.3-9], Section 4.4; however, other parameters such as airborne particulate activity, humidity, temperature could also be tracked and trended by the program.
- The self-assessment also recommended that boric acid leakage be added to the respective system health report.
- WCAP 15988-NP states that high radiation areas with infrequent access should be evaluated to determine boric acid corrosion susceptibility and required inspection frequency. The self-assessment recommended that the program be expanded to address high radiation areas with infrequent access.

An action plan was implemented to incorporate the recommendations, and an SAP Action Tracking Item was generated to track the action plan items to completion. The self-assessment also identified areas of good performance, including employee training, the use of the corrective action process, and the improving trend for tracking leaks at BVPS.

The Boric Acid Program at BVPS was enhanced to include recommendations of the Westinghouse Owner's Group, EPRI guidelines, NRC Bulletin 2002-01, *Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity,* and NRC Bulletin 2003-02, *Leakage from Reactor Coolant Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity* [Reference B.3-10]. For example, in response to NRC Bulletin 2002-01 and the Davis-Besse reactor head event, BVPS identified susceptible locations and performed volumetric and bare-metal visual examinations on the Reactor Vessel top head Alloy 600 materials, as well as bare-metal visual inspections of the Reactor Vessel bottom-mounted instrumentation tubes for Unit 1 and Unit 2. Other susceptible locations, such as Alloy 82/182 pressurizer top head nozzles and Reactor Vessel hot leg nozzles, were also examined. BVPS incorporated other appropriate changes to the program as a result of specific FENOC operating experience and the Fleet Boric Acid Corrosion Control Program based on the Davis-Besse event.

Continued process improvements through incorporation of industry recommendations provide reasonable assurance that the program will remain effective for managing aging effects for passive components during the period of extended operation.

Conclusion

Continued implementation of the Boric Acid Corrosion Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.8 BURIED PIPING AND TANKS INSPECTION

Program Description

The Buried Piping and Tanks Inspection Program is a new program that BVPS will implement prior to the period of extended operation.

This program will include (a) preventive measures to mitigate corrosion and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried components constructed of steel and stainless steel. Preventive measures will be in accordance with standard industry practice for maintaining external coatings and wrappings. Buried components will be inspected when excavated for maintenance or a planned inspection. The program requires that, for each unit at BVPS, at least one opportunistic or focused inspection be performed and documented within the 10-year period prior to, and within the 10-year period after entering, the period of extended operation.

NUREG-1801 Consistency

The Buried Piping and Tanks Inspection Program is a new program that is consistent with NUREG-1801, Section XI.M34, *Buried Piping and Tanks Inspection.*

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.M34, are provided as follows:

- **Scope of Program**

  The program will manage the aging of buried components (piping and tanks) within the scope of license renewal that are exposed to soil.

- **Preventive Actions**

  In accordance with industry practice, coatings and wrapping are used to protect against corrosion by isolating the external surface of the piping from the soil environment. The program will ensure that the integrity of the coatings and wrappings of buried pipe is maintained.

- **Parameters Monitored / Inspected**

  When the opportunity arises, buried piping and tanks will be visually inspected for coating and wrapping integrity. Any evidence of damaged wrapping or coating defects, such as coating perforation, holidays, or other damage, is an indicator of possible corrosion damage to the external surface of piping and tanks.

- **Detection of Aging Effects**

  The program requires that, for each unit at BVPS, at least one opportunistic or focused inspection be performed and documented within the 10-year period prior to, and within the 10-year period after entering, the period of extended operation. Buried piping and tanks will be opportunistically inspected whenever they are excavated during maintenance. The inspections will be performed in areas with the highest likelihood of corrosion, and in areas with a history of corrosion, based on plant-specific and industry operating experience.

  If there are no opportunities for inspection within the 10-year period prior to the period of extended operation, the program will require that a focused inspection at each unit be performed and documented. Likewise, if there are no opportunities for inspection within the 10-year period after entering the period of extended operation, the program will require that a focused inspection at each unit be performed and documented.

- **Monitoring and Trending**

  Results of previous inspections will be used to identify susceptible locations for future inspections.

- **Acceptance Criteria**

  Any coating and wrapping degradations found during inspections of buried piping and tanks will be evaluated, tracked, and repaired using the Corrective Action Program.

- **Corrective Actions**

  This element is discussed in Section B.1.3.

- **Confirmation Process**

  This element is discussed in Section B.1.3.

- **Administrative Controls**

  This element is discussed in Section B.1.3.

- **Operating Experience**

  Industry operating experience has shown that buried steel and cast iron components have experienced corrosion degradation. Critical areas include those at the interface

where the component transitions from aboveground to underground. This is an area where coatings are often missing or damaged.

Leaks have occurred in BVPS buried piping components, and these leaks have been identified and repaired. This plant-specific operating experience demonstrates that leaks have been identified early enough to ensure no loss of intended function. As an example, the buried piping within the Service Water System at Unit 2 experienced a significant leak in 2003. The leak was identified, located, and corrective action was taken to repair the affected pipe.

The review of plant-specific operating experience has shown that buried piping failures are caused by protective coating/wrapping breeches or improper selection or use of backfill. Scheduled or opportunistic inspections of selected buried piping allow evaluation of the coating/wrapping and surrounding backfill. The BVPS Buried Piping and Tanks Inspection Program will incorporate plant-specific and industry operating experience in the selection of piping or tanks for inspection.

Conclusion

The implementation of the Buried Piping and Tanks Inspection Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.9 CLOSED-CYCLE COOLING WATER SYSTEM

Program Description

The Closed-Cycle Cooling Water System Program includes: (1) preventive measures to minimize corrosion, and (2) periodic system and component performance testing and inspection to monitor the effects of corrosion and confirm that intended functions are met. This program manages loss of material, cracking, and reduction of heat transfer for components exposed to closed cooling water systems (Primary Component and Neutron Shield Tank Cooling Water, Chilled Water, diesel-driven fire pump engine cooling water (Common), Emergency Diesel Generator Cooling Water, Security Diesel Generator Cooling Water (Common), Emergency Response Facility Substation diesel generator cooling water (Common), and Unit 2 diesel-driven station standby air compressor engine cooling water).

These systems are closed cooling loops with controlled chemistry, consistent with the NUREG-1801 description of a closed cycle cooling water system. The adequacy of chemistry control is confirmed on a routine basis by sampling and ensuring contaminants and additives are within established limits, and by equipment performance monitoring to identify aging effects. These chemistry activities are controlled using BVPS procedures and processes and are based on EPRI guidance for closed cooling water chemistry located in EPRI 1007820 (EPRI 107396, Rev. 1) [Reference B.3-11].

NUREG-1801 Consistency

The Closed-Cycle Cooling Water System Program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.M21, *Closed-Cycle Cooling Water System*.

Exceptions to NUREG-1801

None

Enhancements

The following enhancements will be implemented prior to the period of extended operation.

Program Elements Affected:

- **Scope of Program**

  Add the diesel-driven fire pump (Unit 1 only) and the diesel-driven standby air compressor (Unit 2 only) to the Closed-Cycle Cooling Water System Program.

- **Parameters Monitored / Inspected**

  The Closed-Cycle Cooling Water System Program will be enhanced to detail performance testing of heat exchangers and pumps and provide direction to perform visual inspections of system components.

- **Detection of Aging Effects**

  The Closed-Cycle Cooling Water System Program will be enhanced to identify closed-cycle cooling water system parameters that will be trended to determine if heat exchanger tube fouling or corrosion product buildup exists.

- **Monitoring and Trending**

  The Closed-Cycle Cooling Water System Program will be enhanced to control performance tests and to perform visual inspections at the required frequency.

Operating Experience

The Closed-Cycle Cooling Water System Program is an existing program that includes preventive measures to manage loss of material, cracking, and reduction of heat transfer for passive components which make up the closed-cycle cooling water (CCCW) systems.

Multiple operating experience tools are used to assess, evaluate, and improve the management of passive aging of the CCCW systems. This includes Corrective Action Program documents, self assessments, quality assessment audits, latent issues reports, Institute for Nuclear Power Operations (INPO) operating experience documents (operating experience messages, Significant Event Reports, Significant Event Notifications, Significant Operating Experience Reports, etc.), and NRC documents (Information Notices, Generic Letters, Bulletins, etc.). Corrective Action Program items or SAP Activity Tracking items will be used to track and document the site response to any internal or external document which is or may be applicable to BVPS.

A Self Assessment was performed on chemistry control of closed cooling water systems in March of 2007. There were two specific program improvement recommendations which were documented using the Corrective Action Program and will be tracked in SAP. The program improvements are (1) evaluating the feasibility of a corrosion coupon monitoring system and (2) determining if implementation of a sessile microbiological monitoring system provides a cost-justified benefit. Including these program recommendations into the Corrective Action Program and SAP Program will ensure that these potential improvements are tracked until it is determined whether or not to implement the proposed changes. The basis for either decision will be documented in the CR investigation summary.

The integrity of the CCCW Systems is ensured by monitoring and maintaining water chemistry parameters within acceptable limits, and by inspecting the physical condition of system piping.

Unexpected CCCW System conditions are addressed through the Corrective Action Program for resolution and to provide documented guidance for similar, future events (operating experience).

BVPS evaluated for applicability an INPO operating experience message regarding unexpected temperature control valve bolting corrosion in the Emergency Diesel Generator (EDG) Jacket Water System. The EDG at the affected plant was built by the same manufacturer as the BVPS Unit 2 EDGs. BVPS was also notified via the EDG owners group (Fairbanks-Morse), of which BVPS is an affiliated member. BVPS documented the assessment of this industry operating experience event in the Corrective Action Program, which provides tracking, documentation and an engineering basis for why no specific actions were needed.

The Closed Cycle Cooling Water System Program has been effective at managing aging effects for passive components which make up the closed cooling water systems. Use of corrective action process to identify, track, and document applicable operating experience events, and improvement recommendations from self-assessments, latent issues reports, and quality assessment audits provide reasonable assurance that the CCCW program, as enhanced, will effectively manage passive component loss of material, cracking, and reduction of heat transfer.

Conclusion

Continued implementation of the Closed-Cycle Cooling Water System Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions, consistent with the current licensing basis, for the period of extended operation.

B.2.10 ELECTRICAL CABLE CONNECTIONS NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS ONE-TIME INSPECTION

Program Description

The Electrical Cable Connections not Subject to 10 CFR 50.49 Environmental Qualification Requirements One-Time Inspection Program is a new, plant-specific program that will focus on the metallic parts of the cable connection. This sampling program will be implemented and completed prior to the period of extended operation. A representative sample of electrical cable connection population subject to aging management review will be inspected or tested. Electrical connections covered under the EQ program, or connections inspected or tested as part of a preventative maintenance program will be excluded from aging management review. The program is a plant-specific alternate to NUREG-1801, XI.E6, *Electrical Cable Connections not Subject to 10 CFR 50.49 Environmental Qualification Requirements.*

This sampling program will provide a one-time inspection to verify that the loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation is not an aging issue that requires a periodic aging management program. The design of these connections accounts for the stresses associated with ohmic heating, thermal cycling, and dissimilar metal connections. Therefore, these stressors or mechanisms should not be a significant aging issue. However, confirmation of the lack of aging effects will be required. The factors to be considered for sample selection will be application (medium and low voltage), circuit loading (high loading), and location (high temperature, high humidity, vibration, etc.). The technical basis for the sample selection will be documented. Any unacceptable conditions found during the inspection will be evaluated through the Corrective Action Program.

For Unit 2 only, the metallic parts of metal enclosed bus connections are managed by the Metal Enclosed Bus Program (Unit 2 only) [Section B.2.26] as delineated in NUREG-1801, XI.E4, *Metal Enclosed Bus,* and are therefore not included within the scope of the program. There is no in-scope metal enclosed bus at Unit 1.

This aging management program is an alternate to NUREG-1801, XI.E6, and will adequately manage the aging effects listed for connections not included in the EQ program.

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1800 [Reference 1.3-4], Appendix A, are provided as follows:

- **Scope of Program**

  Non-EQ connections associated with cables in scope of license renewal are part of this program. This program does not include the higher voltage (> 35 kV) connections, such

as the Switchyard connections. In-scope connections are evaluated for applicability of this program. The criteria for including connections in this program are that the connection is a bolted connection, and is not covered under the EQ program or an existing preventative maintenance program.

- **Preventive Actions**

  This one-time inspection program is a condition monitoring program; therefore, no actions are taken as part of this program to prevent or mitigate aging degradation.

- **Parameters Monitored / Inspected**

  This program will focus on the metallic parts of the cable connections. The one-time inspection verifies that the loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation is not an aging effect that requires a periodic aging management program.

- **Detection of Aging Effects**

  A representative sample of electrical connections within the scope of license renewal, and subject to aging management review will be inspected or tested prior to the period of extended operation to verify there are no aging effects requiring management during the period of extended operation. The factors to be considered for sample selection will be application (medium and low voltage), circuit loading (high loading), and location (high temperature, high humidity, vibration, etc.). The technical basis for the sample selected is to be documented. Inspection methods may include thermography, contact resistance testing, or other appropriate methods including visual based on plant configuration and industry guidance. The one-time inspection provides additional confirmation to support industry operating experience that shows electrical connections have not experienced a high degree of failures, and that existing installation and maintenance practices are effective.

- **Monitoring and Trending**

  Trending actions are not included as part of this program because this is one-time inspection program.

- **Acceptance Criteria**

  The acceptance criteria for each inspection / surveillance are defined by the specific type of inspection or test performed for the specific type of cable connections. Acceptance criteria ensure that the intended functions of the cable connections can be maintained consistent with the current licensing basis.

- **Corrective Actions**

  If the inspection or test acceptance criteria are not met, the Corrective Action Program will be used to perform an evaluation for extent-of-condition, the indications of aging effects,

and possible changes to the one-time inspection program such as increased frequency and sample size. As discussed in the appendix to NUREG-1801, the requirements of 10 CFR Part 50, Appendix B, is acceptable to address the corrective actions. The BVPS Corrective Action Program, which is implemented in accordance with requirements of 10 CFR Part 50, Appendix B, applies to the Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements One-Time Inspection Program.

This element is discussed further in Section B.1.3.

- **Confirmation Process**

  This element is discussed further in Section B.1.3.

- **Administrative Controls**

  This element is discussed further in Section B.1.3.

- **Operating Experience**

  The Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements One-Time Inspection Program is a new aging management program for which there is no plant-specific program operating experience for program effectiveness.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. Future operating experience will be appropriately incorporated into the program.

  Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 Section XI.E6 program description.

Enhancements

None

Conclusion

The implementation of the Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements One-Time Inspection Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.11 ELECTRICAL CABLES AND CONNECTIONS NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Program Description

The Electrical Cables And Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements Program is a new program that BVPS will implement prior to the period of extended operation.

The Electrical Cables And Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements Program will provide reasonable assurance that intended functions of insulated cables and connections exposed to adverse localized environments caused by heat, radiation and moisture can be maintained consistent with the current licensing basis through the period of extended operation. An “adverse localized environment” is an environment that is significantly more severe than the specified service condition for the insulated cable or connection.

A representative sample of accessible insulated cables and connections within the scope of license renewal and located in adverse localized environments will be visually inspected at least once every 10 years for cable and connection jacket surface anomalies, such as embrittlement, discoloration, cracking or surface contamination. The program will require the first inspection to be completed prior to the period of extended operation. The technical basis for sampling will be derived from the guidance provided by applicable EPRI and IEEE documents.

NUREG-1801 Consistency

The Electrical Cables And Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements Program is a new program that is consistent with NUREG-1801, Section XI.E1, *Electrical Cables And Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.E1, are provided as follows:

- **Scope of Program**

  The program will address accessible electrical cables and connections not subject to 10CFR50.49 environmental qualification requirements within the scope of license renewal, and are prone to adverse localized environments.

- **Preventive Actions**

  The program is a visual inspection program and does not contain actions to prevent or mitigate aging degradation. This program is a condition monitoring program.

- **Parameters Monitored / Inspected**

  The program will require the use of walkdowns using the general area and/or focused approach to identify adverse localized environments that pertain to non-EQ cables and connections. The technical basis for a representative sample will be determined using EPRI guidance. Using EPRI documents as a guide, non-EQ cables and connections will be inspected for surface anomalies, such as embrittlement, discoloration, cracking, or surface contamination.

- **Detection of Aging Effects**

  The program will address determination of unacceptable, visual indications of surface anomalies due to aging degradation from heat, radiation, or moisture in the presence of oxygen. Visual inspection of a representative sample will be performed at least once every 10 years, with the first inspection to be completed prior to the period of extended operation.

- **Monitoring and Trending**

  Trending will not be required by the program. However, inspection data sheets will be maintained as program/plant records that are available for review and/or trending during subsequent walkdown inspections. Any trending required by the Corrective Action Program will not be eliminated by this program.

- **Acceptance Criteria**

  The program will provide acceptance criteria that accessible cables and connections are to be free from unacceptable, visual indications of surface anomalies. The technical information and guidance provided by applicable EPRI and IEEE documents are used as general references in the program for performance of visual inspections and evaluations to identify unacceptable indications that, if left un-managed, could lead to a loss of the intended function.

- **Corrective Actions**

  The program will require an engineering evaluation for all unacceptable visual indications of cable and connection jacket surface anomalies. Engineering will evaluate the age and operating environment of the component, as well as the severity of the anomaly and whether such an anomaly has previously been correlated to degradation of conductor insulation or connections. Corrective actions may include, but are not limited to, testing, shielding or otherwise changing the environment, or relocation or replacement of the affected cable or connection. Determination as to whether an unacceptable condition or situation is applicable to other accessible or inaccessible cables or connections will be made as part of the Corrective Action Program.

  This element is discussed further in Section B.1.3.

- **Confirmation Process**

  This element is discussed further in Section B.1.3.

- **Administrative Controls**

  This element is discussed further in Section B.1.3.

- **Operating Experience**

  The Electrical Cables And Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements Program is a new program; therefore, there is no plant-specific program operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

Conclusion

The implementation of the Electrical Cables And Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.12 ELECTRICAL CABLES AND CONNECTIONS NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS USED IN INSTRUMENTATION CIRCUITS

Program Description

The Electrical Cables And Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits Program is a new program that BVPS will implement prior to the period of extended operation.

The purpose of this aging management program will be to demonstrate that sensitive (high voltage – low current applications) instrument cables and connections susceptible to aging effects caused by exposure to adverse localized environments caused by heat, radiation, and moisture will be adequately managed so that there is reasonable assurance that the cables and connections will perform their intended function in accordance with the current licensing basis during the period of extended operation. An “adverse localized environment” is an environment that is significantly more severe than the specified service environment for the cable. This aging management program will require a review of non-EQ instrumentation circuit calibration results at least once every 10 years, with the initial performance of this program to occur prior to the period of extended operation. BVPS will incorporate into the program the appropriate technical information and guidance provided in NUREG/CR-5643, *Insights Gained From Aging Research*, SAND96-0344, *Aging Management Guideline for Commercial Nuclear Power Plants - Electrical cable and Terminations*, and other industry documents.

NUREG-1801 Consistency

The Electrical Cables And Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits Program is a new program that is consistent with NUREG-1801, Section XI.E2, *Electrical Cables And Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.E2, are provided as follows:

- **Scope of Program**

  The program includes electrical cables and connections within the scope of license renewal that are used in high range radiation monitoring (outside Containment) and excore nuclear instrumentation, and are not subject to 10CFR50.49 environmental qualifications.

- **Preventive Actions**

  This program is a condition monitoring program. The program provides for timely detection of aging effects, but does not prevent or mitigate aging degradation.

- **Parameters Monitored / Inspected**

  The program provides the direction necessary for the review of calibration (surveillance) records of low-current instrumentation circuits. The plant surveillance procedures determine the parameters that are monitored for the high range radiation monitors and the excore detector circuits. These calibrations are required by Technical Specifications, and include the entire circuit based on the surveillance procedures.

- **Detection of Aging Effects**

  The program will review the calibration results of the high range radiation monitors and the excore instrumentation circuits. The calibration procedure includes a loop calibration with all components including the detectors connected. The first review of calibration results will be completed before the period of extended operation and at least every 10 years thereafter. The technical specification surveillances (calibrations) are performed at the periodicity stated in the technical specifications, which is more frequent than once every 10 years. An evaluation will be performed through the Corrective Action Process if any of the surveillance acceptance criteria are not met.

  The alternate method of performing cable testing is not used since the calibration procedures include the entire circuit.

- **Monitoring and Trending**

  Trending will not be included as part of the program. However, the review of calibration results will be documented and maintained as part of plant records.

- **Acceptance Criteria**

  The program outlines development of acceptance criteria for the review of calibration results. The calibration surveillances contain acceptance criteria for the specific circuit, and the Corrective Action Process is used if values do not meet the acceptance criteria.

- **Corrective Actions**

  This element is discussed further in Section B.1.3.

- **Confirmation Process**

  This element is discussed further in Section B.1.3.

- **Administrative Controls**

  This element is discussed further in Section B.1.3.

- **Operating Experience**

  The Electrical Cables And Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits Program is a new program; therefore, there is no plant-specific program operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

Conclusion

The implementation of the Electrical Cables And Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.13 ELECTRICAL WOODEN POLES/STRUCTURES INSPECTION (UNIT 2 ONLY)

Program Description

The Electrical Wooden Poles/Structures Inspection Program is a new plant-specific program that BVPS will implement prior to the period of extended operation. This program is applicable only to Unit 2. There are no in-scope electrical wooden poles/structures at Unit 1.

The Electrical Wooden Poles/Structures Inspection Program manages aging effects for wooden poles subject to aging management, such as insect and woodpecker damage, reduced circumference, and moisture intrusion. Appropriate aging management methods include pole sounding, pole boring, and underground inspection. There is no comparable NUREG-1801 aging management program.

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1800 [Reference 1.3-4], Appendix A, are provided as follows:

- **Scope of Program**

  Several electrical wooden poles (wooden H-frame structures) at BVPS Unit 2 have been identified to be within the scope of license renewal and subject to aging management.

- **Preventive Actions**

  This electrical pole and structures inspection program is a condition monitoring program as described in Appendix A.1.1 of NUREG-1800. The program provides for timely detection of aging effects and does not support preventive or mitigating actions. No actions are taken as part of this inspection to prevent or mitigate aging degradation.

- **Parameters Monitored / Inspected**

  The wooden poles within the license renewal scope are inspected for loss of material due to insect, and woodpecker damage, reduced circumference, and moisture intrusion, and inspected for change in material properties due to moisture damage. The visual inspection portion of the activity also includes the cross-arms, guys, hardware, static supports, and insulators.

- **Detection of Aging Effects**

  Inspection on a 10-year period is adequate to ensure detection prior to loss of intended function. The typical life of a wooden pole, based on industry experience is 30-40 years. Industry experience over several decades indicates that a 10-year inspection interval is adequate.

- **Monitoring and Trending**

  This is not a trending activity. The 10-year inspection provides for timely identification of aging effects. Reports are generated and responded to in a timely manner. The first inspection will be performed within a 5-year period prior to the expiration of the current license.

- **Acceptance Criteria**

  No unacceptable indications of loss of material, or change in material properties are found as determined by a qualified inspector.

- **Corrective Actions**

  This element is discussed in Section B.1.3.

- **Confirmation Process**

  This element is discussed in Section B.1.3.

- **Administrative Controls**

  This element is discussed in Section B.1.3.

- **Operating Experience**

  The Electrical Wooden Poles/Structures Inspection Program is a new program; therefore, there is no plant-specific program operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

Enhancements

None

Conclusion

The implementation of the Electrical Wooden Poles/Structures Inspection Program will provide reasonable assurance that the aging effects will be managed so that the structures and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.14 ENVIRONMENTAL QUALIFICATION (EQ) OF ELECTRICAL COMPONENTS

Program Description

The Environmental Qualification (EQ) of Electrical Components Program manages the effects of thermal, radiation, and cyclic aging through the use of aging evaluations based on 10 CFR 50.49 qualification methods. As required by 10 CFR 50.49, environmental qualification program components not qualified for the current license term are refurbished, replaced, or their qualification extended prior to reaching the aging limits established in the evaluations. Aging evaluations for environmental qualification program components are time-limited aging analyses (TLAAs) for license renewal.

NUREG-1801 Consistency

The Environmental Qualification (EQ) of Electrical Components Program is an existing program that is consistent with NUREG-1801, Section X.E1, *Environmental Qualification (EQ) of Electrical Components*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

On a continuing basis, the Environmental Qualification (EQ) of Electrical Components Program, as administrated by the EQ program engineer, ensures that the design and installation of 10 CFR 50.49 Harsh Environment equipment meets site-specific EQ requirements. These EQ requirements, in turn, provide reasonable assurance that the equipment will operate/function properly for the time period relied upon to prevent the occurrence of, or mitigate the effects of, an accident or plant transient.

The overall effectiveness of the EQ of Electric Components Program is demonstrated by the excellent operating experience for systems, structures, and components in the program. A self-assessment in 2006 was performed based upon industry operating experience that identified discrepancies in the information contained within the Preventative Maintenance (PM) database and the associated EQ program documentation. The self-assessment found that one of the 94 EQ Maintenance Assessment Packages was deficient in the PM database and would have

caused the equipment to be installed beyond its qualified life value. A Corrective Action Program report was generated to correct the replacement frequency from 22 years to 20 years.

The Corrective Action Program is used to identify program and component issues, as well as document program engineering assessments and reviews that have or could have an impact on the performance of the EQ program. The Corrective Action Program has been used to document potential program deficiencies based on industry operating experience and track corrective actions, when necessary.

As stated in NUREG-1801, Section X.E1, *Environmental Qualification (EQ) of Electric Components*, "EQ programs include consideration of operating experience to modify qualification bases and conclusions, including qualified life. Compliance with 10 CFR 50.49 provides reasonable assurance that components can perform their intended functions during accident conditions after experiencing the effects of in-service aging." The BVPS program is in compliance with 10 CFR 50.49 and is deemed effective at managing aging effects for electric components.

Conclusion

Continued implementation of the Environmental Qualification (EQ) of Electrical Components Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.15 EXTERNAL SURFACES MONITORING

Program Description

The External Surfaces Monitoring Program is a new program that BVPS will implement prior to the period of extended operation.

The External Surfaces Monitoring Program is based on system inspections and walkdowns. This program will consist of periodic inspections to monitor the external surfaces of in-scope steel components and other metal components for material degradation and leakage, and periodic inspection of in-scope elastomer components for hardening, loss of strength or cracking through physical manipulation. The program will also require inspection of the Emergency Response Facility (ERF) diesel generator jacket water radiator fins for build-up of dust, dirt and debris. Additionally, the program is credited with managing aging effects of internal surfaces, for situations in which material and environment combinations are the same for internal and external surfaces such that external surface condition is representative of internal surface condition.

Loss of material due to boric acid corrosion is managed by the Boric Acid Corrosion Program [Section B.2.7].

NUREG-1801 Consistency

The External Surfaces Monitoring Program is a new program that is consistent with NUREG-1801, Section XI.M36, *External Surfaces Monitoring*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.E1, are provided as follows:

- **Scope of Program**

  The program will require visual inspection of the external surfaces of in-scope components and monitoring of the external surfaces of steel components and other metal components within the scope of license renewal and subject to aging management review for loss of material and leakage. The program will require inspection of in-scope elastomer components for hardening, loss of strength or cracking. The program will also

require inspection of the ERF diesel generator jacket water radiator fins for build-up of dust, dirt and debris.

Inspections shall include, but will not be limited to the following types of inspection:

- Visual inspection for indications of general corrosion (applicable to steel components), pitting corrosion, and crevice corrosion of exposed metal surfaces. For steel components, general corrosion is expected to be present and detectable. If pitting and crevice corrosion should exist, then general corrosion will manifest itself as visible rust or rust by-products (e.g., discoloration or coating degradation) and will be detectable prior to any loss of intended function.
- Visual inspection of elastomers for indications of hardening, loss of strength and cracking. The inspection will include physical manipulation of elastomers to visually confirm flexibility.
- Visual inspection of the ERF diesel generator jacket water radiator fins for build-up of dust, dirt and debris. The ERF diesel generator jacket water radiator is a coil/fin type heat exchanger where the fins are exposed to an air-outdoor environment. The applicable aging effect is reduction of heat transfer due to build-up of dust, dirt and debris.

The External Surfaces Monitoring program is credited with managing aging effects of internal surfaces, for situations in which material and environment combinations are the same for internal and external surfaces, such that external surface condition is representative of internal surface condition.

- **Preventive Actions**

  The External Surfaces Monitoring Program is a visual monitoring program that does not include preventive actions.

- **Parameters Monitored / Inspected**

  The program will require the use of periodic plant system inspections and walkdowns to monitor for material degradation and leakage. The program inspects components such as piping, piping components, ducting and other components. The inspection parameters will include the following:

  - Corrosion and material wastage (loss of material);
  - Leakage from or onto external surfaces;
  - Worn, flaking, or oxide-coated surfaces;
  - Corrosion stains on thermal insulation; and,
  - Protective coating degradation (cracking and flaking).

  The program provides for inspection of bolting used in pressure retaining components (non-safety related) as required by the Bolting Integrity Program.

- **Detection of Aging Effects**

  The program will require periodic visual inspection of in-scope steel components and other metal components to identify loss of material. The program will require periodic inspection of in-scope elastomer components for hardening, loss of strength or cracking. The program will also require periodic inspection of the ERF diesel generator jacket water radiator fins for build up of dust, dirt and debris.

  For metal surfaces that are painted or coated, the program will inspect these surfaces to confirm integrity of the paint or coating. If no degradation is indicated, then no additional inspection of the subject surface will be required.

  The program is credited with managing aging effects of internal surfaces, for situations in which material and environment combinations are the same for internal and external surfaces, such that external surface condition is representative of internal surface condition.

  The program will require a visual inspection to be conducted for in-scope component surfaces at least once per fuel cycle. This frequency allows inspections of components that may be in locations that are only accessible during outages. As such, component surfaces that are inaccessible or not readily visible during plant operations are inspected during refueling outages.

  Component surfaces that are inaccessible or not readily visible during plant operations and refueling outages will be inspected at such intervals that will provide reasonable assurance that the effects of aging will be managed such that applicable components will perform their intended function during the period of extended operation.

  Component surfaces that are insulated will be inspected when the external surface is exposed (i.e., maintenance) at such intervals that will provide reasonable assurance that the effects of aging will be managed such that applicable components will perform their intended function during the period of extended operation.

  The intervals of inspection may be adjusted as necessary based on BVPS inspection results and industry experience.

- **Monitoring and Trending**

  The program provides qualification requirements for personnel associated with visual inspection activities in accordance with site controlled procedures and processes.

  Formal trending will not be required by the program. However, inspection results will be maintained in accordance with System Engineering Walkdown procedures and as such, the inspection results will be available for review and trending during subsequent walkdown inspections. Also, the program will require that deficiencies are documented in the BVPS Corrective Action Program and allow results to be trended.

- **Acceptance Criteria**

  The program defines acceptance criteria as no unacceptable visual indication of leakage, loss of material, hardening and loss of strength or cracking, and reduction of heat transfer that would lead to loss of intended function during the period of extended operation. Visual indications with respect to system design standards, procedural requirements, current licensing basis, industry codes or standards, and engineering evaluations shall be evaluated by assigned engineering personnel. Evaluation of visual indications will determine if the results are acceptable or if corrective action is required.

- **Corrective Actions**

  This element is discussed further in Section B.1.3.

- **Confirmation Process**

  This element is discussed further in Section B.1.3.

- **Administrative Controls**

  This element is discussed further in Section B.1.3.

- **Operating Experience**

  The External Surfaces Monitoring Program is a new program; therefore, there is no plant-specific program operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

Conclusion

The implementation of the External Surfaces Monitoring Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.16 FIRE PROTECTION

Program Description

The Fire Protection Program is a condition monitoring and performance monitoring program, comprised of tests and inspections that follow the applicable National Fire Protection Association (NFPA) recommendations. The Fire Protection Program manages the aging effects on fire barrier penetration seals; fire barrier walls, ceilings and floors; fire wraps and fire rated doors (automatic and manual) that perform a current licensing basis fire barrier intended function. The program also manages the aging effects on the diesel engine-driven fire pump fuel oil supply line. The Fire Protection Program also manages the aging effects on the halon and carbon dioxide fire suppression systems.

NUREG-1801 Consistency

The Fire Protection Program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.M26, *Fire Protection*, with exception.

Exceptions to NUREG-1801

Program Elements Affected:

- **Parameters Monitored / Inspected**

  Halon and carbon dioxide systems Inspections and Testing.

  The frequency of functional testing for the BVPS halon and carbon dioxide systems will be at least once every 18 months, which is less frequent than the NUREG-1801, XI.M26 guideline of at least one test every 6 months for the detection of aging degradation. Previous inspections and testing of the halon and carbon dioxide systems at the 18-month frequency have not identified aging degradation issues. Continued testing and inspection at the current frequency is not expected to reduce the functional reliability of either system during the period of extended plant operation. However, to ensure the optimum integrity of the in-scope halon and carbon dioxide systems, each will be inspected at least once every 6 months during the period of extended operation. Testing will continue to be performed at least once every 18 months during the period of extended operation; therefore, only the frequency of testing will be an exception.

- **Detection of Aging Effects**

  See the exception regarding differences in testing frequency under Parameters Monitored / Inspected.

Enhancements

The following enhancements will be implemented prior to the period of extended operation.

Program Elements Affected:

- **Scope of Program**

  Add a new attachment to the BVPS Fire Protection Program administrative procedure to address the Fire Protection Systems that are in scope for license renewal purposes. The attachment will detail NUREG-1801 inspection and testing guidelines, the plant implementation strategy, surveillance test and inspection frequencies, and affected implementing procedure(s).

- **Parameters Monitored / Inspected**

  Enhance the inspection guidance to include degradation such as concrete cracking and spalling, and loss of material of fire barrier walls, ceilings and floors that may affect the fire rating of the assembly or barrier.

  Also, the program enhancements described under the Scope of Program program element are necessary for consistency with this program element.

- **Detection of Aging Effects**

  The program enhancements described under the Scope of Program program element are necessary for consistency with this program element.

- **Monitoring and Trending**

  The program enhancements described under the Scope of Program program element are necessary for consistency with this program element.

- **Acceptance Criteria**

  The program enhancements described under the Scope of Program program element are necessary for consistency with this program element.

Operating Experience

Operating experience is effectively evaluated and implemented at BVPS to maintain the Fire Protection System in the highest state of operability. This is accomplished by promptly identifying and documenting (using SAP or the Corrective Action Program) any conditions or events which could compromise Fire Protection System component and/or structure operability. In addition, industry operating experience, self assessments, and independent audits provide additional input to ensure that system operability is maintained at an optimum level.

An example of effective operating experience involves missing or damaged fire seals on fire doors, roll-up doors, shakespaces, and wall penetrations which were identified during

inspections, surveillance activities, and plant operator rounds between 2001 and 2006. Discrepancies in fire barrier wrappings were detected during periodic surveillances in 2003. These findings were documented in the Corrective Action Program. Immediate actions were completed to repair these fire barriers. Identification of deficiencies and timely corrective actions provide reasonable assurance that the program will remain effective for managing loss of material of components.

A triennial fire protection team inspection in January 2007 assessed whether the plant has implemented an adequate Fire Protection Program and that post-fire safe shutdown capabilities have been established and are being properly maintained. The inspection team also evaluated the material condition of fire area boundaries, fire doors, and fire dampers, and reviewed the surveillance and functional test procedures for the diesel fire pump and other components. Additionally, the team reviewed the surveillance procedures for structural fire barriers, penetration seals, and structural steel. No findings of significance were identified. Reviews of program specifics provide reasonable assurance that the program is effective for managing loss of material of components.

The Fire Protection System Program has been effective at managing aging effects of passive components which make up its scope. Identification of previous program weaknesses, and subsequent corrective actions, in conjunction with recent assessment where no issues or findings were noted, provides reasonable assurance that the program remains effective for managing age related degradation of fire protection passive components.

Conclusion

Continued implementation of the Fire Protection Program provides reasonable assurance that the aging effects will be managed so that the structures and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.17 FIRE WATER SYSTEM

Program Description

The Fire Water System Program applies to the water filled fire protection subsystems consisting of sprinklers, nozzles, fittings, valves, hydrants, hose stations, standpipes, tanks, and aboveground and underground piping and components that are tested in accordance with applicable National Fire Protection Association (NFPA) codes and standards. This program is credited with managing loss of material and reduction of heat transfer (reduction of heat transfer applies to the diesel-driven fire pump jacket water and oil coolers) for the water-filled Fire Protection Systems. Program activities include periodic inspection and hydro-testing of hydrants and hose stations, performing sprinkler head inspections, and conducting system flow tests. These tests and inspections follow applicable NFPA guidelines as well as recommendations from the fire insurance carrier. Such testing assures functionality of the systems. Also, many of these systems are normally maintained at required operating pressure and monitored such that leakage resulting in loss of system pressure is immediately detected and corrective actions initiated.

All sprinkler heads will be replaced, or a sample population will be inspected using the guidance of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems* [Reference B.3-12]. NFPA 25, Section 5.3.1.1.1 states that, "where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing." If the sampling method is chosen, NFPA 25 also contains guidance to perform this sampling every 10 years after initial field service testing.

NUREG-1801 Consistency

The Fire Water System Program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.M27, *Fire Water System.*

Exceptions to NUREG-1801

None

Enhancements

The following enhancements will be implemented prior to the period of extended operation.

Program Elements Affected:

- **Parameters Monitored / Inspected**

  Add a program requirement to perform flow test or inspection of all accessible fire water headers and piping during the period of extended operation at an interval determined by the Fire Protection System Engineer.

- **Detection of Aging Effects**

  Add a program requirement that requires a representative number of fire water piping locations be identified if piping visual inspections are used as an alternative to non-intrusive testing.

  Add a program requirement which allows test or inspection results from an accessible section of pipe to be extrapolated to an inaccessible, but similar section of pipe. If no similar section of accessible pipe is available, then alternative testing or inspection activities must be used.

  Add a program requirement that states that at least once prior to the period of extended operation, all accessible Fire Protection headers and piping shall be flow tested in accordance with NFPA 25 or visually/ultrasonically inspected.

  Add steps to program procedure which require testing or replacement of sprinkler heads that will have been in service for 50 years prior to entering the period of extended operation.

  Also, the program enhancement described under the Scope of Program program element is necessary for consistency with this program element.

- **Monitoring and Trending**

  Add a program requirement to perform a fire water subsystem internal inspection any time a subsystem (including fire pumps) is breached for repair or maintenance.

Operating Experience

Buried piping constructed of gray cast iron is susceptible to de-alloying corrosion (selective leaching). There have been multiple instances of buried Fire Protection pipe failures at both BVPS units that were attributed to this phenomenon. In all cases, the damaged buried piping was promptly identified, isolated, and subsequently replaced with a plastic-wrapped ductile cast iron pipe which is resilient to selective leaching. These piping failures represent a long-standing deficiency with the use of gray cast iron for underground fire headers and pipes. These buried gray cast iron pipes will be age managed and/or replaced as described in the Buried Piping and

Selective Leaching GALL programs. The Buried Piping Program will include a formal evaluation of operating experience based on these fire water system pipe failures. In the Main Control Room, fire water header pressure is continuously monitored (by way of fire pump auto start status) for unexpected drops in pressure which could be indicative of an underground (or aboveground) piping failure.

Through wall pipe leaks in aboveground pipes have occurred within the Fire Water System throughout the life of both units. Most of these leaks are slow (i.e., drops per minute) at discovery and are attributable to microbiologically-influenced corrosion (MIC) activity. Once identified, the affected section of pipe is replaced or repaired.

A self assessment was performed in 2006 for the Fire Protection System, including the Fire Protection Water Systems, which accounted for the highest number of equipment degradation issues. This is not an unexpected result given the large number of active components, the use of untreated river water, and the age of the system. Actions to improve the health of the Fire Protection water suppression system are on-going or planned, including chemical treatment, replacement of sectional valves with resilient wedge gate valves, and a piping replacement plan.

In January 2007, the NRC completed a triennial fire protection team inspection at BVPS to assess whether the plant has implemented an adequate Fire Protection Program and to ensure that post-fire safe shutdown capabilities have been established and are being properly maintained. The inspection team reviewed the adequacy of selected pre-action and wet pipe sprinklers, including the adequacy of surveillance procedures. No findings of significance were identified.

A industry event of interest, described in an INPO operating experience message, involves an exploding battery on the diesel-driven fire pump when the pump was started for a surveillance run. Evaluation of the event and impact to BVPS test procedures were tracked and documented in the Corrective Action Program. Battery preventative maintenance procedures at BVPS were evaluated and determined to provide sufficient guidance to preclude a hydrogen ignition. A possible causal factor for the exploding battery may be related to utilizing the battery beyond the vendor recommended maximum lifetime. A recurring BVPS maintenance item to replace the diesel-driven fire pump battery every 192 weeks was confirmed.

Operating experience events are evaluated and implemented at BVPS to maintain the effectiveness of the Fire Water System Program. Use of operating experience also demonstrates awareness of and compliance with Industry guidelines. Identification of system degradation and taking corrective action prior to loss of intended function provide evidence that the program effectively manages loss of material from fire water system components.

Conclusion

Continued implementation of the Fire Water System Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of

this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.18 FLOW-ACCELERATED CORROSION

Program Description

The Flow-Accelerated Corrosion Program is based on EPRI guidelines in NSAC-202L-R2, *Recommendations for an Effective Flow Accelerated Corrosion Program* [Reference B.3-13]. The program predicts, detects, and monitors wall thinning in piping, valve bodies, and other in-line components. Analytical evaluations and periodic examinations of locations that are most susceptible to wall thinning due to flow-accelerated corrosion are used to predict the amount of wall thinning. The program includes analyses to determine critical locations. Initial inspections are performed to determine the extent of thinning at these critical locations, and follow-up inspections are used to confirm the predictions. Inspections are performed using ultrasonic or other approved inspection techniques capable of detecting wall thinning. Repairs and replacements are performed as necessary.

NUREG-1801 Consistency

The Flow-Accelerated Corrosion Program is an existing program that is consistent with NUREG-1801, Section XI.M17, *Flow-Accelerated Corrosion*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

The Flow-Accelerated Corrosion Program has evolved through industry experience and is now described in NSAC-202L-R2. This program includes (a) an evaluation to determine critical locations, (b) initial operational inspections to determine the extent of thinning at these locations, and (c) follow-up inspections to confirm predictions, or repair or replace components as necessary. Thus, the frequency of the inspections on individual locations is determined by the results of previous inspections. The program has been effective in managing loss of material (wall thinning) due to flow-accelerated corrosion, as shown in program inspection reports.

For the program inspections during the last Unit 1 refueling outage (Cycle 17 Refueling Outage, February - April 2006), 73 locations were originally scheduled for inspection. 13 additional areas were examined as expanded scope. There were 5 planned replacement areas identified. Emergent replacements were performed when unexpected wall thinning was identified. The Corrective Action Program was used to track and resolve issues identified during the outage.

For the program inspections during the last Unit 2 refueling outage (Cycle 12 Refueling Outage, October - November 2006), 75 locations were inspected. Two (2) additional areas were examined as expanded scope. There were 9 planned replacement areas identified. Emergent replacements were performed when unexpected wall thinning was identified. The Corrective Action Program was used to track and resolve issues identified during the outage.

A self-assessment of the Flow-Accelerated Corrosion program at BVPS was performed in September, 2006. The assessment found that, in practice, the program was in compliance with NRC Inspection Procedure 49001. However, several procedural and process enhancements were recommended to clarify the guidance and strengthen the process. All recommendations were incorporated into the program.

A fleet review of best practices for the Flow-Accelerated Corrosion Program at all FirstEnergy sites was performed as part of the development of a fleet-wide program procedure. Guidance from the EPRI CHECWORKS User's Group was applied to the program procedure. Comparison of program techniques, conformance to industry standards, recent audit and inspection results, and use of shared "best practices" in the development of fleet-wide procedures provide reasonable assurance that the program will remain effective for managing aging effects for passive components.

Conclusion

Continued implementation of the Flow-Accelerated Corrosion Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation

B.2.19 FLUX THIMBLE TUBE INSPECTION

Program Description

The Flux Thimble Tube Inspection Program serves to identify loss of material due to wear prior to leakage by monitoring for and predicting unacceptable levels of wall thinning in the Movable Incore Detector System Flux Thimble Tubes, which serve as a Reactor Coolant System (RCS) pressure boundary. The program implements the recommendations of NRC IE Bulletin 88-09, *Thimble Tube Thinning in Westinghouse Reactors* [Reference B.3-14].

The main attribute of the program is periodic nondestructive examination (NDE) of the flux thimble tubes which provides actual values of existing tube wall thinning. This information provides the basis for an extrapolation to determine when tube wall thinning will progress to an unacceptable value. Based on this prediction, preemptive actions are taken to reposition, replace or isolate the affected thimble tube prior to a pressure boundary failure.

NUREG-1801 Consistency

The Flux Thimble Tube Inspection Program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.M37, *Flux Thimble Tube Inspection*.

Exceptions to NUREG-1801

None

Enhancements

The following enhancement will be implemented prior to the period of extended operation.

Program Element Affected:

- **Corrective Actions**

  Add a requirement to the program procedure to state that, if a flux thimble tube cannot be inspected over the tube length (tube length that is subject to wear due to restriction or other defect), and cannot be shown by analysis to be satisfactory for continued service, the thimble tube must be removed from service to ensure the integrity of the RCS pressure boundary.

Operating Experience

Eddy current examinations are performed on all accessible flux thimble tubes during every other refueling outage. The results are used as a starting value for calculating projected wear rates for the subsequent two fuel cycles. If thimble tube wear is projected to exceed 70% through wall (TW) thinning, then the tube will be repositioned, replaced, or capped at the seal table. The 70%

TW threshold used at BVPS is more restrictive than the 80% limit recommended by Westinghouse (WCAP-12866) and also includes a margin for instrument uncertainty.

During the Unit 1 Cycle 13 Refueling Outage (February - April 2000), a proactive decision was made to replace 18 flux thimble tubes at Unit 1 which were either inoperable or showed the greatest amount of tube wall thinning. This action was taken to ensure that the Technical Specification minimum number of operable flux thimble tubes would be satisfied.

During the Unit 1 Cycle 15 Refueling Outage (March - April 2003), the next successive Unit 1 outage where flux thimble tube eddy-current measurements were performed, several of the tubes replaced during the Cycle 13 outage displayed elevated wall thinning. As described in the *Flux Thimble Eddy Current Data Evaluation Report* for the Unit 1 Cycle 15 Refueling Outage, this was due in part to use of a limiting (worst case) value in the wear calculation since there was no prior wear history for the replaced tubes. Of those with significant wall thinning, only two tubes were projected to exceed the BVPS 70% threshold for wall thinning during the following two fuel cycles. Westinghouse specifically recommended repositioning of two flux thimble tubes prior to the beginning of Unit 1 Cycle 17 (November 2004).

At Unit 2, the *Flux Thimble Eddy Current Data Evaluation Report* for the Cycle 10 Refueling Outage (September - October 2003) identified a single flux thimble tube that was projected to approach the BVPS 70% acceptance criteria for wall thinning. Since the tube in question had been repositioned once before, BVPS, with input from Westinghouse, decided to cap the flux thimble at the seal table.

The Flux Thimble Tube Examination Program establishes limits on tube wall thinning which provide reasonable assurance that the thimble tube pressure boundary will be maintained during normal plant operating conditions. FENOC will continue to monitor operating experience documentation for potential applicability to BVPS, and documentation relative to BVPS is entered into either the Corrective Action Program or SAP Activity Tracking for resolution.

The BVPS Flux Thimble Tube Examination Program is established to meet the requested actions of NRC Bulletin 88-09. Identification of flux thimble tube degradation prior to loss of function is an indication that the program effectively manages the aging effects of the flux thimble tube RCS pressure boundary.

Conclusion

Continued implementation of the Flux Thimble Tube Inspection Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.20 FUEL OIL CHEMISTRY

Program Description

The Fuel Oil Chemistry Program is a mitigation and condition monitoring program which manages aging effects of the internal surfaces of oil storage tanks and associated components in systems that contain diesel fuel oil. The program includes (a) surveillance and monitoring procedures for maintaining diesel fuel oil quality by controlling contaminants in accordance with ASTM Standards D 975, D 1796, D 2276 and D 4057; (b) periodic sampling of fuel oil tanks and new fuel oil shipments for the presence of water and contaminants, and draining of any accumulated water from the tanks; (c) sampling of fuel oil tanks and new fuel oil shipments for numerous other factors such as sediment, viscosity, and flash point; (d) periodic or conditional visual inspection of internal surfaces or wall thickness measurements (e.g., ultrasonic testing) of tanks.

The One-Time Inspection Program (Section B.2.30) will be used to verify the effectiveness of the Fuel Oil Chemistry Program.

NUREG-1801 Consistency

The Fuel Oil Chemistry Program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.M30, *Fuel Oil Chemistry*, with exception.

Exceptions to NUREG-1801

Program Elements Affected:

- **Scope of Program**

  BVPS does not use ASTM standard D 2709. BVPS uses ASTM D 1796 versus ASTM D 2709 for guidance on the determination of water and sediment contamination. The use of ASTM D 1796, with an acceptance criterion for water and sediment content of less than or equal to 0.05% is required by BVPS Technical Specification Surveillance Requirements.

  BVPS does not use ASTM standard D 6217. BVPS uses ASTM D 2276 versus ASTM D 6217 for guidance on the determination of particulate contamination. The use of ASTM D 2276, with an acceptance criterion of a total particulate contamination of less than 10 mg/liter, is required by BVPS Technical Specification Surveillance Requirements.

- **Preventive Actions**

  Biocides, stabilizers, and corrosion inhibitors are not used at BVPS. A recent review, documented using the Corrective Action Program, evaluated the possibility of using fuel oil additives, and determined that additives would not provide any significant benefit and thus were not recommended for use at BVPS. Results from "for-cause" testing,

performed in response to Corrective Action Program reports written when excessive sediment was detected within a fuel oil system, indicate that microbiological activity has not been a problem in any fuel oil subsystem at BVPS. Due to the materials of construction and a lack of water in the fuel oil tanks, there is also no benefit to the addition of corrosion inhibitors or metal deactivators to the fuel oil.

- **Parameters Monitored / Inspected**

  See the two exceptions regarding use of different ASTM standards under Scope of Program.

  BVPS does not routinely sample fuel oil for microbiological organisms. BVPS monitors for corrosion products and sediment; if detected, BVPS will evaluate the need for further laboratory analysis to detect the presence of microbiological organisms or by-products.

  BVPS does not use a filter with a pore size of 3.0 microns when testing fuel oil for particulates. BVPS will continue to use the 0.8 micron pore size filter recommended by ASTM D 2276 (which is required by BVPS Technical Specification Surveillance Requirements). Use of a filter with a smaller pore size results in a larger sample of particulates because smaller particles are retained. Thus, use of a 0.8 micron filter is more conservative than use of a 3.0 micron filter.

- **Monitoring and Trending**

  See the exception regarding not routinely sampling fuel oil for microbiological organisms under Parameters Monitored / Inspected.

- **Acceptance Criteria**

  See the two exceptions regarding use of different ASTM standards under Scope of Program.

  See the exception regarding not using a filter with a pore size of 3.0 microns under Parameters Monitored / Inspected.

Enhancements

The following enhancements will be implemented prior to the period of extended operation.

Program Elements Affected:

- **Parameters Monitored / Inspected**

  Revise implementing procedure for sampling and testing the diesel-driven fire pump fuel oil storage tank (Unit 1 only) to include a test for particulate and accumulated water in addition to the test for sediment and water.

Generate a new implementing procedure for sampling and testing the security diesel generator fuel oil day tank (Common) for accumulated water, particulate contamination, and sediment/water.

- **Detection of Aging Effects**

  The two program enhancements described under the Parameters Monitored / Inspected program element are necessary for consistency with this program element.

Operating Experience

The Fuel Oil Chemistry Program is an existing program that utilizes sampling and analysis to ensure that adequate diesel fuel quality is maintained to prevent loss of material and fouling in the various in-scope fuel oil systems. Exposure of fuel oil to contaminants such as water and particulates is also minimized by periodic draining of accumulated water, tank interior cleaning, and by verifying the quality of new oil before its introduction into the storage tanks.

Water has occasionally been discovered in various BVPS diesel fuel oil storage tanks during sampling activities. In accordance with sampling and analysis procedures, any detected water is removed from the affected tank as part of the sampling process.

There have been multiple, but infrequent, instances during the past five years, where fuel oil particulate concentrations were near or above the Technical Specification limit for Emergency Diesel Generator fuel oil storage tanks. Four Corrective Action Program items were identified since 2002, which documented elevated fuel oil particulate levels in Emergency Diesel Generator fuel oil storage and day tanks. In all cases, corrective actions were taken such as recirculating the tank contents through a particulate filter. Other than these events, fuel oil sample results from 2001 through 2005 reveal that fuel oil quality is being maintained in compliance with industry standards. Regular analysis and confirmation of diesel fuel quality provide reasonable assurance that the program is effectively managing fuel oil chemistry.

A sampling schedule for diesel generator fuel oil tanks has been established, to allow timely identification of excessive concentrations of water and/or particulates, which will minimize tank loss of material. Sampling frequency is adequate as evidenced by the relatively few instances of particulate levels exceeding the Technical Specification limit. A recent CR identified elevated particulate levels which had yet to exceed the limit, but were monitored with sufficient frequency to identify a rising trend.

An important element of fuel oil (or any other) analysis is operation of the testing laboratory. Fuel oil samples from BVPS are sent to Beta Laboratory (a First Energy subsidiary) after an initial set of factors are measured at the BVPS site. The laboratory completes the oil analysis by measuring parameters such as viscosity, flash point, and percent sulfur.

A fleet oversight Quality Assurance audit was conducted to assess the operation practices and regulatory compliance of the Beta Laboratory facility. The principal tool for this assessment was

the FENOC Quality Assurance Program Manual. The results of the audit reveal that Beta Lab is effective in performing analyses of the fuel oil samples from BVPS, however multiple areas for improvement were identified and Corrective Action Program items were generated to document and track the recommended improvements. The Quality Assurance audit process provides an additional level of assurance that the fuel oil chemistry program will continue to effectively monitor and manage fuel oil chemistry.

Conclusion

Continued implementation of the Fuel Oil Chemistry Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.21 INACCESSIBLE MEDIUM-VOLTAGE CABLES NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Program Description

The Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program is a new program that BVPS will implement prior to the period of extended operation.

The purpose of this aging management program will be to demonstrate that inaccessible, non-EQ medium-voltage cables, susceptible to aging effects caused by moisture and voltage stress, will be managed such that there is reasonable assurance that the cables will perform their intended function in accordance with the current licensing basis during the period of extended operation.

In this aging management program, periodic actions are taken, at least once every two years, to prevent cables from being exposed to significant moisture, such as inspecting for water collection in cable manholes and conduit, and draining water, as needed. In-scope, medium-voltage cables exposed to significant moisture and significant voltage are tested to provide an indication of the condition of the conductor insulation. The specific type of test performed will be determined prior to the initial test, and is to be a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or other testing that is state-of-the-art at the time the test is performed. Testing will be conducted at least once every 10 years, with initial testing completed prior to the period of extended operation.

NUREG-1801 Consistency

The Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program is a new program that is consistent with NUREG-1801, Section XI.E3, *Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.E3, are provided as follows:

- **Scope of Program**

  The program is applicable to inaccessible medium-voltage cables within the scope of license renewal that are exposed to significant moisture simultaneously with significant voltage.

  The definition for significant moisture and significant voltage defined in the program is consistent with NUREG-1801. Cables qualified for submergence (i.e., submarine cables) are excluded from this program.

- **Preventive Actions**

  The program identifies the applicable manholes and will require inspection of these manholes once every two years to inspect for water collection in cable manholes, and draining of water as needed.

- **Parameters Monitored / Inspected**

  The program allows that the specific type of test performed will be determined prior to the initial test, and is to be a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, as described in EPRI guidance documents, or other testing that is state-of-the-art at the time the test is performed.

- **Detection of Aging Effects**

  Testing of medium-voltage cables exposed to significant moisture and significant voltage that are within the scope of the program will be conducted at least once every 10 years, with the first inspection to be completed prior to the period of extended operation.

  The program identifies the applicable manholes and will require inspection of these manholes at least once every two years. The inspection frequency will be based on actual plant experience with water accumulation in the manhole, with the first inspection to be completed prior to the period of extended operation.

- **Monitoring and Trending**

  Trending will not be included as part of the program. However, all test and inspection results will be maintained as part of plant records. Therefore, these results are available for review and/or trending during subsequent tests and inspections as needed.

- **Acceptance Criteria**

  The acceptance criteria will be defined by the specific type of test performed and the specific cable tested.

- **Corrective Actions**

  The program will require that unacceptable cable test results are documented in the BVPS Corrective Action Program. Any subsequent engineering evaluations and extent-of-condition determinations are conducted according to the Corrective Action Program.

  This element is discussed further in Section B.1.3.

- **Confirmation Process**

  This element is discussed further in Section B.1.3.

- **Administrative Controls**

  This element is discussed further in Section B.1.3.

- **Operating Experience**

  The Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program is a new BVPS aging management program for which there is no plant-specific operating experience for program effectiveness. Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801, Section XI.E3 program description. BVPS plant-specific operating experience is consistent with the operating experience in the program description.

  The BVPS program is based on industry operating experience. As such, incorporation of industry and plant-specific operating experience into the program provides reasonable assurance that the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program will manage the effects of aging such that the applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. Future operating experience will be appropriately incorporated into the program.

  BVPS currently has a manhole inspection program, which identifies and evaluates water collection in the manholes. This prevention program has been effective in monitoring and evaluating the exposure of cable and cable supports located in manholes to water. Reducing the exposure to water minimizes the aging effects of the applicable non-EQ medium-voltage cables, so these cables will continue to perform their intended function.

  BVPS plant-specific operating experience demonstrates the effectiveness of the prevention portion of the XI.E3 program. The BVPS manhole inspection was last performed in September 2006. The findings included missing seals, cracked walls, corroded supports, and water intrusion. No cable damage was found. No water was reported in in-scope manholes.

The plant-specific operating experience supports the Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualifications Requirements Program manhole inspection frequency of once every two years for in-scope manholes. The lack of cable failures combined with the plant-specific operating experience for manhole inspections supports the cable testing frequency of at least once every 10 years.

Conclusion

The implementation of the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.22 INSPECTION OF INTERNAL SURFACES IN MISCELLANEOUS PIPING AND DUCTING COMPONENTS

Program Description

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is a new program that BVPS will implement prior to the period of extended operation.

The program will consist of inspections of the internal surfaces of piping, piping components, ducting and other components within the scope of license renewal that are not covered by other aging management programs. These internal inspections are performed during the periodic system and component surveillances or during the performance of maintenance activities when the surfaces are made accessible for visual inspection. These inspections will assure that existing environmental conditions are not causing material degradation that could result in a loss of intended function.

NUREG-1801 Consistency

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is a new program that is consistent with NUREG-1801, Section XI.M38, *Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.M38, are provided as follows:

- **Scope of Program**

  The program will consist of inspections of the internal surfaces of piping, piping components, ducting and other components within the scope of license renewal that are not managed by other aging management programs. The program will include inspection for indications of borated water leakage on internal surfaces, where applicable.

- **Preventive Actions**

  The program will be a condition monitoring program; therefore, no preventive actions or steps exist to mitigate component degradation.

- **Parameters Monitored / Inspected**

  The program will inspect for visible evidence of corrosion which may indicate possible loss of material. Inspections will be performed during the periodic system and component surveillance tests or during the performance of maintenance activities (whether scheduled outages or otherwise) when internal surfaces are made accessible for visual inspection.

- **Detection of Aging Effects**

  For inspections that are performed during periodic system and component surveillance tests, established inspection intervals will provide for a timely detection of degradation prior to the loss of intended function.

  Inspections that are conducted during maintenance activities, when the surfaces are made accessible, are performed on an opportunistic basis. When systems are opened up for maintenance activities, the program will delineate that inspection locations should be chosen that are most likely to exhibit aging effects based on industry and plant-specific operating experience.

  For metal surfaces that are painted or coated, the program will require a visual inspection to confirm integrity of the paint or coating. Inspection parameters will include discoloration, blistering, cracking and flaking. If no degradation is indicated, no additional inspection of the subject surface will be required.

- **Monitoring and Trending**

  The program will require visual inspection activities to be performed by personnel qualified in accordance with applicable BVPS procedures and processes.

  The program will monitor aging degradation of internal surfaces. Trending of aging degradation of internal surfaces will be accomplished through the Corrective Action Program.

- **Acceptance Criteria**

  The program will inspect for indications of paint/coating degradation, corrosion, fouling, cracking, and build-up of dust/dirt/debris that could affect component intended function.

  Inspection results not meeting the acceptance criteria shall be documented and processed in accordance with the Corrective Action Program.

- **Corrective Actions**

  This element is discussed further in Section B.1.3.

- **Confirmation Process**

  This element is discussed further in Section B.1.3.

- **Administrative Controls**

  This element is discussed further in Section B.1.3.

- **Operating Experience**

  The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is a new program for which there is no operating experience for program effectiveness. Industry and plant-specific operating experience will be evaluated in the development of this program. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801, Section XI.M38 program description. BVPS plant-specific operating experience is consistent with the operating experience in the program description.

  Inspection of internal surfaces during the performance of periodic surveillances and maintenance activities has been in effect at BVPS in support of plant component reliability programs.

  For example, a 1999 internal inspection of a tank visually indicated that the protective coating was not degraded. However, rust scale was found on the bottom of the tank and was determined to have originated from carbon steel piping between the compressor and the tank. An engineering examination and evaluation was conducted on the piping to determine its condition. The piping was found to be within acceptable design margins for continued operation.

  These inspection and follow-up engineering evaluation activities have proven effective in maintaining the material condition of plant systems, structures, and components, including the internal surfaces of piping and ducting components. Future operating experience will be appropriately incorporated into the program.

  Incorporation of operating experiences provides reasonable assurance that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will manage the aging effects of such components through the period of extended operation.

Conclusion

The implementation of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will provide reasonable assurance that the aging effects will be managed

so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.23 INSPECTION OF OVERHEAD HEAVY LOAD AND LIGHT LOAD (RELATED TO REFUELING) HANDLING SYSTEMS

Program Description

The Inspection of Overhead Heavy Load & Light Load (Related To Refueling) Handling Systems Program manages loss of material of structural components for heavy load and fuel handling components within the scope of license renewal and subject to aging management. The program is implemented through plant procedures and preventive maintenance activities that provide for visual inspections of the in-scope load handling components.

The inspections are focused on structural components that make up the bridge, trolley, and rails of the cranes and hoists. These cranes and hoists also comply with the maintenance rule requirements provided in 10 CFR 50.65.

Overhead heavy load cranes are controlled in accordance with the guidance provided in NUREG-0612, *Control of Heavy Loads at Nuclear Power Plants* [Reference B.3-15].

NUREG-1801 Consistency

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.M23, *Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems*.

Exceptions to NUREG-1801

None

Enhancements

The following enhancements will be implemented prior to the period of extended operation.

Program Elements Affected:

- **Scope of Program**

  Include guidance in the program administrative procedure to inspect for loss of material due to corrosion on crane and trolley structural components and rails.

- **Detection of Aging Effects**

  Include guidance in the crane and hoist inspection procedures to inspect for loss of material due to corrosion on crane and trolley structural components and rails or extendable arms, as appropriate.

Operating Experience

There are relatively few events involving aging of passive crane components such as rails. BVPS and industry operating experiences are regularly reviewed and documented using the Corrective Action Program or SAP. An example of a plant operating experience event occurred in 2003 in the Waste Handling Building when programmatic deficiencies and degraded crane material conditions related to a lift of a high integrity container (HIC) grapple necessitated a Stop Work Order for radiological lifts. This action demonstrates the BVPS commitment to only use equipment that is acceptable material condition, especially when dealing with radiological loads.

An event at another Westinghouse PWR resulted in two BVPS procedures being modified to apply the lesson-learned. The evolution being performed was the polar crane lift removal of the reactor lower internals. Due to an alignment problem which had not been identified, the crane experienced an overload condition. BVPS changed the lower head lift procedure to verify alignment prior to attempting to lift the lower internals.

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its associated activities are effective at managing aging effects of the cranes and hoists structural components (including bridge, trolley, rails, and girders). A review of applicable Corrective Action Program documents indicated that BVPS has not experienced aging-related degradation of cranes within the scope of license renewal and subject to aging management. Several corrective actions documented reviews of industry guidance and experience. The review of industry Operating Experience events, however, did not identify any age-related degradation applicable to the subject cranes. This operating experience provides reasonable assurance that inspection of the in-scope load handling equipment will ensure the program remains effective for managing age-related degradation of passive components during the period of extended operation.

Conclusion

Continued implementation of the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.24 LUBRICATING OIL ANALYSIS

Program Description

The purpose of the Lubricating Oil Analysis Program is to ensure the lubricating oil environment for in-scope mechanical systems is maintained to the required quality. The program monitors and controls abnormal levels of contaminants (primarily water and particulates) for in-scope components in the lubricating oil systems, thereby preserving an environment that is not conducive to loss of material, cracking, or reduction of heat transfer.

The One-Time Inspection Program (Section B.2.30) will be used to verify the effectiveness of the Lubricating Oil Analysis Program.

NUREG-1801 Consistency

The Lubricating Oil Analysis Program is an existing program that is consistent with NUREG-1801, Section XI.M39, *Lubricating Oil Analysis*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

The Lubricating Oil Analysis Program is an existing program that maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. Program activities include sampling and analysis of lubricating oil for contaminants, water, particulates, and bearing wear materials.

Analysis of samples taken in 2006 from lube oil subsystems for several in-scope pumps and motors showed that the oil in these components was within normal tolerances and was satisfactory for continued use. However, the presence of elevated amounts of water, wear particles, and contaminants in routine sampling led to documenting the issues in the Corrective Action Program. Use of warning level indicators to direct corrective actions prior to equipment degradation provides evidence that the program is effective in managing aging effects caused by oil impurities.

The BVPS practice of regular lube oil system analysis is consistent with industry operating experience in which significant and potentially disabling failures could have been prevented by following this same policy. A specific example is described in NRC Information Notice, 2001-06 in

which a 40-fold increase in particle count for the lube oil in a high-head SI pump thrust bearing was not recognized as a potential indicator of bearing damage.

Other good practices such as assessing the storage and distribution of lubricating oil from the site warehouse helps to ensure that high quality contaminant-free oil is added to the lubricating systems for in-scope pumps and motors.

The BVPS Lubricating Oil Analysis Program incorporates operating experience from the sampling and testing of lubricating oil for the various in-scope pump and motor bearing packages. Operating experience has shown that a precursor event to bearing failures is elevated lubricating oil particulate concentration. The program is designed to detect this elevated particulate concentration which allows preemptive actions such as oil replacement to be performed prior to loss of intended function. Current operating experience (Corrective Action Program documents, Information Notices, etc.) validates the effectiveness of the BVPS Lubricating Oil Analysis Program. The BVPS Lubricating Oil Analysis Program has been effective at managing aging effects by periodically sampling and analyzing lubricating oil from these in-scope components.

Conclusion

Continued implementation of the Lubricating Oil Analysis Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.25 MASONRY WALL

Program Description

The Masonry Wall Program manages the aging effects of masonry walls that are within the scope of License Renewal and subject to aging management review. The program consists of visual inspections to identify cracks in masonry walls and ensure the sound condition of structural steel supports and bracing associated with masonry walls.

Masonry walls in close proximity to, or having attachments from, safety-related systems or components are inspected in response to NRC IE Bulletin 80-11, *Masonry Wall Design* [Reference B.3-16], and NRC Information Notice 87-67, *Lessons Learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11* [Reference B.3-17]. These inspections consist of a visual examination by qualified personnel to ensure that the evaluation basis for these walls remains valid through the period of extended operation.

In addition, a general visual inspection is performed on both safety-related and nonsafety-related masonry walls that are within the scope of license renewal. These inspections are implemented by the Structures Monitoring Program [Section B.2.39] and consist of visual inspection for cracking in joints, deterioration of penetrations, missing or broken blocks, missing mortar, and general mechanical soundness of steel supports.

NUREG-1801 Consistency

The Masonry Wall Program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.S5, *Masonry Wall Program*.

Exceptions to NUREG-1801

None

Enhancements

The following enhancement will be implemented prior to the period of extended operation.

Program Element Affected:

- **Scope of Program**

  The scope of the existing program is comprised of masonry walls within the scope of 10 CFR 50.65 (The Maintenance Rule). The scope of the program will be enhanced to include additional masonry walls identified as having aging effects requiring management for License Renewal.

Operating Experience

BVPS inspections show adequate performance of required 10-year masonry wall inspections per IEB 80-11 [Reference B.3-16] and IN 87-67 [Reference B.3-17]. The last safety-related masonry wall inspection was performed in June, 2000 and the results were forwarded to design engineering for evaluation.

The 10-year inspection was completed in 2001 on the Structures as outlined in the Maintenance Rule System Basis Documents. The inspection included safety and nonsafety-related masonry walls. Overall, the report concluded that the plant structures were in good condition and performing well. The inspections found no conditions requiring immediate maintenance or repair. Conditions noted were minor in nature and did not affect the structural integrity of any of the structures reviewed. Some cracks in the mortar joints of masonry walls were observed. In general, the cracks corresponded to those noted in past masonry wall inspections. All observed cracks were narrow and tight. Cracks previously repaired had not reoccurred.

Identification of minor degradation and monitoring of indications provide reasonable assurance that the program is effective for managing cracking of masonry walls and masonry wall joints for both safety and nonsafety-related masonry walls.

Conclusion

Continued implementation of the Masonry Wall Program provides reasonable assurance that the aging effects will be managed so that the structures and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.26 METAL ENCLOSED BUS (UNIT 2 ONLY)

Program Description

The Metal Enclosed Bus Program is a new program that BVPS will implement prior to the period of extended operation. This program is applicable only to the Unit 2 480-VAC Metal Enclosed Bus Feeders to the Emergency Substations (2-8 and 2-9). There is no in-scope metal enclosed bus at Unit 1.

In-scope metal enclosed bus internal surfaces will be visually inspected for aging degradation of insulating and conductive components. This visual inspection will also identify evidence of foreign debris, excessive dust buildup, or moisture intrusion. The bus insulating system, including the internal supports, will be visually inspected for structural integrity and signs of aging degradation. A sample of accessible bolted connections will be checked for loose connection using thermography. Inspections will be completed prior to the period of extended operation and every 10 years thereafter.

NUREG-1801 Consistency

The Metal Enclosed Bus Program is a new program that is consistent with NUREG-1801, Section XI.E4, *Metal Enclosed Bus*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.E4, are provided as follows:

- **Scope of Program**

  The program applies to metal enclosed buses within the scope of license renewal, specifically the Unit 2 480 VAC Metal Enclosed Bus Feeders to the Emergency Substations (2-8 and 2-9).

- **Preventive Actions**

  This program is a condition monitoring inspection program. No actions are taken by this program to prevent or mitigate aging degradation.

- **Parameters Monitored / Inspected**

  The program requires that a sample of accessible bolted connections will be visually inspected and tested for loose connections. The program provides for the inspection of the internal portion of metal enclosed buses for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of moisture intrusion. The bus insulation will be inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. The internal bus supports will be inspected for structural integrity and signs of cracks.

- **Detection of Aging Effects**

  The program requires that a sample of accessible bolted connections will be checked for loose connection by use of thermography. The program elects not to perform measurement of connection resistance using a low range ohmmeter.

  The program will require visual inspection of the internal surfaces of metal enclosed buses for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of moisture intrusion, bus insulation for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation, and internal bus supports for structural integrity and signs of cracks.

  Inspection activities required by the program will be performed prior to the period of extended operation and at least every 10 years thereafter.

- **Monitoring and Trending**

  Trending will not be included as part of the program. However, all test/inspection results are documented and retained in accordance with plant procedures.

- **Acceptance Criteria**

  The program requires that when thermography is used, bolted connections need to be below the maximum allowed temperature for the application. The program elects not to perform measurement of connection resistance using a low range ohmmeter. Therefore, no acceptance criterion is required for resistance measurement tests.

  The program requires that metal enclosed buses shall be free from unacceptable visual indications of surface anomalies, which suggest that conductor insulation degradation exists. In addition, no unacceptable indication of corrosion, cracks, foreign debris, excessive dust buildup or evidence of moisture intrusion is to exist. An unacceptable indication is defined as a noted condition or situation that, if left un-managed, could lead to a loss of intended function.

- **Corrective Actions**

  The program requires that further investigation, evaluation and extent-of-condition determination are performed as part of the BVPS Corrective Action Program.

This element is discussed further in Section B.1.3.

- **Confirmation Process**

  This element is discussed further in Section B.1.3.

- **Administrative Controls**

  This element is discussed further in Section B.1.3.

- **Operating Experience**

  The Metal Enclosed Bus Program is a new program; therefore, there is no plant-specific program operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

Conclusion

The implementation of the Metal Enclosed Bus Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.27 METAL FATIGUE OF REACTOR COOLANT PRESSURE BOUNDARY

Program Description

The Metal Fatigue of Reactor Coolant Pressure Boundary Program is a time-limited aging analysis (TLAA) program that uses preventive measures to mitigate fatigue cracking caused by anticipated cyclic strains in metal components of the reactor coolant pressure boundary. The preventive measures consist of monitoring and tracking critical thermal and pressure transients for RCS components to prevent the fatigue design limit from being exceeded. Critical transients are the subset of the design transients that are expected to approach or exceed the number of design cycles during the sixty year operating life of the units. These critical transients include plant heatup, plant cooldown, reactor trip from full power (Unit 1 only), inadvertent auxiliary spray, safety injection activation (Unit 1 only), and RCS cold overpressurization. Supplemental transients were also identified by the program for monitoring. These supplemental transients include pressurizer insurge transient, selected Chemical and Volume Control System transients, Auxiliary Feedwater injections and RHR actuation (Unit 2 only). Prior to exceeding the fatigue design limit, preventive and/or corrective actions are triggered by the program.

In addition, environmental effects are evaluated in accordance with NUREG/CR-6260, *Application of NUREG/CR-5999 Interim Fatigue Curves for Selected Nuclear Power Plant Components* [Reference B.3-18], and the guidance of EPRI Technical Report MRP-47, *Guidelines for Addressing Fatigue Environmental Effects in a License Renewal Application* [Reference B.3-19]. Selected components are evaluated using material specific guidance presented in NUREG/CR-6583, *Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low Alloy Steels* [Reference B.3-20], and in NUREG/CR-5704, *Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels* [Reference B.3-21].

NUREG-1801 Consistency

The Metal Fatigue of Reactor Coolant Pressure Boundary Program is an existing program that is consistent with NUREG-1801, Section X.M1, *Metal Fatigue of Reactor Coolant Pressure Boundary*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

Concerns for the overall health of the transient/cycle counting program were documented using the Corrective Action Program. Corrective actions included identifying a program owner, developing an administration program document and updating it to incorporate responsibilities, improving cycle counting, and establishing a process for engineering to evaluate plant data. Fatigue monitoring to date indicates that the number of design transient events assumed in the original design analysis will be sufficient for a 60-year operating period. The program has remained responsive to emerging issues and concerns, particularly the pressurizer surge and spray nozzle, hot leg surge nozzle, and surge line transients.

For example, in 2002, a Westinghouse evaluation identified that the BVPS Unit 2 letdown, charging, and excess letdown piping could potentially exceed their design allowable cycle counts for several design transients. However, further evaluation of existing plant operations and the physical separation distance of the letdown and excess letdown piping demonstrated that no further evaluation of the letdown or excess letdown piping was required for current operation or for the period of extended operation. A re-analysis of the charging piping was required to account for the appropriate transients for a 60-year plant life.

This responsiveness to emerging issues and continued program improvements provide evidence that the program will remain effective for managing cumulative fatigue damage for passive components.

Conclusion

Continued implementation of the Metal Fatigue of Reactor Coolant Pressure Boundary Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.28 NICKEL-ALLOY NOZZLES AND PENETRATIONS

For the Nickel-Alloy Nozzles and Penetrations Program, regarding activities for managing the aging of nickel-alloy and nickel-alloy clad components susceptible to primary water stress corrosion cracking - PWSCC (other than upper reactor vessel closure head nozzles and penetrations), BVPS has provided in Appendix A a commitment to develop a plant-specific aging management program that will implement applicable:

1. NRC Orders, Bulletins and Generic Letters; and,
2. staff-accepted industry guidelines.

B.2.29 NICKEL-ALLOY PENETRATION NOZZLES WELDED TO THE UPPER REACTOR VESSEL CLOSURE HEAD

Program Description

The Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Head Program manages cracking due to primary water stress corrosion cracking in nickel-alloy vessel head penetration nozzles. The program scope includes the reactor vessel closure head, upper vessel head penetration nozzles, and associated welds. The program also is used in conjunction with the Boric Acid Corrosion Program to examine the reactor vessel upper head for any loss of material due to boric acid wastage. This program was developed in response to NRC Order EA-03-009, *Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors* [Reference B.3-22], and NRC First Revised Order EA-03-009, *Issuance of First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors* [Reference B.3-23]. Detection of cracking is accomplished through implementation of a combination of bare metal visual examination (external surface of head) and non-visual examination techniques.

NUREG-1801 Consistency

The Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Head Program is an existing program that is consistent with NUREG-1801, Section XI.M11A, *Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRS Only)*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

The BVPS Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Head Program manages cracking due to primary water stress corrosion cracking in nickel-alloy vessel head penetration nozzles. Detection of cracking is accomplished through implementation of a combination of bare metal visual examination (external surface of head) and non-visual examination techniques.

The Corrective Action Program has documented examples demonstrating program awareness of and sensitivity to industry guidance and experience, and the evaluation of that experience for applicability to BVPS. For example, the evaluation of NRC Regulatory Issue Summary RIS 2003-13, which summarized an NRC review of multiple plant responses to NRC Bulletin 2002-01. The Corrective Action Program was used to facilitate a site review of the identified weaknesses and the steps suggested by the NRC for licensees to strengthen their inspection programs to address potential cracking and leakage in materials susceptible to Primary Water Stress Corrosion Cracking. The operating experience also demonstrates the effective use of corrective actions to document and resolve program deficiencies or adverse conditions.

In 2004, the NRC issued First Revised Order EA-03-009 [Reference B.3-23]. This Order superseded the original NRC Order from 2003. BVPS reviews of both NRC Orders were documented in the Corrective Action Program. The program included inspections as required by the Orders.

In March, 2006, a new reactor head was installed at Unit 1 utilizing Alloy 690 penetration material. Installation of the new reactor head places these Nickel-Alloy penetrations in the "replaced" susceptibility category for EA-03-009.

During the Unit 2 Cycle 12 Refueling Outage (October - November 2006), ultrasonic examination (UT) indications were observed. BVPS used additional examination methods, and identified flaws on several Reactor Vessel upper closure head CRDM nozzles that required repair. Repairs were performed based on accepted industry practices, and the nozzles successfully passed further examinations.

Detection and repair of cracking, continuous improvement of material condition, use of recent operating experience and industry guidance in the development of fleet-wide procedures, site Quality Assurance oversight and continuous process improvement provide reasonable assurance that the program is effective for managing aging effects for passive RCS components.

Conclusion

Continued implementation of the Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Head Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.30 ONE-TIME INSPECTION

Program Description

The One-Time Inspection Program is a new program that BVPS will implement prior to the period of extended operation.

This program will require one-time inspections to verify effectiveness of the Water Chemistry Program [Section B.2.42], the Fuel Oil Chemistry Program [Section B.2.20], and the Lubricating Oil Analysis Program [Section B.2.24]. One-time inspections may be needed to address concerns for potentially long incubation periods for certain aging effects on structures and components. There are cases where either (a) an aging effect is not expected to occur but there is insufficient data to completely rule it out, or (b) an aging effect is expected to progress very slowly. For these cases, there will be confirmation that either the aging effect is indeed not occurring, or the aging effect is occurring very slowly as not to affect the component or structure intended function during the extended period of operation. The one-time inspections will provide additional assurance that, either aging is not occurring, or aging is so insignificant that an aging management program is not warranted.

The elements of the program will include:

- Determination of a representative sample size based on an assessment of materials of fabrication, environment, plausible aging effects, and operating experience;
- Identification of the inspection locations in the system or component based on the aging effect, or areas susceptible to concentration of agents that promote certain aging effects;
- Determination of the examination technique, including acceptance criteria that would be effective in managing the aging effect for which the component is examined; and,
- Evaluation of the need for follow-up examinations to monitor the progression of any aging degradation.

In addition to verifying program effectiveness, the program is used to verify that loss of material is not occurring in the following components:

- Steam generator feedwater ring; and,
- Selected bottoms of tanks that sit on concrete pads (by volumetric examination).

When evidence of an aging effect is revealed by a one-time inspection, the routine evaluation of the inspection results would identify appropriate corrective actions.

NUREG-1801 Consistency

The One-Time Inspection Program is a new program that is consistent with NUREG-1801, Section XI.M32, *One-Time Inspection*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.M32, are provided as follows:

- **Scope of Program**

  The program will require one-time inspections to verify effectiveness of the Water Chemistry Program, the Fuel Oil Chemistry Program, and the Lubricating Oil Analysis Program.

  In addition to verifying program effectiveness, the program will be used to verify loss of material is not occurring in the following components:

  - Several tanks that sit on concrete pads are in identified in the Aging Management Review Reports as having their external surface exposed to soil and credit this aging management program. The external bottom surfaces of these tanks will be inspected for loss of material (by volumetric examination) as part of the One-Time Inspection Program.
  - The Unit 1 and Unit 2 steam generator feedwater rings will be inspected for loss of material as part of the program.

- **Preventive Actions**

  The program will consist of inspection activities independent of methods to mitigate or prevent degradation. The program will therefore include no preventive actions.

- **Parameters Monitored / Inspected**

  The program will require inspections to be performed by qualified personnel following procedures consistent with the requirements of the American Society of Mechanical Engineers (ASME) Code and 10 CFR 50, Appendix B. Inspections will be performed using a variety of nondestructive examination methods, including visual, volumetric, and

surface techniques. The program will monitor parameters directly related to the degradation of the components such as wall thickness and visual evidence of corrosion.

- **Detection of Aging Effects**

  The program owner will determine a representative sample of the system and component population to be inspected. The sample will be inspected using a variety of nondestructive examination methods, including visual, volumetric, and surface techniques. The inspections will be completed early enough to ensure that the aging effects that may affect intended functions early in the period of extended operation are appropriately managed. At the same time, inspections will be timed to allow the inspected components to attain sufficient age to ensure that the aging effects with long incubation periods can be identified.

  In addition to inspecting a representative sample of the in-scope system and component population, the program will also inspect the following components to verify loss of material is not occurring:

  - Steam generator feedwater ring; and,
  - Selected bottoms of tanks that sit on concrete pads (by volumetric examination).

- **Monitoring and Trending**

  The program owner will determine the inspection sample size based on an assessment of materials of fabrication, environment, plausible aging effects, and operating experience. Inspection findings will be evaluated by assigned engineering personnel. Inspection findings not meeting the acceptance criteria will be evaluated and tracked through the Corrective Action Program. The Corrective Action Program will be used to identify appropriate corrective actions including additional inspections or expansion of inspection sample size.

- **Acceptance Criteria**

  Determination of acceptance criteria will include evaluation of design standards and industry codes or standards, as applicable. Unacceptable inspection findings will include cracking, loss of material, or reduction of heat transfer that would lead to loss of intended function during the period of extended operation.

  Inspection findings will be evaluated by assigned engineering personnel. Inspection findings not meeting the acceptance criteria will be evaluated and tracked through the Corrective Action Program.

- **Corrective Actions**

  This element is discussed further in Section B.1.3.

- **Confirmation Process**

  This element is discussed further in Section B.1.3.

- **Administrative Controls**

  This element is discussed further in Section B.1.3.

- **Operating Experience**

  The One-Time Inspection Program is a new program; therefore, there is no plant-specific program operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

Conclusion

The implementation of the One-Time Inspection Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.31 ONE-TIME INSPECTION OF ASME CODE CLASS 1 SMALL BORE PIPING

Program Description

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping Program is a new program that BVPS will implement prior to the period of extended operation, and within the last 10 years of, the current operating period.

The program manages cracking of stainless steel ASME Code Class 1 piping less than 4-inches nominal pipe size (NPS 4). The program will manage this aging effect by performing volumetric examinations for selected ASME Code Class 1 small-bore butt welds.

Should evidence of significant aging be revealed by the one-time inspection, periodic inspection will be proposed, as managed by a plant-specific aging management program.

NUREG-1801 Consistency

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping Program is a new program that is consistent with NUREG-1801, Section XI.M35, *One-Time Inspection of ASME Code Class 1 Small-Bore Piping*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.M32, are provided as follows:

- **Scope of Program**

  The program will include one-time volumetric examinations of a sample of Class 1 small-bore butt welds. This sample will include locations that are susceptible to cracking. The program will include measures to verify that unacceptable degradation is not occurring in Class 1 small-bore piping, thereby validating the effectiveness of the Water Chemistry Program to mitigate aging-related degradation and confirming that no additional aging management programs are needed for the period of extended operation.

- **Preventive Actions**

  The program is an inspection activity that detects degradation of components before loss of intended function. Therefore, no guidance is provided on preventive or mitigating activities.

- **Parameters Monitored / Inspected**

  The program will consist of nondestructive examinations (i.e., volumetric) performed by qualified personnel following procedures consistent with Section XI of ASME Code and 10 CFR 50, Appendix B. The volumetric examination technique will be qualified on small-bore piping prior to examination.

- **Detection of Aging Effects**

  BVPS has not experienced significant cracking of ASME Code Class 1 small-bore piping due to stress corrosion or thermal and mechanical loading, and therefore this program is appropriate. This program will perform one-time volumetric examinations on a sample of ASME Code Class 1 small-bore butt weld locations to detect cracking.

- **Monitoring and Trending**

  One-time volumetric examinations will be performed on a sample of ASME Code Class 1 small-bore butt weld locations. The sample selection will be based on susceptibility, inspectability, dose considerations, operating experience, and limiting locations of the total population of ASME Code Class 1 small-bore piping locations. Where practical, the sample selection will focus on the bounding or lead components most susceptible to cracking. The sample size will consist of three welds from each unit. Should evidence of significant aging be revealed by the one-time inspection, periodic inspection will be proposed, as managed by a plant-specific Aging Management Program.

- **Acceptance Criteria**

  If flaws or indications exceed the acceptance criteria of ASME Code, Section XI, Paragraph IWB-3400, they will be evaluated in accordance with ASME Code, Section XI, Paragraph IWB-3131, and additional examinations are performed in accordance with ASME Code, Section XI, Paragraph IWB-2430.

- **Corrective Actions**

  This element is discussed further in Section B.1.3.

- **Confirmation Process**

  This element is discussed further in Section B.1.3.

- **Administrative Controls**

  This element is discussed further in Section B.1.3.

- **Operating Experience**

  The One-Time Inspection of ASME Code Class 1 Small-Bore Piping Program is a new program; therefore, there is no operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

  Relevant historical BVPS operating experience was reviewed and summarized. A self-assessment of the RI-ISI program was completed in November 2004. The assessment team evaluated 13 assessment areas. The assessment included a review of industry operating experience relating to ISI that identified a situation where ultrasonic testing examination volume was marginally acceptable. The BVPS program was reviewed and found to have incorporated the ISI extended examination volume requirement in their ultrasonic testing procedures.

  Quality Assurance surveillances in 2004 identified minor issues that would improve program performance and reduce human errors, but did not identify issues or findings that would impact the overall effectiveness of the program. The review of the ISI program identified items for improvement including use of detailed procedure references, more consistent document formatting, and thorough and timely processing of vendor (i.e., Westinghouse) evaluations. The Corrective Action Program is used to revise the program and to process vendor evaluations in accordance with the required procedures.

  The lack of degradation which could lead to possible failure, demonstrated through a regular program of inspections, provides reasonable assurance that the program is effective for managing aging effects for passive components.

Conclusion

The implementation of the One-Time Inspection of ASME Code Class 1 Small-Bore Piping Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.32 OPEN-CYCLE COOLING WATER SYSTEM

Program Description

The Open-Cycle Cooling Water System Program implements the site commitments to NRC Generic Letter 89-13, *Service Water System Problems Affecting Safety-Related Equipment* [Reference B.3-25], including Supplement 1. This program manages the aging effects on the open-cycle cooling water systems such that the systems will be able to fulfill their intended function during the period of extended operation. The program includes surveillance and control techniques to manage aging effects caused by biofouling, corrosion, erosion, protective coating failures, and silting in the River Water (Unit 1 only) / Service Water (Unit 2 only) Systems or structures and components serviced by the systems.

NUREG-1801 Consistency

The Open-Cycle Cooling Water System Program is an existing program that is consistent with NUREG-1801 Section XI.M20, *Open-Cycle Cooling Water System*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

Microbiologically influenced corrosion (MIC) and macro-fouling have occurred on occasion at BVPS within the River and Service Water systems and other heat exchangers which reject heat directly to the river. Those systems using water from the Ohio River as a heat sink are collectively referred to as the Open Cycle Cooling Water (OCCW) system.

MIC can result in pipe and component wall thinning, which if left unchecked, can cause failure of the affected component. Macro-fouling and MIC also produce silting, which can lead to a decrease in system flow and a subsequent reduction in heat removal. The OCCW program is designed for timely identification of the symptoms of MIC and macro-fouling which will allow corrective actions, such as cleaning, chemical addition, or component replacement, to be taken.

Quality Assurance audits of the OCCW and river water chemistry control programs evaluate the BVPS compliance with NRC guidance (Generic Letter 89-13) for MIC and macro-fouling control within OCCW system components. The most recent audit was completed in December of 2004, the result of which revealed that BVPS satisfies NRC and industry guidelines for OCCW system chemistry control and regulation of MIC and macro-fouling. However, areas for improvement

were identified and documented within the Corrective Action Program. The audit showed that a sufficient number of parameters are measured to detect abnormal conditions which could be indicative of MIC, macro-fouling, or silting. Biocide concentrations were maintained within specified bands, and associated systems were found to be treated and controlled to acceptable levels consistent with industry and NRC guidelines. Adherence to recommended chemistry specifications and regular monitoring of key system flow parameters provide reasonable assurance that the OCCW program will effectively manage loss of material and reduction of heat transfer for in-scope OCCW components.

The OCCW system program at BVPS satisfies GL 89-13 commitments for managing aging effects due to biofouling, corrosion, protective coating failures, and silting within system components. In October, 2004, an NRC audit was conducted on the implementation of Generic Letter, GL 89-13. The audit did not reveal any findings, however, suggested improvements were identified to further strengthen the OCCW system program. For example, a recommendation was made to increase the inspection and cleaning frequencies of OCCW system components which would allow the program to sooner identify a component in the early stages of material loss. The recommended improvement, to modify the monitoring program administrative procedure, was documented within the Corrective Action Program and incorporated into the program.

Thermal Performance Testing of River/Service water cooled heat exchangers, a Generic Letter 89-13 requirement, also provides valuable data on the internal condition of OCCW components. The 2005 Ultimate Heat Sink Biennial Inspection, which included evaluation of the Thermal Performance Testing program, was completed in December with no findings. As part of this inspection, BVPS completed three thermal performance tests on River/Service Water cooled heat exchangers. Specifically, the Unit 1 and Unit 2 charging pump lube oil coolers and Unit 1 diesel generator jacket water cooler were evaluated. All heat exchanger thermal performance test results were satisfactory.

An important element of OCCW system program evaluation is benchmarking trips to other facilities to assess comparable systems and learn from and apply actions which may be applicable to BVPS. Such a trip was taken to the North Anna Station in 2002, which was documented in the Corrective Action Program. Valuable examples of operating experience were identified and evaluated for applicability at BVPS using the Corrective Action Program. Specific examples include use of more accurate flow measuring instrumentation to assess performance changes within the River/Service Water systems, and a program in which large-bore pipes and heat exchanger end bells are hydro-lazed and lined with an epoxy resin.

Program audits, thermal performance testing, and benchmarking other facilities provide reasonable assurance that the OCCW program will effectively manage loss of material and reduction of heat transfer for in-scope OCCW component.

Conclusion

Continued implementation of the Open-Cycle Cooling Water System Program provides reasonable assurance that the aging effects will be managed so that the systems and

components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.33 PWR VESSEL INTERNALS

BVPS has provided in Appendix A (UFSAR Supplement), Table A.4-1 (Unit 1 only) and Table A.5-1 (Unit 2 only) commitments to:

1. Participate in the industry programs applicable to BVPS for investigating and managing aging effects on reactor internals;
2. Evaluate and implement the results of the industry programs as applicable to the BVPS reactor internals; and,
3. Upon completion of these programs, but not less than 24 months before entering the period of extended operations, submit an inspection plan for the BVPS reactor internals to the NRC for review and approval.

B.2.34 REACTOR HEAD CLOSURE STUDS

Program Description

The Reactor Head Closure Studs Program at BVPS Unit 1 and Unit 2 is an existing program that manages the aging effects of the reactor head closure studs, nuts, washers and associated Reactor Vessel flange threads. The program is part of the BVPS ASME Code Section XI Inservice Inspection (ISI) Program. The examinations are performed in accordance with Code Section XI, 1989 edition with no Addenda. The Program is updated periodically as required by 10 CFR 50.55a. The program preventive measures are consistent with the recommendations of Regulatory Guide 1.65, *Materials and Inspections for Reactor Vessel Closure Studs* [Reference B.3-26].

NUREG-1801 Consistency

The Reactor Head Closure Studs Program is an existing program that is consistent with NUREG-1801, Section XI.M3, *Reactor Head Closure Studs*, with exception.

Exceptions to NUREG-1801

Program Elements Affected:

- **Scope of Program**

  NUREG-1801, Section XI.M3, *Reactor Head Closure Studs* specifies the use of ASME Section XI, 2001 edition through 2002 and 2003 Addenda. The applicable ASME Code for the third (Unit 1 only) and second (Unit 2 only) interval of the BVPS Reactor Head Closure Studs Program is ASME Section XI, 1989 edition (with no Addenda). The use of the 1989 edition of the ASME Code is consistent with provisions in 10 CFR 50.55a to use the Code in effect 12 months prior to the start of the inspection interval. BVPS will use the ASME Code edition consistent with the provisions of 10 CFR 50.55a during the period of extended operation.

- **Parameters Monitored or Inspected**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Detection of Aging Effects**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Monitoring and Trending**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Acceptance Criteria**

  See the exception regarding differences in ASME Code edition under Scope of Program.

- **Corrective Actions**

  See the exception regarding differences in ASME Code edition under Scope of Program.

Enhancements

None

Operating Experience

The extent and schedule of the inspection and test techniques prescribed by the program are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of the component. The Inspection schedule of IWB-2400, and the extent and frequency of IWB-2500-1 provide timely detection of cracks, loss of material, and leakage. Implementation of the program provides reasonable assurance that the effects of cracking due to SCC or IGSCC and loss of material due to wear will be adequately managed so that the intended functions of the reactor head closure studs and bolts will be maintained consistent with the current licensing basis for the period of extended operation. (NUREG-1801, Section XI.M3)

Unit 1 reactor head studs ultrasonic testing examinations performed during the Cycle 17 Refueling Outage (February - April 2006) had no undesirable indications. The visual examinations (VT-1) indicated no unsatisfactory conditions. The examination indicated minor nicks and scratches, but the overall results were satisfactory.

Unit 2 reactor head studs ultrasonic testing examinations performed during the Cycle 12 Refueling Outage (October - November 2006) had no undesirable indications. The visual examinations (VT-1) indicated no unsatisfactory conditions. The examination indicated minor nicks and scratches, but the overall results were satisfactory.

The review of plant-specific operating experience has indicated minor surface discontinuities (minor nicks and scratches) on Reactor Vessel studs, nuts, and washers, but no cases of cracking have been identified with the BVPS Reactor Vessel head studs, nuts, or washers.

As part of the ISI program, the Reactor Head Closure Studs Program at BVPS is updated to account for industry and plant-specific operating experience. The implementation of this program provides reasonable assurance that monitoring and evaluating various aging effects related to the reactor head closure studs, nuts, washers and associated Reactor Vessel flange threads will be effective for managing aging effects. Aging effects are analyzed by appropriate personnel and corrected according to the resulting analysis.

Conclusion

Continued implementation of the Reactor Head Closure Studs Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.35 REACTOR VESSEL INTEGRITY

Program Description

The Reactor Vessel Integrity Program is an existing plant-specific program.

The Reactor Vessel Integrity Program manages loss of fracture toughness due to neutron embrittlement in reactor materials exposed to a neutron fluence exceeding 1.0E+17 n/cm^2 (E>1.0 MeV). The program is based on 10 CFR 50, Appendix H, *Reactor Vessel Material Surveillance Requirements* [Reference 1.3-1], and ASTM Standard E 185-82, *Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels* [Reference B.3-27] (incorporated by reference into 10 CFR 50, Appendix H). Capsules are periodically removed during the course of plant operating life. Neutron embrittlement is evaluated through surveillance capsule testing and evaluation, fluence calculations and monitoring of effective full power years (EFPYs). Best-estimate values of Reactor Vessel accumulated neutron fluence are determined utilizing analytical models that satisfy the guidance contained in NRC Regulatory Guide 1.190, *Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence* [Reference B.3-28]. Data resulting from the program is used to:

- Determine pressure-temperature limits, minimum temperature requirements, and end-of-life Charpy upper-shelf energy (C_VUSE) in accordance with the requirements of 10 CFR 50 Appendix G, *Fracture Toughness Requirements* [Reference 1.3-1], and,
- Determine end-of-life RT_{PTS} values in accordance with 10 CFR 50.61, *Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock* [Reference 1.3-1].

The Reactor Vessel Integrity Program provides guidance for removal and testing or storage of material specimen capsules. All capsules that have been withdrawn were tested and stored. Standby capsules at Unit 1 and Unit 2 will be available for future testing. Standby capsules from each unit will be removed from the vessel when the neutron fluences are approximately equivalent to the expected vessel wall neutron fluence at 60 years of operation (corrected for lead and capacity factors).

In addition, the Reactor Vessel Integrity Program implements flux reduction programs as required by 10 CFR 50.61.

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1800 [Reference 1.3-4], Appendix A, are provided as follows:

- **Scope of Program**

  The program monitors changes in the fracture toughness properties of ferritic materials in the Reactor Vessel beltline region which result from exposure of these materials to neutron irradiation and the thermal environment. Under the program, fracture toughness test data are obtained from material specimens exposed in surveillance capsules, which are withdrawn periodically from the Reactor Vessel. The test data are then analyzed and used to establish operating limits and setpoints in compliance with the pressure and temperature requirements of 10 CFR 50 Appendix G. The extended beltline materials that have projected fluence values of greater than 1.0E+17 n/cm^2 (E>1.0 MeV) at the end-of-license-extended were evaluated, and none of these materials were determined to be limiting. Therefore, these materials need not be added to the material surveillance program for the license renewal term.

- **Preventive Actions**

  Surveillance capsule test data is used to determine operating pressure-temperature limits, minimum temperature requirements, and end-of-life C_VUSE in accordance with the requirements of 10 CFR 50 Appendix G, and determine end-of-life RT_{PTS} values in accordance with 10 CFR 50.61. In addition, the Reactor Vessel Integrity Program implements flux reduction programs as allowed by 10 CFR 50.61. Flux reduction program documentation will be submitted in accordance with the requirements of 10 CFR 50.61.

- **Parameters Monitored / Inspected**

  The Reactor Vessel Integrity program monitors the loss of fracture toughness due to neutron irradiation embrittlement of the Reactor Vessel beltline materials in accordance with 10 CFR 50, Appendix H. Various environmental and metallurgical parameters are monitored, including fluence and material chemistry. Once all surveillance capsules are removed, alternative dosimetry will be used to monitor neutron fluence during the period of extended operation.

- **Detection of Aging Effects**

  Fracture toughness test data are obtained from encapsulated, in-vessel material specimen surveillance coupons, which are withdrawn periodically from the Reactor Vessel and destructively tested. Charpy V-notch testing is conducted on the coupons to measure loss of fracture toughness.

- **Monitoring and Trending**

  The irradiated material properties (Charpy test results) are compared to available unirradiated properties, and the resulting irradiation shift is measured. The shift is a measure of the effect of irradiation on material toughness for the plate and weld materials. The BVPS data is not trended.

- **Acceptance Criteria**

  The program requirements are set forth in 10 CFR 50, Appendices G and H, and ASTM Standard E 185-82, *Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels*, which is incorporated by reference into 10 CFR 50, Appendix H.

- **Corrective Actions**

  This element is discussed in Section B.1.3.

- **Confirmation Process**

  This element is discussed in Section B.1.3.

- **Administrative Controls**

  This element is discussed in Section B.1.3.

- **Operating Experience**

  The Reactor Vessel Integrity Program has provided materials data and dosimetry for the monitoring of irradiation embrittlement since plant startup. The use of this program has been reviewed and approved by the NRC during the period of current operation. Surveillance capsules have been withdrawn during the period of current operation, and the data from these surveillance capsules and sister plant data have been used to verify and predict the performance of BVPS Reactor Vessel beltline materials with respect to neutron embrittlement. Calculations have been performed as required to project the reference temperature for pressurized thermal shock (RT_{PTS}) and Charpy upper-shelf energy (C_VUSE) values to the end-of-license-extended (EOLE). BVPS pressure-temperature limit curves are valid up to a stated vessel fluence limit, and must be revised prior to operating beyond that limit. As part of the Extended Power Uprate review, the continued applicability of each unit's pressure-temperature limits was evaluated.

  In 2001, a BVPS self-assessment of the program was conducted. As a result, program enhancements were made. The self-assessment identified two strengths and five areas for improvement for the program, which were documented in the Corrective Action Program. The areas for improvement dealt with the need to better document and control technical information used within the program. The Corrective Action Program was used as needed to track resolution of the areas for improvement. Program enhancements as a

result of issues identified in a self-assessment provides reasonable assurance that the program is effective.

Actions to manage the Reactor Vessel fluence at the limiting location have been underway at BVPS Unit 1 since the 1990s. Starting with Cycle 11 in 1995, BVPS instituted a flux management program to manage the fluence effects on the RT_{PTS} value of the limiting plate (lower shell plate B6903-1). This flux management plan included the addition of hafnium rods in the peripheral fuel bundles and continued use of the standard L4P low-leakage core loading. The operation of Unit 1 with hafnium rods installed for three cycles (removed in fall of 2001) reduced the irradiation rate by approximately 25 percent during that time period.

The program operating experience provides reasonable assurance that the program will remain effective in managing aging effects of Reactor Vessel materials.

Enhancements

None

Conclusion

Continued implementation of the Reactor Vessel Integrity Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.36 SELECTIVE LEACHING OF MATERIALS INSPECTION

Program Description

The Selective Leaching of Materials Inspection Program is a new program that BVPS will implement prior to the period of extended operation.

The program includes a one-time visual inspection and hardness examination of selected components that are susceptible to selective leaching. The program scope includes components and commodities (such as piping, pump casings, valve bodies and heat exchanger components) made of copper alloys with zinc content greater than 15% or gray cast iron which are exposed to a raw water, treated water, air, condensation, or soil environment.

This program will determine whether selective leaching is occurring for selected components. Should evidence of significant aging be revealed by the one-time inspection or previous operating experience, the Corrective Action Program will be used for the unacceptable inspection findings. The resolution will include evaluation for expansion of the inspection sample size, locations, and frequency.

NUREG-1801 Consistency

The Selective Leaching of Materials Inspection Program is a new program that is consistent with NUREG-1801, Section XI.M33, *Selective Leaching of Materials*, with exception.

Exceptions to NUREG-1801

Program Element Affected:

- **Detection of Aging Effects**

  BVPS takes exception to Brinell hardness testing as described in NUREG-1801. Examinations, other than Brinell hardness testing, will be used to identify the presence of selective leaching. A qualitative determination of selective leaching will be used in lieu of Brinell hardness testing for components within the scope of this program. The exception is justified, because (1) Brinell hardness testing may not be feasible for most components due to form and configuration (i.e., heat exchanger tubes), and (2) other mechanical means, such as scraping or chipping, provide an equally valid method of identification

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.M33, are provided as follows:

- **Scope of Program**

  The scope of the program will include all components and commodities identified in the Aging Management Reviews as susceptible to loss of material due to selective leaching. This includes components and commodities (such as piping, pump casings, valve bodies and heat exchanger components) made of gray cast iron and copper alloys with zinc content greater than 15% that are exposed to a raw water, treated water, air, condensation, or soil environment.

  The program will determine a representative sample of components that are susceptible to selective leaching for examination.

- **Preventive Actions**

  The program will be an evaluation and inspection program with no preventive actions to preclude or mitigate aging effects.

- **Parameters Monitored / Inspected**

  The program will consist of visual inspections and qualitative hardness examinations of internal surfaces of susceptible components. These examinations will determine if loss of material due to selective leaching has occurred and if it will affect the component's intended function.

- **Detection of Aging Effects**

  A representative sample of components will be selected for inspection based on the specific plant component material/environment combinations. At least one component of each material type (gray cast iron and copper alloys > 15% Zn) will be included and inspected in the representative sample. A qualitative hardness examination, such as scraping or chipping of internal surfaces of susceptible components, will determine if loss of material due to selective leaching has occurred.

- **Monitoring and Trending**

  The program consists of one time inspections only. It therefore does not include provisions for monitoring and trending.

- **Acceptance Criteria**

  Any indications of degradation that are detected during an inspection for selective leaching will be evaluated using the Corrective Action Program.

- **Corrective Actions**

  This element is discussed in Section B.1.3.

- **Confirmation Process**

  This element is discussed in Section B.1.3.

- **Administrative Controls**

  This element is discussed in Section B.1.3.

- **Operating Experience**

  The Selective Leaching of Materials Inspection Program is a new program; therefore, there is no plant-specific program operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

Conclusion

The implementation of the Selective Leaching of Materials Inspection Program will provide reasonable assurance that the aging effects will be managed so that the structures and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.37 SETTLEMENT MONITORING (UNIT 2 ONLY)

Program Description

The Settlement Monitoring Program (Unit 2 only) is an existing plant-specific condition monitoring program for structures and piping that are within the scope of license renewal. The program monitors the settlement of structures to prevent stresses in the structures or piping from increasing beyond analyzed stress levels. The analyses of the structures and piping addressed by the program are time-limited aging analyses (TLAAs) discussed in Section 4.7.5 of the LRA.

As documented in UFSAR Section 2.5.4.13, the settlement of each Unit 2 Category I structure was monitored during construction, and is monitored through the plant's life until the settlement of a particular structure has been determined to be stable as defined by the Settlement Monitoring Program. For such structures, settlement monitoring is then discontinued. The Settlement Monitoring Program provides the requirements to measure the settlement of Unit 2 structures at selected locations. If the settlement of a structure exceeds that anticipated, a review of current analysis (as it relates to the integrity of the structure and the maintenance of settlement assumptions in the piping stress analysis) is required.

The Settlement Monitoring Program ensures that the current 40-year settlement assumptions in the Unit 2 pipe stress analyses are maintained for the period of extended operation.

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1800 [Reference 1.3-4], Appendix A, are provided as follows:

- **Scope of Program**

  The program monitors designated Unit 2 safety-related structures. Therefore, the program is applicable only to Unit 2. Unit 1 in-scope structures are no longer monitored because use of the program established that Unit 1 in-scope structures are no longer settling.

- **Preventive Actions**

  This program is a condition monitoring program, so there are no preventive actions.

- **Parameters Monitored / Inspected**

  The elevations of buildings are surveyed and compared to previously recorded elevations. Any changes in elevations are evaluated with respect to previously established limits on changes in structure elevations.

- **Detection of Aging Effects**

  The program does not detect aging effects. The program uses surveys to measure structure settlement. If the settlement of a structure exceeds that anticipated, a review of current analysis (as it relates to the integrity of the structure and the maintenance of settlement assumptions in the piping stress analysis) is required.

- **Monitoring and Trending**

  Settlement of the structures has been projected and bounded by a maximum allowed for in the Current Licensing Basis. The program manages Time Limited Aging Analyses established to maintain component stress levels within the capabilities of the associated components. The settlements of structures are trended incrementally to measure and predict the extent of settling.

- **Acceptance Criteria**

  Each monitored structure has an allowable settlement limit. The Structure Settlement Evaluation is a comparison of observed structure settlement to that anticipated by the original plant designer or that amount of settlement later determined to be acceptable by more recent analyses. The program requires action to be taken if there are discrepancies between measured and anticipated settlements.

- **Corrective Actions**

  This element is discussed in Section B.1.3.

- **Confirmation Process**

  This element is discussed in Section B.1.3.

- **Administrative Controls**

  This element is discussed in Section B.1.3.

- **Operating Experience**

  The program uses surveys to measure structure settlement. Structure settlement is projected. If the settlement of a structure exceeds that anticipated, a review of current analysis (as it relates to the integrity of the structure and the maintenance of settlement assumptions in the piping stress analysis) is required.

  In 1995, an evaluation of settlement data showed that the Unit 1 structures being monitored had stopped settling, or become stable. A settlement marker location is “stable” if, over a reasonable time frame (2 to 3 years), a trend can be established that the marker has maintained a fixed elevation within a tolerance range of plus or minus 0.125 inch. As a result, the Unit 1 structures were removed from the scope of the program; the Corrective Action Program was used to document this scope change.

In 2004, a review of the program by the Company Nuclear Review Board questioned the ongoing validity of the removal of the Unit 1 structures from scope, given the possibility of changes in precipitation trends and potential leakage from underground fire protection piping. The engineering evaluations from 2003 were re-evaluated to ensure that an increase in precipitation or potential leakage from underground piping would not invalidate them. The Corrective Action Program was used to document the assessment.

To date, the only structure to exceed its anticipated settlement is a Unit 2 Valve Pit. In 1997, an evaluation of settlement data showed that the Valve Pit was settling faster than expected. As a result, the pipe stress and other calculations associated with the Valve Pit were recalculated to account for the observed settlement.

Comparison of program techniques and methods and use of the Corrective Action Program for implementation and modification of procedures demonstrate that the Settlement Monitoring Program is effectively monitoring and evaluating settlement of safety-related structures.

Enhancements

None

Conclusion

Continued implementation of the Settlement Monitoring Program (Unit 2 only) provides reasonable assurance that the aging effects will be managed so that the structures and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.38 STEAM GENERATOR TUBE INTEGRITY

Program Description

The Steam Generator Tube Integrity Program is based on NEI 97-06, *Steam Generator Program Guidelines* [Reference B.3-29]. The Steam Generator Tube Integrity Program is credited for aging management of the tubes, tube plugs, tube supports, and the secondary-side internal components whose failure could prevent the steam generator from fulfilling its intended safety function. The program includes performance criteria that are intended to provide assurance that steam generator tube integrity is being maintained consistent with the plant's licensing basis, and provides guidance for monitoring and maintaining the tubes to provide assurance that the performance criteria are met at all times between scheduled inspections of the tubes.

The Steam Generator Tube Integrity Program provides the requirements for inspection activities for the detection of flaws in tubes, plugs, tube supports, and secondary-side internal components needed to maintain tube integrity. Degradation assessments identify both potential and existing degradation mechanisms. Inservice inspections (i.e., eddy current testing, ultrasonic testing and visual inspections) are used for the detection of flaws. Condition monitoring compares the inspection results against performance criteria, and an operational assessment provides a prediction of tube conditions to ensure that the performance criteria will not be exceeded during the next operating cycle. Primary to secondary leakage is continually monitored during operation.

NUREG-1801 Consistency

The Steam Generator Tube Integrity Program is an existing program that is consistent with NUREG-1801, Section XI.M19, *Steam Generator Tube Integrity*.

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

BVPS Unit 1 steam generators (SGs) were replaced during the Unit 1 Cycle 17 Refueling Outage (February - April 2006), and the plant achieved full, uprated core thermal power in January of 2007. BVPS Unit 2 continues to operate with its original steam generators and has partially uprated its core thermal power output. Unit 2 is expected to achieve its full, uprated power after future plant modifications.

During each refueling outage, SG degradation assessments are performed in accordance with the provisions of NEI 97-06 and Section 5.2 of the EPRI PWR SG examination guidelines. These industry guidelines are based in part on operating experience and inspection results from other operating PWRs. Incorporation of plant and industry operating experience and use of industry guidance documents in the development of an inspection program provide assurance that the SG tube integrity program will continue to effectively manage aging effects of these passive components.

Results of recent degradation assessments performed during the Unit 1 Cycle 16 Refueling Outage (October - November 2004) and the Unit 2 Cycle 11 Refueling Outage (April 2005) are summarized in SG degradation assessment reports. Topics covered in the reports include SG tube degradation mechanisms, inspection & expansion requirements, tube repair criteria, structural limits, guidelines for testing, and chemical cleaning provisions.

As a result of the Unit 1 Cycle 16 Refueling Outage inspections at Unit 1, 196 SG tubes were plugged. As with all previous inspections, the condition of the Unit 1 SGs (with the degraded tubes plugged) met industry and regulatory structural and leakage integrity guidance, and were expected to meet these criteria following the outage inspection.

The outcome of the Unit 2 Cycle 11 Refueling Outage SG inspections necessitated that 55 tubes be plugged. The condition of the three SGs (with the degraded tubes plugged) met industry and regulatory structural and leakage integrity guidance, and the SGs were expected to meet these criteria following the outage inspection.

The degradation assessments also include discussions of specific and recent industry events (section 4.7 of the Unit 1 Cycle 16 Refueling Outage report and section 3.7 of the Unit 2 Cycle 11 Refueling Outage report). For example, lessons learned from false indications of eddy current testing at the Comanche Peak station resulted in changes to the BVPS bobbin analysis method. At the Shearon Harris plant, low level primary-to-secondary leakage was determined to be caused by foreign object wear just above the top of the cold leg side of the tubesheet. The inspection of the affected tube during the previous outage did not identify any flaw, however, subsequent manual reanalysis of the data suggested that flaw was present when the affected tube was tested. The failure to identify the flaw in the affected tube was attributed to a "sorting logic" gap that resulted in ½ inch section of tube which was not analyzed. The flaw was located within this unanalyzed ½ inch section of tube. As a result of this event, BVPS evaluated the sorting logic to verify that the logic did not contain similar gaps.

Using the accepted industry approach to testing and evaluation, and incorporation of pertinent industry operating experience, insures that the steam generator tube integrity program manages the effects of component aging such that the steam generators will continue to perform their intended functions, consistent with the current licensing basis, during the period of extended operation.

Conclusion

Continued implementation of the Steam Generator Tube Integrity Program provides reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.39 STRUCTURES MONITORING

Program Description

The Structures Monitoring Program implements the requirements of 10 CFR 50.65, *Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants* (the Maintenance Rule), using the guidance of NUMARC 93-01, *Industry Guidelines for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants* [Reference B.3-30] and Regulatory Guide 1.160, *Monitoring the Effectiveness of Maintenance at Nuclear Power Plants* [Reference B.3-31].

The program relies on periodic visual inspections to monitor the condition of structures and structural components so that intended functions are maintained through the period of extended operation.

The Intake Structure (Common) and the Alternate Intake Structure (Common) are within the scope of the program, but are not water-control structures as defined in Regulatory Guide 1.127, *Inspection of Water-Control Structures Associated with Nuclear Power Plants* [Reference B.3-32]. However, the elements of the Structures Monitoring Program that manage the aging of the Intake Structure (Common) and the Alternate Intake Structure (Common) are consistent with the applicable elements of Regulatory Guide 1.127.

NUREG-1801 Consistency

The Structures Monitoring Program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.S6, *Structures Monitoring*.

Exceptions to NUREG-1801

None

Enhancements

The following enhancements will be implemented prior to the period of extended operation.

Program Elements Affected:

- **Scope of Program**

  The scope of the existing program is comprised of 10 CFR 50.65 (Maintenance Rule) structures and structural components. These and some additional structures and structural components were identified in the license renewal aging management review reports. The scope of the program will be enhanced to include the additional structures and structural components.

- **Parameters Monitored / Inspected**

  Include inspection guidance in program implementing procedures to detect significant cracking in concrete surrounding the anchors of vibrating equipment.

  Include a requirement in program procedures to perform opportunistic inspections of normally inaccessible below-grade concrete when excavation work uncovers a significant depth.

  Include a requirement in program procedures to perform periodic sampling of groundwater for pH, chloride concentration, and sulfate concentration.

  Include a requirement in program procedures to monitor elastomeric materials used in seals and sealants, including compressible joints and seals, waterproofing membranes, etc., associated with in-scope structures and structural components for cracking and change in material properties.

Operating Experience

The Structures Monitoring Program inspections are performed every five years to monitor parameters specific to each structure/aging effect combination. The inspections assess the overall condition of BVPS structures, including spalling, cracking, corrosion, compromised structural integrity, settlement, loose or missing anchors/fasteners, and seismic gaps. The degree of inspections depends on factors including importance to safety, age, environmental conditions, and service requirements. The results of program inspections are documented for comparison with future inspection results. Significant degradation is evaluated through the Corrective Action Program.

The baseline programmatic inspection of BVPS structures was performed in 1996. In 2001, the second programmatic inspection of BVPS structures was completed and documented. The 2006 inspection was performed, but the report had not been issued as of the date of this assessment.

Overall, the 2001 inspection report concluded that plant structures were in good condition and performing well. The inspection found no conditions requiring immediate maintenance or repair. Conditions noted were minor in nature and did not affect the structural integrity of any of the structures reviewed. Many of the observed conditions were noted for further review during the next programmatic inspection. Conditions noted in the 1996 baseline inspection were revisited. In most cases, little or no change was noted from the baseline observations.

The 2001 inspection report identified that, in some cases, corroded steel that was painted as a result of the baseline inspection had corrosion reappear. In such cases, the steel was located in a damp or wet environment. None of this corrosion was detrimental. Some minor concrete cracks were noted. The cracks were narrow and shallow, and presented no structural integrity problems. Some exterior surfaces of concrete structures evidenced pop-outs and spalls. These conditions were not detrimental and no repair or patching was necessary. No exposed reinforcing steel was

noted. Areas of peeling or cracked paint were observed. Some areas had been painted since the baseline inspection. Other areas were noted for future painting. Some calcium deposits and water stains were noted, however no active wall leaks were observed. Deposits and stains noted in the baseline inspection that were cleaned had not reappeared.

In 2001, degraded structural bolting was found and replaced at BVPS in Intake Bay B of the Intake Structure. As a result of the finding, the program inspection scope was expanded. The Corrective Action Program was used to identify the problem and track the revision to the scope of the Structures Monitoring Program. The program implementing document was modified to incorporate a specific requirement assuring inspection of normally submerged structural items (steel supports and seismically mounted structures) in the Intake Structure and Auxiliary Intake Structure.

Industry operating experience has been evaluated for applicability to the program. The NRC issued Information Notice 2003-08, *Potential Flooding Through Unsealed Concrete Floor Cracks* [Reference B.3-33]. In 2002, at Energy Northwest's Columbia Generating Station, water spilled from a firewater drain line onto the floor. A small amount of this water leaked down into the remote shutdown room and a switchgear room. The leakage pathway was determined to be cracks in the concrete floor. An assessment of applicability of this event to BVPS was done. The Structures Monitoring Program inspection of floors was found to be sufficient to identify and repair any cracks large enough to allow water seepage.

The Structures Monitoring Program has identified and corrected age-related issues for in-scope structures and structural components. Where applicable, program improvements were implemented to incorporate site operating experience. The program has appropriately evaluated applicable industry operating experience. Ongoing identification of degradation and corrective action prior to loss of intended function provide reasonable assurance that the program is effective for managing aging effects for structural components.

Conclusion

Continued implementation of the Structures Monitoring Program provides reasonable assurance that the aging effects will be managed so that the structures and structural components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.40 THERMAL AGING AND NEUTRON IRRADIATION EMBRITTLEMENT OF CAST AUSTENITIC STAINLESS STEEL (CASS)

Program Description

The Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program is a new program that BVPS will implement prior to the period of extended operation.

Reactor Vessel Internals will be inspected in accordance with ASME Code Section XI, Subsection IWB, Category B-N-3. This inspection will be augmented to detect the effects of loss of fracture toughness due to thermal aging and neutron irradiation embrittlement of CASS components. The program will include identification of the limiting susceptible components from the standpoint of thermal aging susceptibility, neutron fluence, and cracking. For each identified component, aging management will be accomplished through either a supplemental examination or a component-specific evaluation, including a mechanical loading assessment.

BVPS will participate in the EPRI Materials Reliability Project established to investigate the impacts of aging on PWR vessel internal components. The results of this project will provide additional bases for the inspections and evaluations performed under this program.

NUREG-1801 Consistency

The Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program is a new aging management program that will be consistent with NUREG-1801, Section XI.M13, *Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.M13, are provided as follows:

- **Scope of Program**

  The CASS components with service conditions above 250°C (482°F) shall be screened for potential susceptibility to thermal aging embrittlement. The screening criteria is set forth in the letter dated May 19, 2000, from Christopher I Grimes, Nuclear Regulatory Commission, to Douglas J. Walters, Nuclear Energy Institute, License Renewal Issue No. 98-0030, Thermal Aging Embrittlement of Cast Stainless Steel Components. The screening criteria is applicable to components constructed from SA-351 Grades CF3, CF3A, CF8, CF8A, CF3M, CF3MA, CF8M, with service conditions above 250°C (482°F). In applying the screening method, ferrite content is calculated by using Hull's equivalent factors described in NUREG/CR-4513, Rev. 1.

  For potentially susceptible components, the program will require evaluation of the synergistic loss of fracture toughness due to neutron embrittlement and thermal aging embrittlement.

  For each such component, aging management will be accomplished through either a supplemental examination of the affected component as part of a 10-year Inservice Inspection program during the license renewal term, or a component-specific evaluation to determine the component's susceptibility to loss of fracture toughness.

- **Preventive Actions**

  The program is a condition monitoring program that detects degradation of components before loss of intended function. Therefore, there are no preventive or mitigating attributes that are associated with these activities.

- **Parameters Monitored / Inspected**

  The program will identify the Reactor Vessel Internals cast austenitic stainless steel materials that have a projected 60-year neutron fluence of greater than 1.0E+17 n/cm^2 (E>1.0 MeV) or are determined to be susceptible to thermal aging embrittlement. For such materials, the program will consist of either a supplemental examination of the affected component or a component-specific evaluation to determine the component's susceptibility to loss of fracture toughness.

- **Detection of Aging Effects**

  For Reactor Vessel Internals cast austenitic stainless steel components that have a projected 60-year neutron fluence of greater than 1.0E+17 n/cm^2 (E>1.0 MeV) or are determined to be susceptible to thermal embrittlement, the 10-year Inservice Inspection program in effect during the renewal period will include supplemental inspections

covering portions of the susceptible components determined to be limiting from the standpoint of thermal aging susceptibility, neutron fluence, and cracking susceptibility.

The program will require an inspection technique capable of detecting the critical flaw size with adequate margin. The critical flaw size will be determined based on the service loading conditions and service-degraded material properties. Examination methods that meet the criteria of the ASME Code Section XI, Appendix VIII are acceptable.

As an alternate to supplemental inspections, a component-specific evaluation may be performed, including a mechanical loading assessment to determine the maximum tensile loading on the component during ASME Code Service Level A, B, C, and D conditions. If the loading is compressive or low enough (<5 ksi) to preclude fracture, then supplemental inspection of the component will not be required. Failure to meet this criterion will require continued use of the supplemental inspection program.

For each cast austenitic stainless steel component that is projected to have a neutron fluence of less than 1.0E+17 n/cm^2 (E>1.0 MeV) and is susceptible to thermal aging, the supplemental inspection program applies.

For each cast austenitic stainless steel component that is projected to have a neutron fluence of less than 1.0E+17 n/cm^2 (E>1.0 MeV) and is not susceptible to thermal aging, the existing ASME Code Section XI inspection requirements are adequate.

- **Monitoring and Trending**

  Inspection schedules will be in accordance with ASME Section XI, Subsection IWB-2400.

- **Acceptance Criteria**

  Flaws detected in cast austenitic stainless steel components are evaluated in accordance with the applicable procedures of ASME Code Section XI IWB-3500. Flaw tolerance evaluation for components with ferrite content up to 25% will be performed according to the principles associated with IWB-3640 procedures for submerged arc welds (SAW), disregarding the code restriction of 20% ferrite in IWB-3641(b)(1). Flaw tolerance evaluations for components with greater than 25% ferrite will be performed on a case-by-case basis using fracture toughness data provided in industry literature.

- **Corrective Actions**

  This element is discussed in Section B.1.3.

- **Confirmation Process**

  This element is discussed in Section B.1.3.

- **Administrative Controls**

  This element is discussed in Section B.1.3.

- **Operating Experience**

  The Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program is a new program; therefore, there is no plant-specific program operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

Conclusion

The implementation of the Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.41 THERMAL AGING EMBRITTLEMENT OF CAST AUSTENITIC STAINLESS STEEL (CASS)

Program Description

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) Program is a new program that BVPS will implement prior to the period of extended operation.

Reactor Coolant System components will be inspected in accordance with the ASME Boiler and Pressure Vessel Code, Section XI. The ASME Section XI inspection will be augmented to detect the effects of loss of fracture toughness due to thermal aging embrittlement of cast austenitic stainless steel components. This program will include a determination of the susceptibility of the subject cast austenitic stainless steel components to thermal aging embrittlement based on casting method, molybdenum content, and percent ferrite. For potentially susceptible components, aging management will be accomplished utilizing additional inspections or a component-specific flaw tolerance evaluation. Additional inspections or evaluations will not be required for components that are determined not to be susceptible to thermal aging embrittlement. Screening for susceptibility to thermal aging embrittlement is not required for pump casings and valve bodies. The existing ASME Section XI inspection requirements, including the alternative requirements of ASME Code Case N-481 *Alternate Examination Requirements for Cast Austenitic Pump Casings*, [Reference B.3-34], are adequate for all pump casings and valve bodies.

In addition, cast austenitic stainless steel components that are not part of the reactor coolant pressure boundary, but that have service conditions above 250º C (> 482º F), are included in this program. These components will be inspected, evaluated, or replaced as appropriate if screening determines they are susceptible to thermal aging embrittlement. The screening exclusion (pump casings and valve bodies) is not applicable to these components.

NUREG-1801 Consistency

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) Program is a new aging management program that will be consistent with NUREG-1801, Section XI.M12, *Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)*.

Exceptions to NUREG-1801

None

Enhancements

None

Aging Management Program Elements

The results of an evaluation of each of the 10 aging management program elements described in NUREG-1801, Section XI.M12, are provided as follows:

- **Scope of Program**

  CASS components with service conditions above 250°C (482°F) shall be screened for potential susceptibility to thermal aging embrittlement. The screening criteria is set forth in the letter dated May 19, 2000, from Christopher I Grimes, Nuclear Regulatory Commission, to Douglas J. Walters, Nuclear Energy Institute, License Renewal Issue No. 98-0030, Thermal Aging Embrittlement of Cast Stainless Steel Components. The screening criteria is applicable to components constructed from SA-351 Grades CF3, CF3A, CF8, CF8A, CF3M, CF3MA, CF8M, with service conditions above 250°C (482°F). In applying the screening method, ferrite content is calculated by using Hull's equivalent factors described in NUREG/CR-4513, Rev. 1. Screening for susceptibility to thermal aging embrittlement is not required for pump casings and valve bodies that are part of the reactor coolant pressure boundary. The existing ASME Section XI inspection requirements, including the alternative requirements of ASME Code Case N-481 "Alternate Examination Requirements for Cast Austenitic Pump Casings," are adequate for pump casings and valve bodies.

  For potentially susceptible reactor coolant pressure boundary components, aging management will be accomplished through either enhanced volumetric examination or a component-specific flaw tolerance evaluation.

  In addition, cast austenitic stainless steel components that are not part of the reactor coolant pressure boundary but that have service conditions above 250º C (> 482º F) will be included in this program. These components will be inspected, evaluated, or replaced as appropriate if screening determines they are susceptible to thermal aging embrittlement. The screening exclusion (pump casings and valve bodies) is not applicable to these components.

- **Preventive Actions**

  The program is a condition monitoring program that detects degradation of components before loss of intended function. Therefore, no guidance is provided on preventive or mitigating activities.

- **Parameters Monitored / Inspected**

  The program monitors the effects of loss of fracture toughness on the intended function of the component by identifying CASS materials that are susceptible to thermal aging embrittlement. For potentially susceptible materials that are part of the reactor coolant pressure boundary, the program will consists of either volumetric examination of the base metal or a component-specific flaw tolerance evaluation (loss of fracture toughness is of consequence only if cracks exist).

Potentially susceptible components that are not part of the reactor coolant pressure boundary will be inspected, evaluated, or replaced as appropriate. BVPS will determine required inspections on a case by case basis.

- **Detection of Aging Effects**

  For potentially susceptible materials that are part of the reactor coolant pressure boundary, the program will consist of either volumetric examination of the base metal or a component-specific flaw tolerance evaluation. Examination methods will meet the criteria of ASME Section XI, Appendix VIII. Component-specific flaw tolerance evaluations will be performed using specific geometry and stress information, to demonstrate that the potentially susceptible material has adequate toughness.

  Potentially susceptible components that are not part of the reactor coolant pressure boundary will be inspected, evaluated, or replaced as appropriate. BVPS will determine required inspections on a case by case basis. The screening exclusion (pump casings and valve bodies) is not applicable to these components.

- **Monitoring and Trending**

  Inspection schedules will be in accordance with ASME Section XI, Subsection IWB-2400 or IWC-2400. For components that are not part of the reactor coolant pressure boundary, the inspection schedules will be determined on a case by case basis.

- **Acceptance Criteria**

  Flaws detected in reactor coolant pressure boundary CASS components will be evaluated in accordance with IWB-3500 or IWC-3500. Flaw tolerance evaluation for components with ferrite content up to 25% will be performed according to the principles associated with IWB-3640 procedures for submerged arc welds (SAW), disregarding the code restriction of 20% ferrite in IWB-3641(b)(1). Flaw tolerance evaluations for components with greater than 25% ferrite will be performed on a case-by-case basis using fracture toughness data provided in industry literature.

  For components that are not a part of the reactor coolant pressure boundary, the acceptance criteria will be determined on a case by case basis.

- **Corrective Actions**

  This element is discussed in Section B.1.3.

- **Confirmation Process**

  This element is discussed in Section B.1.3.

- **Administrative Controls**

  This element is discussed in Section B.1.3.

- **Operating Experience**

  The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) Program is a new program; therefore, there is no plant-specific program operating experience for program effectiveness. Industry operating experience that forms the basis for the program is described in the operating experience element of the NUREG-1801 program description.

  Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. As additional operating experience is obtained, lessons learned will be appropriately incorporated into the program.

Conclusion

The implementation of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) Program will provide reasonable assurance that the aging effects will be managed so that the systems and components within the scope of this Program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B.2.42 WATER CHEMISTRY

Program Description

The main objective of the Primary and Secondary Water Chemistry Program is to mitigate damage caused by corrosion and stress corrosion cracking. The Water Chemistry Program relies on monitoring and control of water chemistry based on EPRI TR-105714, Rev. 5 (TR-1002884), *PWR Primary Water Chemistry Guidelines* [Reference B.3-35], and EPRI TR-102134, Rev. 6 (TR-1008224), *PWR Secondary Water Chemistry Guidelines* [Reference B.3-36].

The One-Time Inspection Program [Section B.2.30] will be used to verify the effectiveness of the Water Chemistry Program for the circumstances identified in NUREG-1801 that require augmentation of the Water Chemistry Program.

NUREG-1801 Consistency

The Water Chemistry Program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.M2, *Water Chemistry*.

Exceptions to NUREG-1801

None

Enhancements

The following enhancement will be implemented prior to the period of extended operation.

Program element affected:

- **Monitoring and Trending**

  Change BVPS frequency for reactor coolant silica monitoring to once per week for MODES 1 and 2, and once per day during heatup in MODES 3 and 4 to be consistent with EPRI guidelines.

Operating Experience

The BVPS Water Chemistry Program is based on EPRI primary and secondary water chemistry guidelines, and as such, is sensitive to industry operating experience. Operating experience events are evaluated for potential inclusion in subsequent revisions of the EPRI guidelines based on significance and frequency of occurrence. The implementation of the EPRI guidelines at BVPS is monitored using the Corrective Action Program and is validated using Nuclear Quality Assurance audits. During the interim between revisions to the EPRI documents, operating experience from INPO is evaluated for applicability to BVPS.

BVPS Unit 1 RCS zinc concentration was occasionally out of specification between September of 2004 and November of 2006. Industry operating experience demonstrated that cracking in alloy-600 is minimized if zinc concentration is maintained at an optimum value. Evidence at BVPS Unit 1 supports this assertion. The number of PWSCC indications during the Unit 1 Cycle 16 Refueling Outage (October - November 2004) (following zinc injection) decreased from a predicted number of 25, to 5 actual indications.

Between July, 2000 and September, 2006, secondary chemistry parameters at both BVPS units were occasionally out-of-spec for sulfate, sodium, dissolved oxygen, pH, and chloride concentration resulting in potential chemistry action level 1 conditions. The Corrective Action Program was used to document and investigate the reason(s) for these out-of-spec conditions and to recommend corrective actions to restore the affected parameter(s) to an acceptable value before a plant shutdown is required.

In December, 2002, BVPS demonstrated its responsiveness to industry operating experience by applying a significant lesson learned from a human-performance chemistry addition error which occurred several days earlier at another plant. At BVPS, a chemistry technician independently performed a self-check and determined that he was obtaining the wrong chemical for addition to the feedwater system. He was motivated to perform this self-check as a result of a recent review of an INPO operating experience document which described a similar error at another plant in which the incorrectly obtained chemical was actually added to the secondary system resulting in an unplanned plant shutdown. The technician's application of pertinent operating experience prevented this near miss from becoming a significant plant event.

A Quality Assurance audit of the primary and secondary plant chemistry program was conducted in 2006. This audit revealed that monitoring and action requirements for Primary and Secondary water chemistry complied with BVPS Technical Specifications, implementing procedures, and the Licensing Requirements Manual (LRM). The BVPS chemistry sampling guidelines and limits were consistent with industry guidelines endorsed by EPRI, and were designed to extend the operating life of primary and secondary systems and components. An example of the BVPS adherence to chemistry control is evident from the primary chemistry performance indicator (percent of time that RCS hydrogen, lithium, & zinc concentrations were within spec) which, for Unit 1 and Unit 2 (no zinc) during 2005, were 97% and 99.8%, respectively.

Conformance to procedural requirements and industry guidelines, and sensitivity to operating experience reports provide reasonable assurance that the Water Chemistry program will effectively manage loss of material, cracking, and reduction of heat transfer for in-scope components during the period of extended operation.

Conclusion

Continued implementation of the Water Chemistry Program provides reasonable assurance that the aging effects will be managed such that the systems and components within the scope of this program will continue to perform their intended functions, consistent with the current licensing basis, for the period of extended operation.

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B.3 APPENDIX B REFERENCES

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