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September 13, 2010
GO2-10-135

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Subject: **COLUMBIA GENERATING STATION, DOCKET NO. 50-397 RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LICENSE RENEWAL APPLICATION**

References:
1) Letter, G02-10-011, dated January 19, 2010, WS Oxenford (Energy Northwest) to NRC, "License Renewal Application"

2) Letter dated July 15, 2010, NRC to WS Oxenford (Energy Northwest), "Request for Additional Information for the Review of the Columbia Generating Station, License Renewal Application," (ADAMS Accession No. ML101900125)

Dear Sir or Madam:

By Reference 1, Energy Northwest requested the renewal of the Columbia Generating Station (Columbia) operating license. Via Reference 2, the Nuclear Regulatory Commission (NRC) requested additional information related to the Energy Northwest submittal.

Transmitted herewith in the Attachment is the Energy Northwest response to the Request for Additional Information (RAI) contained in Reference 2. Enclosure 1 contains Amendment 7 to the License Renewal Application (LRA) that was submitted in Reference 1.

A035
NRR

Commitment 49 in LRA Appendix A, Table A-1 is revised. It is provided in Enclosure 1, LRA Amendment 7. No new commitments are included in this response.

If you have any questions or require additional information, please contact Abbas Mostala at (509) 377-4197.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the date of this letter.

Respectfully,

SK Gambhir
Vice President, Technical Services

Attachment: Response to Request for Additional Information

Enclosure: License Renewal Application Amendment 7

cc: NRC Region IV Administrator
NRC NRR Project Manager
NRC Senior Resident Inspector/988C
EJ Leeds - NRC NRR
EFSEC Manager
RN Sherman – BPA/1399
WA Horin – Winston & Strawn
EH Gettys - NRC NRR (w/a)
BE Holian - NRC NRR
RR Cowley – WDOH

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

RAI B.2.A-1:

Request for Additional Information (RAI) for the Following Aging Management Programs (AMPs):

B.2.12 ("Chemistry Program Effectiveness Inspection")
B.2.14 ("Cooling Units Inspection")
B.2.16 ("Diesel Starting Air Inspection")
B.2.17 ("Diesel System Inspection")
B.2.18 ("Diesel Driven Fire Pumps Inspection")
B.2.27 ("Flexible Connection Inspection")
B.2.30 ("Heat Exchangers Inspection")
B.2.37 ("Lubricating Oil Inspection")
B.2.41 ("Monitoring and Collection Systems Inspection")
B.2.48 ("Service Air Inspection")
B.2.51 ("Supplemental Piping/Tank Inspection")

Background:

Under the program element "parameters monitored or inspected," the above applicant AMPs state that "inspections will be performed by qualified personnel using established NDE techniques." GALL Report AMP XI.M32 ("One-Time Inspection") states that inspections are to be performed by qualified personnel following procedures consistent with the requirements of the ASME Code and 10 CFR 50, Appendix B.

Issue:

The above applicant AMPs do not specifically state that the inspections will be performed in conformance with the requirements of the ASME Code nor does the AMP or AMP basis document reference a site-specific procedure outlining the training requirements for individuals assigned to perform inspections in accordance with the above AMPs.

Request:

Provide details regarding the training requirements for individuals assigned to perform the inspections described in the above AMPs. Describe how this training program is consistent with training requirements stipulated in the applicable ASME Code requirements.

Energy Northwest Response:

During the implementation phase, following receipt of the renewed license, approved procedures will be revised or developed to direct these one-time inspections. Per plant procedures, personnel performing VT-1, 2, or 3 inspections, ultrasonic examinations in

accordance with ASME Section XI, and other nondestructive examinations in accordance with ASME Section V or Section XI are required to be trained in accordance with ASME requirements. Training requirements for all inspections will be consistent with the requirements of 10 CFR 50 Appendix B.

RAI B.2.A-2:

RAI for the Following AMPs:

B.2.12 ("Chemistry Program Effectiveness Inspection")
B.2.14 ("Cooling Units Inspection")
B.2.16 ("Diesel Starting Air Inspection")
B.2.17 ("Diesel System Inspection")
B.2.18 ("Diesel Driven Fire Pumps Inspection")
B.2.27 ("Flexible Connection Inspection")
B.2.30 ("Heat Exchangers Inspection")
B.2.37 ("Lubricating Oil Inspection")
B.2.41 ("Monitoring and Collection Systems Inspection")
B.2.48 ("Service Air Inspection")
B.2.51 ("Supplemental Piping/Tank Inspection")

Background:

Under the "detection of aging effects" program element, the above applicant AMPs states that "a sample population will be determined by engineering evaluation based on sound statistical sampling methodology." The GALL Report AMP XI.M32 ("One-Time Inspection") states under this program element that "the inspection includes a representative sample of the system population, and where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin."

Issue:

Although the above AMPs require the inspection of a representative sample of the material and environment combinations for systems within the scope of the program, they present no details of the proposed sampling plan and provide no assurance that a representative population of sufficient size and scope will be inspected.

Request:

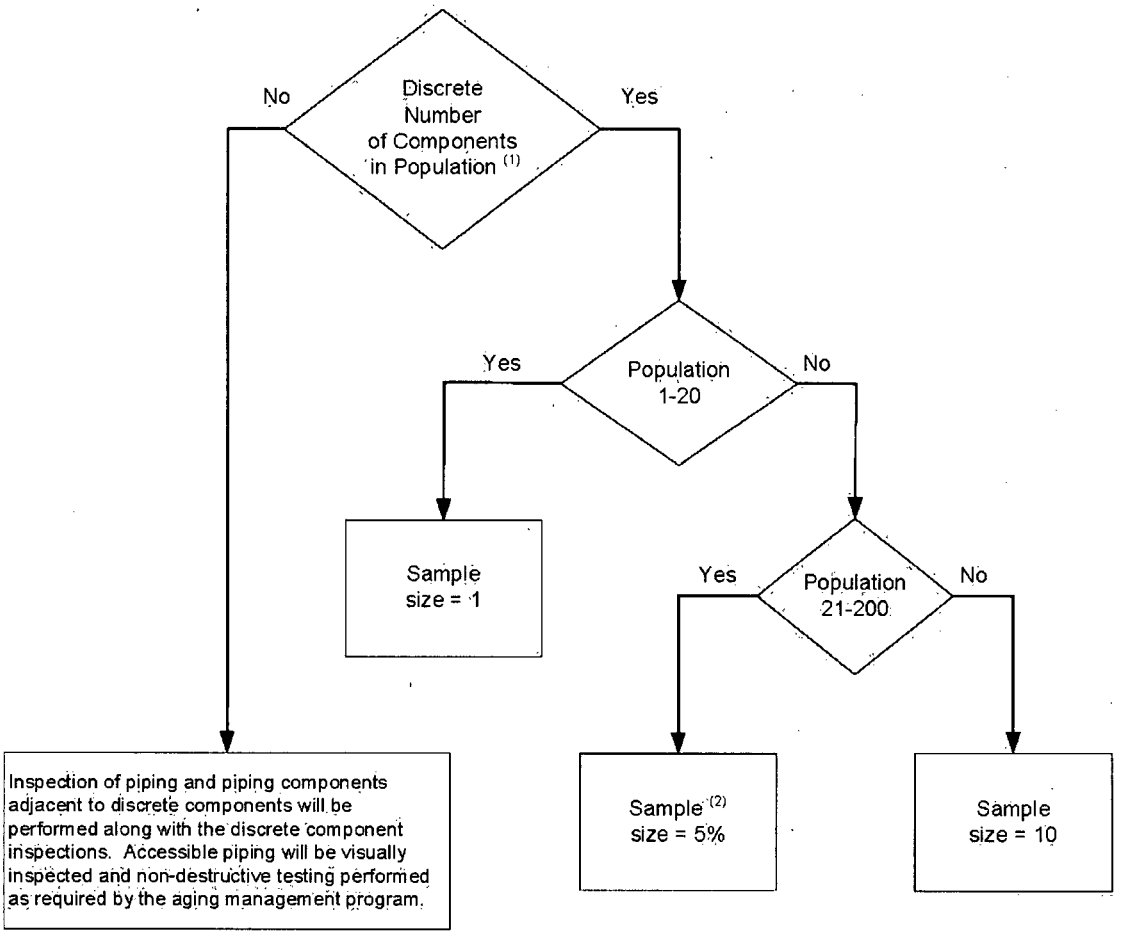
Describe the sampling methodology, including how the population for each of the material-environment-aging effect combinations is being selected, and what type of engineering, design, or operating experience considerations would be used to select the sample of components for both the scheduled and supplemental inspections.

Energy-Northwest Response:

During the implementation phase, following receipt of the renewed license (but prior to the period of extended operation), engineering evaluations will be conducted to determine a sample population for each material and environment combination within the scope of the individual One-Time Inspections. This sample population will be based on sound statistical sampling methodology and, where practical, focused on the components most susceptible to aging. The basis for determining the susceptibility of components to aging would include their time in service, the severity of conditions during normal plant operations, and design margins.

To provide consistency in determination of sample size, guidance that will be used during one-time inspections is provided below. This sample size guidance is intended for use in determining an appropriate sample size for those inspection programs that do not already specify sample size criteria.

For mechanical AMPs, required piping inspections will be performed as part of the inspections of discrete components included in a pipe run. For example, if a pipe run includes a population of four valves requiring inspection, the sample size guidance indicates that inspection of one valve is sufficient. Visual inspection of the piping would be performed by looking upstream and downstream of the valve when it is disassembled for inspection. If volumetric inspection (e.g., ultrasonic testing (UT)) of the piping is required by the AMP, then UT inspection of the accessible piping on both sides of the valve would be performed. An inspection of the adjacent pipe segments is performed for each discrete component included in the inspection sample. Supplemental inspections sample size would be determined as part of the corrective action program.



Once the sample size of each population is determined, the actual sample locations are determined based on the bounding or lead component most susceptible to aging due to time in service and severity of operating conditions, e.g. low or stagnant flow. Opportunistic inspections can be substituted and applied to the sample as long as they represent the material/environment expected for that sample.

1) Population is based on component material, internal/external environment, and component type.
2) A fraction is always rounded up to a whole value when determining sample size.

RAI B.2.49-1:

Background:

A review of operating experience at Columbia Generating Station (CGS) has indicated that multiple failures of small-bore socket welds have occurred at CGS due to cracking.

Issue:

GALL Report, Section XI.M35 recommends the use of the One-Time Inspection of ASME Code Class 1 small-bore piping only for those plants that have not experienced cracking of ASME Code Class 1 small-bore piping resulting from stress corrosion or thermal and mechanical loading. For those plants that have experienced cracking, the GALL Report recommends periodic inspection of the subject piping to be managed by a plant-specific AMP.

Request:

Since cracking of socket welds has occurred at CGS, either provide a plant-specific AMP that includes periodic inspections to manage cracking, or provide justification why a plant-specific AMP that includes periodic inspections is not necessary for ASME Code Class 1 small-bore piping.

Energy Northwest Response:

Since cracking of socket welds has occurred at CGS, an aging management program, Small Bore Class 1 Piping Program, will be developed and implemented to detect and characterize cracking of small bore Class 1 piping components that are exposed to reactor coolant.

This periodic program will provide physical evidence as to whether, and to what extent, cracking due to stress corrosion cracking or thermal or mechanical loading has occurred in small bore Class 1 piping components. It will also verify, by inspections for cracking, that reduction of fracture toughness due to thermal embrittlement requires no additional aging management for small Class 1 cast austenitic stainless steel valve bodies. The Small Bore Class 1 Piping Program will be a condition monitoring program with no actions to prevent or mitigate aging effects. The program will include visual and volumetric inspection of a representative sample of small bore Class 1 piping, including butt welds and socket welds.

The Small Bore Class 1 Piping Program is a new program that will be implemented prior to the period of extended operation. Inspection activities will start during the fourth 10-year inservice inspection interval and continue through the period of extended operation. The Small Bore Class 1 Piping Program will credit portions of the Inservice Inspection Program. The Small Bore Class 1 Piping Program will verify the effectiveness of the BWR Water Chemistry Program in mitigating cracking of small bore piping and piping components.

The Small Bore Class 1 Piping Program is added in Amendment 7 to the LRA and is provided in Enclosure 1 to this letter.

RAI B.2.26-3:

Background:

Standard Review Plan-License Renewal (SRP-LR) Table 3.3-1, item 84 addresses copper alloy with >15% zinc piping, piping components, piping elements, and heat exchanger components exposed to raw water, treated water, or closed cycle cooling water, and recommends GALL AMP XI.M33, ("Selective Leaching of Materials Program") to manage loss of material due to selective leaching for these components. GALL AMP XI.M33 recommends managing selective leaching of components using a one-time visual inspection and hardness measurement of selected components to determine whether selective leaching is occurring. GALL AMP XI.M27, "Fire Water System Program," does not include activities to manage loss of material due to selective leaching.

License renewal application (LRA) Section B.2.26 states an enhancement to the "acceptance criteria" program element of its Fire Water System Program to include hardness testing, or equivalent, on its sprinkler heads as part of its NFPA testing in order to manage selective leaching. The sprinkler heads are constructed of copper alloy with >15% zinc.

Issue:

GALL AMP XI.M33 states that if selective leaching is occurring, an engineering evaluation is initiated to determine acceptability of the affected components for further service. GALL AMP XI.M33 also states that, if necessary, the evaluation will include a root cause analysis. In its review of the "detection of aging effects" and "acceptance criteria" program elements described in LRA Section B.2.26 for the Fire Water System Program, and in its basis document the staff noted that the AMP did not include any details regarding how to detect whether selective leaching has occurred or any acceptance criteria or follow-up evaluations that will be performed if selective leaching is identified.

Request:

Describe how selective leaching of copper alloy with >15% zinc components will be detected by hardness testing or equivalent methods, and define the acceptance criteria and follow-up actions that will be implemented if selective leaching is identified as part of the activities performed in the Fire Water System Program.

Energy Northwest Response:

NUREG-1801, Rev 1, Section XI.M33 states in the Detection of Aging Effects element that the one-time visual inspection and hardness measurement includes close

examination of a select set of components to determine whether selective leaching has occurred and whether the resulting loss of strength and/or material will affect the intended functions of these components during the period of extended operation.

The Fire Water Program conducts visual inspections of sprinklers and the associated piping and fittings, as well as inspections of hose station valves and fire hydrants, conducted at periodic intervals to look for corroded, damaged, or obstructed components. To provide confirmation of the condition of sprinkler heads, either all sprinkler heads will be replaced or hardness testing of a sample number of sprinkler heads will be performed as part of the Fire Water Program. This hardness testing, or an NRC-approved alternative, will determine whether, and to what extent, a loss of material due to selective leaching has occurred or is likely to occur that could result in a loss of intended function. Sampling (or replacement) of 50-year service life sprinkler heads will be performed in accordance with the acceptance criteria to be established based on applicable NFPA standards and field service laboratory testing procedures. Evaluation of the test results by engineering will determine if they are acceptable. Follow-up actions as a result of the engineering evaluation will be implemented as described in LRA Section B.1.3.

RAI 3.3.2.2.13-1:

Background:

GALL Report Section IX.F defines wear as follows: "Wear is defined as the removal of surface layers due to relative motion between two surfaces or under the influence of hard abrasive particles. Wear occurs in parts that experience intermittent relative motion, frequent manipulation, or in clamped joints where relative motion is not intended but may occur due to a loss of the clamping force." SRP-LR, Section 3.3.2.2.13, states that loss of material due to wear could occur in the elastomer seals and components exposed to air-indoor uncontrolled (internal or external). The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

LRA Section 3.3.2.2.13 refers to LRA Table 3.3.1, item 3.3.1-34, and addresses loss of material due to wear for elastomer seals and components exposed to air-indoor uncontrolled (internal or external). The applicant addressed the further evaluation criteria of the SRP-LR by stating that wear of elastomer seals and components exposed to air-indoor was not identified as an aging effect requiring management. The applicant also stated that loss of material due to wear is the result of relative motion between two surfaces in contact and wear occurs during the performance of an active function as a result of improper design, application or operation; or to a very small degree with insignificant consequences, and therefore, loss of material due to wear is not an aging effect requiring management for elastomers exposed to air-indoor uncontrolled.

Issue:

The staff does not have sufficient information to determine that improper design, application or operation is not a factor resulting in loss of material due to wear in elastomeric components exposed to air-indoor uncontrolled.

Request:

Provide justification why improper design, application or operation is not a factor resulting in the loss of material due to wear for elastomeric components exposed to an air-indoor uncontrolled environment, or provide an AMP to manage this aging effect.

Energy Northwest Response:

Consistent with the Statements of Consideration for 10 CFR 54, Section III.d.(i), improper design, faulty manufacturing processes, improper application, faulty maintenance, improper operation, or personnel errors may cause events that result in significant wear of components, but this cause of degradation is not aging related.

Therefore, loss of material due to wear is not an applicable aging effect for the elastomeric components that are subject to an air-indoor uncontrolled environment.

RAI 3.3.2.3-1:

Background:

The GALL Report does not contain a recommended AMR line item for elastomers exposed to lubricating oil or fuel oil. However, in LRA Tables 3.3.2-20 and 3.3.2-22, the applicant stated that for elastomer flexible connections exposed to lubricating or fuel oil there is no aging effect and no AMP is proposed.

Issue:

Resistance of natural rubber to lubricating or fuel oil is poor (P.A. Schweitzer, - Corrosion Resistance Tables -Metals, Nonmetals, Coatings, Mortars, Plastics, Elastomers and Linings, and Fabrics, Fifth Edition, Marcel Dekker, 2004). The staff does not have sufficient information to determine that there is no aging effect for this material/environment combination.

Request:

Provide additional information (e.g., elastomer material type, fuel oil and lube oil composition) that would demonstrate that the plant-specific applications for the elastomer and fuel or lube oil environment does not have an aging effect requiring management during the extended period of operation or provide an AMP to manage any applicable aging effect.

Energy Northwest Response:

LRA Table 3.3.2-20 – Diesel Lube Oil

As stated in the basis documents for the diesel lubricating oil system, flex connections DLO-FLX-7A1, A2, B1, B2 & C are made of either Buna-N or fluoroelastomer rubber (elastomer) and steel. Industry literature indicates these synthetic elastomers have a good resistance to lubricating oils.

LRA Table 3.3.2-22 – Fire Protection (Fuel Oil and Lube Oil)

As stated in the basis documents for the fire protection system flex connections DO-FLX-11 and 36 are constructed of Viton, which is a fluoropolymer elastomer. Industry literature indicates these synthetic elastomers have a good resistance to fuel oils.

As stated in the basis documents for the fire protection system, flex connections for lube oil are constructed of Viton, which is a fluoropolymer elastomer. Industry literature indicates these synthetic elastomers have a good resistance to lube oils.

In addition, as stated in the EPRI Mechanical Tools 1010639, Appendix C, page 2-6, elastomers are defined as rubber or polymers that have properties similar to those of rubber. They are used in nuclear plants in various capacities, such as joint sealants, flexible connections/hoses and moisture barriers. Furthermore, certain elastomers such as natural rubbers and ethylene-propylene-diene (EPDM) are not resistant to fuel oil or lubricating oil and only qualified elastomers, that are resistant, are used for oil or fuel oil service. Therefore, based on industry operating experience review, the assumption of proper design and application of the material, and considering that the oil and fuel oil environments do not typically include contaminants or conditions that would result in the degradation of glass (including fiberglass), thermoplastics, and elastomers, aging of these materials is not a concern in lubrication oil and fuel oil environments.

RAI 3.5.2.3-1:

Background:

GALL Report Table III A6, Group 6 Structures (Water-Control Structures), line item III.A6-12 (TP-7) recommends that AMP XI.S6, ("Structures Monitoring Program"), should be used to manage the aging effects of loss of sealing/deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) for elastomers exposed to various environments. In LRA Table 3.5.2-13, Bulk Commodities, Waterstops, the applicant stated that for elastomer waterstops exposed to air-indoor (within walls, floors, or foundation) there is no aging effect and no proposed AMP.

Issue:

Continuous waterstops are provided in the reactor building at all horizontal and vertical construction joints in exterior walls and interior walls between and including the top of the foundation mat. High temperature and radiation could exist in the reactor building walls, floors, and foundation mat, and could cause hardening and loss of strength for the elastomer components. The staff does not have sufficient information to determine that there is no aging effect for this material/environment combination.

Request:

Provide justification why hardening and loss of strength due to elastomer degradation for elastomer waterstops exposed to air-indoor (within walls, floors, or foundation) is not considered an aging effect requiring aging management.

Energy Northwest Response:

EPRI 1015078 "Aging Effects for Structures and Structural Components (Structural Tools)" was used to identify potential aging effects for elastomer components including waterstops. The potential aging effects associated with elastomers as presented in the EPRI Structural Tools are cracking and change in material properties. These aging effects may be the result of thermal exposure or exposure to ionizing radiation and, in the case of rubber, the result of exposure to ultraviolet radiation and ozone. Potential aging effects due to exposure to ultraviolet radiation and ozone are eliminated regardless of material as the subject waterstops are only potentially exposed to an air-indoor environment. Per the EPRI Structural Tools the aging effects as a result of thermal exposure and ionizing radiation are not applicable if the temperature is less than 95°F and radiation level is less than 10^6 rads. Columbia's basis documents show that for the areas of the reactor building where the waterstops were installed the normal room temperature is 70 to 90°F and the maximum radiation dose is 3.6×10^7 rads.

The subject elastomer waterstops are located in the construction joints of the concrete components (walls and floor slabs) in the Emergency Core Cooling Systems (ECCS) pump rooms at the lower elevations of the reactor building. The minimum thickness for any wall for the ECCS pump rooms is 2'-6". This provides a minimum concrete cover of 1'-3" as the waterstops are installed in construction joints along the centerline of each wall. Using industry guidelines for radiation safety and shielding, the concept of half-value layer (HVL) will be used to determine the dose level at this elastomer (waterstop). Based on this concept of HVL the minimum thickness of 15" of concrete cover at the waterstop locations is sufficient to reduce the ionizing radiation levels to below the threshold of the Structural Tools. Therefore, the actual installed locations of the waterstops will eliminate the potential aging effects associated with thermal exposure or ionizing radiation.

Additionally, as noted above, the waterstops are physically installed within the permanent concrete walls and as such are considered a subcomponent of the wall and implicitly included at the component (wall) level. This means that these waterstops will implicitly be monitored under the Structures Monitoring Program (SMP) when the

concrete walls are inspected. That is, the waterstops will be considered to be in similar condition of the walls they are installed within when the walls are inspected and monitored under the SMP. Note that the physical location of the waterstops makes them inaccessible for any type of inspection.

Time Limited Aging Analysis (TLAA):

RAI 4.2.1-1:

Background:

Regulatory Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," states that the core neutron source should be determined by the power distribution, the power level, and the fuel management scheme.

Issue:

LRA Section 4.2.1 states that 54 effective full power year (EFPY) fluence values were extrapolated from 51.6 EFPY fluence values.

Request:

Please confirm that the flux used for this extrapolation was that assumed for post-Cycle 11, uprated operation. If it is not, please provide the basis for the assumed flux value and justify its use.

Energy Northwest Response:

The flux used for this extrapolation was that assumed for post-Cycle 11 uprated operation.

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Section 3.1.2.1.3	3.1-5	RAI B.2.49-1
Section 3.1.2.2.4.1	3.1-7	RAI B.2.49
Section 3.1.2.2.8.1	3.1-8	RAI B.2.49-1
Table 3.1.1 Item 3.1.1-48	3.1-21	RAI B.2.49-1
Table 3.1.1 Item 3.1.1-55	3.1-24	RAI B.2.49-1
Table 3.1.2-3 Items 1 and 3	3.1.94	RAI B.2.49-1
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Table 3.1.2-3 Item 47	3.1-99	RAI B.2.49-1
Table 3.1.2-3 Items 61, 63, and 68	3.1-101	RAI B.2.49-1
Table 3.1.2-3 Item 70	3.1-102	RAI B.2.49-1
Table 3.1.2-3 Items 79 and 80	3.1-103	RAI B.2.49-1
Table 3.1.2-3 Items 85 and 87	3.1-104	RAI B.2.49-1
Table 3.1.2-3 Item 92	3.1-105	RAI B.2.49-1
Table 3.1.2-3 Items 122 and 124	3.1-108	RAI B.2.49-1
Table 3.1.2-3 Items 129, 131, and 134	3.1-109	RAI B.2.49-1
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Section A.1.2.49	A-24a	RAI B.2.49-1
Section A.1.2.49	A-25	RAI B.2.49-1
Table A-1 Item 26	A-61	RAI B.2.49-1
Table A-1 Item 26	A-61a	RAI B.2.49-1
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Section no.	Page no.	RAI response
Table B-1 Number XI.M12	B-12	RAI B.2.49-1
Table B-1 Item XI.M35	B-14	RAI B.2.49-1
Table B-1 Item XI.M35	B-14a	RAI B.2.49-1
Table B-2	B-24	RAI B.2.49-1
Section B.2.11	B-57	RAI B.2.49-1
Section B.2.49	B-187 though B-191	RAI B.2.49-1
Section B.2.49	B-187a though B-191a	RAI B.2.49-1
Table C-11	C-27	RAI B.2.49-1

- Loss of Pre-load
- Reduction of Fracture Toughness
- Reduction in Heat Transfer

Aging Management Programs

The following aging management programs and activities address the aging effects requiring management for the reactor coolant pressure boundary systems:

- Bolting Integrity Program
- BWR Stress Corrosion Cracking Program
- BWR Water Chemistry Program
- Chemistry Program Effectiveness Inspection
- Closed Cooling Water Chemistry Program
- External Surfaces Monitoring Program
- Flow-Accelerated Corrosion Program
- Heat Exchangers Inspection
- Inservice Inspection (ISI) Program
- Small Bore Class 1 Piping ~~Inspection~~ Program

3.1.2.2 Further Evaluation of Aging Management as Recommended by NUREG-1801

For the Reactor Vessel, Internals, and Reactor Coolant System, those items requiring further evaluation are addressed in the following sections.

3.1.2.2.1 Cumulative Fatigue Damage

Fatigue is a time-limited aging analysis as defined in 10 CFR 54.3. Time-limited analyses are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this time-limited analysis is addressed separately in Section 4.3.

3.1.2.2.2 Loss of Material due to General, Pitting, and Crevice Corrosion

3.1.2.2.2.1 BWR Top Head and Top Head Nozzles, PWR Steam Generator Shell Assembly

The BWR Water Chemistry Program mitigates loss of material due to general, pitting, and crevice corrosion. The BWR Water Chemistry Program manages aging effects through periodic monitoring and control of contaminants. The Chemistry Program Effectiveness Inspection will provide a verification of the effectiveness of the BWR Water Chemistry Program to manage loss of material due to general, pitting, and crevice corrosion through examination of components.

3.1.2.2.3.2 Reactor Vessel Beltline Shell, Nozzle, and Welds

Reduction of fracture toughness due to radiation embrittlement could occur for reactor vessel beltline region materials exposed to reactor coolant and neutron flux. The effects of embrittlement on the reactor vessel are discussed in Section 4.2. A reactor vessel materials surveillance program monitors radiation embrittlement of the steel reactor vessel beltline materials with stainless steel cladding. The Reactor Vessel Surveillance Program, and the results of its evaluation for license renewal, are presented in Appendix B.

3.1.2.2.4 Cracking due to Stress Corrosion Cracking (SCC) and Intergranular Stress Corrosion Cracking (IGSCC)

3.1.2.2.4.1 BWR Top Head Enclosure Vessel Flange Leak Detection Lines

The reactor vessel flange leak detection nozzle and associated piping at Columbia is a Class 1 line that is normally dry. The stainless steel piping is evaluated for a reactor coolant environment and is therefore susceptible to cracking due to SCC. Cracking of the piping is managed by the Small Bore Class 1 Piping ~~Inspection~~ Program. The nickel-alloy nozzle is evaluated for a reactor coolant environment and is therefore susceptible to cracking due to SCC. Cracking of the nozzle is managed with a combination of the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection.

In addition, loss of material for the stainless steel piping that forms the tube-in-a-tube seal cooler for the reactor recirculation pump is managed by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection.

3.1.2.2.4.2 Isolation Condenser Components

Cracking of BWR isolation condenser components is not applicable since the Columbia design does not include an isolation condenser.

3.1.2.2.5 Crack Growth due to Cyclic Loading

The associated items in Table 3.1.1 are applicable to PWRs only.

3.1.2.2.6 Loss of Fracture Toughness due to Neutron Irradiation Embrittlement and Void Swelling

The associated items in Table 3.1.1 are applicable to PWRs only.

3.1.2.2.7 Cracking due to Stress Corrosion Cracking

The associated items in Table 3.1.1 are applicable to PWRs only.

3.1.2.2.8 Cracking due to Cyclic Loading

3.1.2.2.8.1 Stainless Steel BWR Jet Pump Sensing Lines

For Columbia, the jet pump instrumentation lines inside the vessel are not subject to AMR, as they do not perform an intended function. The lines outside of the vessel are part of the reactor coolant pressure boundary and are subject to AMR for a reactor coolant environment. Cracking of the stainless steel lines external to the vessel is managed with a combination of the BWR Water Chemistry Program and the Small Bore Class 1 Piping ~~Inspection.~~ Program

3.1.2.2.8.2 Isolation Condenser Components

Cracking of BWR isolation condenser components is not applicable since the Columbia design does not include an isolation condenser.

3.1.2.2.9 Loss of Preload due to Stress Relaxation

The associated items in Table 3.1.1 are applicable to PWRs only.

3.1.2.2.10 Loss of Material due to Erosion in Steam Generators

The associated items in Table 3.1.1 are applicable to PWRs only.

3.1.2.2.11 Cracking due to Flow-Induced Vibration

Cracking due to flow-induced vibration for stainless steel steam dryers exposed to reactor coolant is managed by the BWR Vessel Internals Program.

3.1.2.2.12 Cracking due to Stress Corrosion Cracking and Irradiation-Assisted Stress Corrosion Cracking (IASCC)

The associated items in Table 3.1.1 are applicable to PWRs only.

3.1.2.2.13 Cracking due to Primary Water Stress Corrosion Cracking (PWSCC)

The associated items in Table 3.1.1 are applicable to PWRs only.

3.1.2.2.14 Wall Thinning due to Flow-Accelerated Corrosion in Steam Generators

The associated items in Table 3.1.1 are applicable to PWRs only.

3.1.2.2.15 Changes in Dimension due to Void Swelling

The associated items in Table 3.1.1 are applicable to PWRs only.

3.1.2.2.16 Cracking due to Stress Corrosion Cracking and Primary Water Stress Corrosion Cracking

The associated items in Table 3.1.1 are applicable to PWRs only.

Table 3.1.1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of NUREG-1801

Item Number	Component/Commodity	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-48	Steel and stainless steel Class 1 piping, fittings and branch connections < NPS 4 exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking (for stainless steel only), and thermal and mechanical loading	Inservice Inspection (IWB, IWC, and IWD), Water chemistry, and One-Time Inspection of ASME Code Class 1 Small-bore Piping	No	Consistent with NUREG-1801. Cracking of piping and in-line components is managed by the BWR Water Chemistry Program and the Small Bore Class 1 Piping ~~Inspection.~~ Program This item is also used for cracking of reactor vessel components (bottom head, closure flange, shell rings, nozzles) managed by the Inservice Inspection (ISI) Program and the BWR Water Chemistry Program. A Note C is applied.

Table 3.1.1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of NUREG-1801

Item Number	Component/Commodity	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-54	Copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not applicable. The reactor coolant pressure boundary does not have any copper alloy components.
3.1.1-55	Cast austenitic stainless steel Class 1 pump casings, and valve bodies and bonnets exposed to reactor coolant >250 °C (>482 °F)	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection (IWB, IWC, and IWD). Thermal aging susceptibility screening is not necessary, inservice inspection requirements are sufficient for managing these aging effects. ASME Code Case N-481 also provides an alternative for pump casings.	No	Consistent with NUREG-1801. Loss of fracture toughness for Class 1 pump casings and valve bodies is managed by the Inservice Inspection (ISI) Program. Reduction of fracture toughness for CASS valve bodies less than 4 inches is included in this item and managed by the Small Bore Class 1 Piping ~~Inspection.~~ Program
3.1.1-56	Copper alloy >15% Zn piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable. The reactor coolant pressure boundary does not include any copper alloy >15% Zn components.

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
1	Annubar	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~	N/A	N/A	H
2	Annubar	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.C1-1	3.1.1-48	A
3	Annubar	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~	IV.C1-1	3.1.1-48	~~A~~
4	Annubar	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
5	Annubar	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A
6	Annubar	Pressure Boundary	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
7	Bolting	Pressure boundary	Stainless Steel	Air-Indoor Uncontrolled (External)	Loss of Pre-load	Bolting Integrity	IV.C2-8	3.1.1-52	B
8	Bolting	Pressure boundary	Steel	Air-Indoor Uncontrolled (External)	Cracking - Fatigue	Bolting Integrity	IV.A1-6	3.1.1-1	E

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Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
9	Bolting	Pressure Boundary	Steel	Air-Indoor Uncontrolled (External)	Cracking - SCC	Bolting Integrity	N/A	N/A	G
10	Bolting	Pressure boundary	Steel	Air-Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity	IV.C1-12	3.1.1-52	B
11	Bolting	Pressure boundary	Steel	Air-Indoor Uncontrolled (External)	Loss of Pre-load	Bolting Integrity	IV.C1-10	3.1.1-52	B
12	Condensing Unit	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
13	Condensing Unit	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
14	Condensing Unit	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.C1-1	3.1.1-48	A
15	Condensing Unit	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~ Program	IV.C1-1	3.1.1-48	~~A~~ E
16	Condensing Unit	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
17	Condensing Unit	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
18	Condensing Unit	Pressure boundary	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
19	Flow Elements < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
20	Flow Elements < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
21	Flow Elements < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.C1-1	3.1.1-48	A
22	Flow Elements < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~ Program	IV.C1-1	3.1.1-48	~~A~~ E
23	Flow Elements < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
24	Flow Elements < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A
25	Flow Elements < 4 inches	Pressure boundary	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
26	Flow Elements ≥ 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
43	Heat Exchanger (tube in a tube)	Heat transfer	Stainless Steel	Closed cycle cooling water (External)	Reduction in heat transfer	Closed Cooling Water Chemistry	VII.C2-3	3.3.1-52	B
44	Heat Exchanger (tube in a tube)	Heat transfer	Stainless Steel	Closed cycle cooling water (External)	Reduction in heat transfer	Heat Exchangers Inspection	VII.C2-3	3.3.1-52	E
45	Heat Exchanger (tube in a tube)	Heat transfer	Stainless Steel	Reactor Coolant (Internal)	Reduction in heat transfer	BWR Water Chemistry	V.D2-13	3.2.1-10	A
46	Heat Exchanger (tube in a tube)	Heat transfer	Stainless Steel	Reactor Coolant (Internal)	Reduction in heat transfer	Heat Exchangers Inspection	V.D2-13	3.2.1-10	A
47	Heat Exchanger (tube in a tube)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
48	Heat Exchanger (tube in a tube)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.A1-10	3.1.1-19	E
49	Heat Exchanger (tube in a tube)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Chemistry Program Effectiveness Inspection	IV.A1-10	3.1.1-19	E
50	Heat Exchanger (tube in a tube)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of material	BWR Water Chemistry	VII.A4-2	3.3.1-23	A
51	Heat Exchanger (tube in a tube)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of material	Chemistry Program Effectiveness Inspection	VII.A4-2	3.3.1-23	A

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
61	Orifice < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
62	Orifice < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.C1-1	3.1.1-48	A
63	Orifice < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~ Program	IV.C1-1	3.1.1-48	~~A~~ E
64	Orifice < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
65	Orifice < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A
66	Orifice < 4 inches	Pressure boundary	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
67	Orifice < 4 inches	Throttling	Stainless Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
68	Orifice < 4 inches	Throttling	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~	N/A	N/A	H
69	Orifice < 4 inches	Throttling	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.C1-1	3.1.1-48	A

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
70	Orifice < 4 inches	Throttling	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~	IV.C1-1	3.1.1-48	~~A~~ E
71	Orifice < 4 inches	Throttling	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
72	Orifice < 4 inches	Throttling	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A
73	Orifice < 4 inches	Throttling	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
74	Piping	Structural integrity	Stainless Steel	Treated water (Internal)	Loss of Material	BWR Water Chemistry	VII.A4-11	3.3.1-24	A
75	Piping	Structural integrity	Stainless Steel	Treated water (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	VII.A4-11	3.3.1-24	A
76	Piping	Structural integrity	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
77	Piping	Structural integrity	Steel	Air-Indoor Uncontrolled (Internal)	Loss of Material	External Surfaces Monitoring	VII.I-8	3.3.1-58	C 0106

Program

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
78	Piping & Fittings < 4 inches (RV flange leak off lines)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
79	Piping & Fittings < 4 inches (RV flange leak off lines)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
80	Piping & Fittings < 4 inches (RV flange leak off lines)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~ Program	IV.A1-10	3.1.1-19	E
81	Piping & Fittings < 4 inches (RV flange leak off lines)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
82	Piping & Fittings < 4 inches (RV flange leak off lines)	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
83	Piping & Fittings < 4 inches (RV flange leak off lines)	Pressure boundary	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
84	Piping & Fittings < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
85	Piping & Fittings < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
86	Piping & Fittings < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.C1-1	3.1.1-48	A
87	Piping & Fittings < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~ Program	IV.C1-1	3.1.1-48	~~A~~ E
88	Piping & Fittings < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
89	Piping & Fittings < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A
90	Piping & Fittings < 4 inches	Pressure boundary	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
91	Piping & Fittings < 4 inches	Pressure boundary	Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
92	Piping & Fittings < 4 inches	Pressure boundary	Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
93	Piping & Fittings < 4 inches	Pressure boundary	Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.A1-11	3.1.1-11	C
94	Piping & Fittings < 4 inches	Pressure boundary	Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.A1-11	3.1.1-11	C
95	Piping & Fittings < 4 inches	Pressure boundary	Steel	Reactor Coolant (Internal)	Loss of Material - FAC	Flow-Accelerated Corrosion	IV.C1-7	3.1.1-45	A 0105
96	Piping & Fittings < 4 inches	Pressure boundary	Steel	Air-Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring	VII.I-8	3.3.1-58	A
97	Piping & Fittings ≥ 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
98	Piping & Fittings ≥ 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking – Flaw Growth	Inservice Inspection	N/A	N/A	H
99	Piping & Fittings ≥ 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Stress Corrosion Cracking	IV.C1-9	3.1.1-41	A

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
118	RRC Pump Stuffing Box	Pressure boundary	CASS	Closed cycle cooling water (Internal)	Loss of material	Chemistry Program Effectiveness Inspection	VII.C2-10	3.3.1-50	E
119	RRC Pump Casing	Pressure boundary	CASS	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
120	RRC Pump Motor Flange	Pressure boundary	Steel	Air-Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring	VII.I-8	3.3.1-58	A
121	Tubing	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
122	Tubing	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
123	Tubing	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.C1-1	3.1.1-48	A
124	Tubing	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~ Program	IV.C1-1	3.1.1-48	~~A~~ E
125	Tubing	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
126	Tubing	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
127	Tubing	Pressure boundary	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
128	Valve Bodies < 4 inches	Pressure boundary	CASS	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
129	Valve Bodies < 4 inches	Pressure boundary	CASS	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
130	Valve Bodies < 4 inches	Pressure boundary	CASS	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.C1-1	3.1.1-48	A
131	Valve Bodies < 4 inches	Pressure boundary	CASS	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~ Program	IV.C1-1	3.1.1-48	~~A~~ E
132	Valve Bodies < 4 inches	Pressure boundary	CASS	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
133	Valve Bodies < 4 inches	Pressure boundary	CASS	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A
134	Valve Bodies < 4 inches	Pressure boundary	CASS	Reactor Coolant (Internal)	Reduction of Fracture Toughness	Small Bore Class 1 Piping ~~Inspection~~ Program	IV.C1-3	3.1.1-55	E
135	Valve Bodies < 4 inches	Pressure boundary	CASS	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A

Table 3.1.2-3 Aging Management Review Results – Reactor Coolant Pressure Boundary

Row No.	Component Type	Intended Function(s)	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Volume 2 Item	Table 1 Item	Notes
136	Valve Bodies < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
137	Valve Bodies < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - Flaw growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H
138	Valve Bodies < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	BWR Water Chemistry	IV.C1-1	3.1.1-48	A
139	Valve Bodies < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Cracking - SCC/IGA	Small Bore Class 1 Piping ~~Inspection~~ Program	IV.C1-1	3.1.1-48	~~A~~ E
140	Valve Bodies < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	BWR Water Chemistry	IV.C1-14	3.1.1-15	A
141	Valve Bodies < 4 inches	Pressure boundary	Stainless Steel	Reactor Coolant (Internal)	Loss of Material	Chemistry Program Effectiveness Inspection	IV.C1-14	3.1.1-15	A
142	Valve Bodies < 4 inches	Pressure boundary	Stainless Steel	Air-Indoor Uncontrolled (External)	None	None	IV.E-2	3.1.1-86	A
143	Valve Bodies < 4 inches	Pressure boundary	Steel	Reactor Coolant (Internal)	Cracking - Fatigue	TLAA	IV.C1-15	3.1.1-03	A
144	Valve Bodies < 4 inches	Pressure boundary	Steel	Reactor Coolant (Internal)	Cracking - Flaw Growth	Small Bore Class 1 Piping ~~Inspection~~ Program	N/A	N/A	H

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coolant water chemistry in accordance with BWRVIP guidelines to ensure the long-term integrity and safe operation of the vessel internal attachment welds.

The BWR Vessel ID Attachment Welds Program credits portions of the BWR Vessel Internals Program and the Inservice Inspection (ISI) Program.

A.1.2.10 BWR Vessel Internals Program

The BWR Vessel Internals Program is an existing condition monitoring program that manages cracking due to stress corrosion cracking and irradiation assisted stress corrosion cracking (SCC/IASCC), SCC/IGA, flaw growth, and flow-induced vibration for various components and subcomponents of the reactor vessel internals. The BWR Vessel Internals Program consists of mitigation, inspection, flaw evaluation, and repair in accordance with the guidelines of BWRVIP reports and the requirements of the ASME Boiler and Pressure Vessel Code, Section XI. The BWR Water Chemistry Program monitors and controls reactor coolant water chemistry in accordance with BWRVIP guidelines to ensure the long-term integrity and safe operation of the vessel internal components.

The BWR Vessel Internals Program credits portions of the Inservice Inspection (ISI) Program.

A.1.2.11 BWR Water Chemistry Program

The BWR Water Chemistry Program is an existing program that mitigates degradation of components that are within the scope of license renewal and contain or are exposed to treated water, treated water in the steam phase, reactor coolant, or treated water in a sodium pentaborate solution. The program manages the relevant conditions that could lead to the onset and propagation of a loss of material due to corrosion or erosion, cracking due to SCC, or reduction in heat transfer due to fouling through proper monitoring and control of chemical concentrations consistent with BWRVIP water chemistry guidelines.

The BWR Water Chemistry Program is supplemented by the Chemistry Program Effectiveness Inspection and the Heat Exchangers Inspection, to provide verification of the effectiveness of the program in managing the effects of aging. Additionally, the BWR Water Chemistry Program is supplemented by the BWR Feedwater Nozzle Program, BWR Stress Corrosion Cracking Program, BWR Penetrations Program, BWR Vessel ID Attachment Welds Program, BWR Vessel Internals Program, Inservice Inspection (ISI) Program, and Small Bore Class 1 Piping ~~Inspection~~ Program to provide verification of the program's effectiveness in managing the effects of aging for reactor pressure vessel, reactor vessel internals, and reactor coolant pressure boundary components.

Energy Northwest follows the requirements of the BWRVIP ISP and applies the ISP data to Columbia. The NRC has approved the use of the BWRVIP ISP in place of a unique plant program for Columbia.

The provisions of 10 CFR 50 Appendix G require Columbia to operate within the currently licensed pressure-temperature (P-T) limit curves, and to update these curves as necessary. The P-T limit curves, as contained in plant technical specifications, will be updated as necessary through the period of extended operation as part of the Reactor Vessel Surveillance Program. Reactor vessel P-T limits will thus be managed for the period of extended operation.

A.1.2.47 Selective Leaching Inspection

The Selective Leaching Inspection detects and characterizes the conditions on internal and external surfaces of subject components exposed to raw water, treated water, fuel oil, soil, and moist air (including condensation) environments. The inspection provides direct evidence through a combination of visual examination and hardness testing, or NRC-approved alternative, as to whether, and to what extent, a loss of material due to selective leaching has occurred.

The Selective Leaching Inspection is a new one-time inspection that will be implemented prior to the period of extended operation. The inspection activities will be conducted within the 10-year period prior to the period of extended operation.

A.1.2.48 Service Air System Inspection

The Service Air System Inspection detects and characterizes the material condition of steel piping and valve bodies exposed to an "air (internal)" (i.e., compressed air) environment within the license renewal boundary of the Service Air System. The inspection provides direct evidence as to whether, and to what extent, a loss of material due to corrosion has occurred.

The Service Air System Inspection is a new one-time inspection that will be implemented prior to the period of extended operation. The inspection activities will be conducted within the 10-year period prior to the period of extended operation.

A.1.2.49 Small Bore Class 1 Piping ~~Inspection~~

Program

Insert A from Page A-24a

~~The Small Bore Class 1 Piping Inspection will detect and characterize the conditions on the internal surfaces of small bore Class 1 piping components that are exposed to reactor coolant. The Small Bore Class 1 Piping Inspection will provide physical evidence as to whether, and to what extent, cracking due to SCC or to thermal or mechanical loading has occurred in small bore Class 1 piping components. The Small Bore Class 1 Piping Inspection will also verify, by inspections for cracking, that~~

Insert A to Page A-24

The Small Bore Class 1 Piping Program will detect and characterize cracking of small bore Class 1 piping components that are exposed to reactor coolant. This periodic program will provide physical evidence as to whether, and to what extent, cracking due to SCC or to thermal or mechanical loading has occurred in small bore Class 1 piping components. It will also verify, by inspections for cracking, that reduction of fracture toughness due to thermal embrittlement requires no additional aging management for small Class 1 cast austenitic stainless steel valve bodies. The Small Bore Class 1 Piping Program will be a condition monitoring program with no actions to prevent or mitigate aging effects. The program will include visual and volumetric inspection of a representative sample of small bore Class 1 piping, including butt welds and socket welds.

The Small Bore Class 1 Piping Program is a new program that will be implemented prior to the period of extended operation. Inspection activities will start during the fourth 10-year inservice inspection interval and continue through the period of extended operation. The Small Bore Class 1 Piping Program will credit portions of the Inservice Inspection Program. The Small Bore Class 1 Piping Program will verify the effectiveness of the BWR Water Chemistry Program in mitigating cracking of small bore piping and piping components.

~~reduction of fracture toughness due to thermal embrittlement requires no additional aging management for small bore cast austenitic stainless steel valves.~~

~~The Small Bore Class 1 Piping Inspection includes visual and volumetric inspection of a representative sample of small bore Class 1 piping components. The inspection provides additional assurance that cracking of small bore Class 1 piping is not occurring or is insignificant, such that an aging management program is not warranted during the period of extended operation. This one-time inspection is appropriate as Columbia has not experienced cracking of small bore Class 1 piping from stress corrosion or thermal and mechanical loading. Should evidence of significant aging be revealed by the one-time inspection or through plant operating experience, periodic inspection will be considered as a plant-specific aging management program.~~

~~The Small Bore Class 1 Piping Inspection credits portions of the Inservice Inspection (ISI) Program. The Small Bore Class 1 Piping Inspection is credited to verify the effectiveness of the BWR Water Chemistry Program in mitigating cracking of small bore piping and piping components.~~

~~The Small Bore Class 1 Piping Inspection is a new one-time inspection that will be implemented prior to the period of extended operation. The inspection activities will be conducted within the portion of the fourth 10-year ISI interval that occurs prior to the period of extended operation.~~

A.1.2.50 Structures Monitoring Program

The Structures Monitoring Program manages age-related degradation of plant structures and structural components within its scope to ensure that each structure or structural component retains the ability to perform its intended function. Aging effects are detected by visual inspection of external surfaces prior to the loss of the structure's or component's intended function. The Structures Monitoring Program encompasses and implements the Water Control Structures Inspection and the Masonry Wall Inspection. This program implements provisions of the Maintenance Rule, 10 CFR 50.65, that relate to structures, masonry walls, and water control structures. Concrete and masonry walls that perform a fire barrier intended function are also managed by the Fire Protection Program.

The Structures Monitoring Program is an existing program that requires enhancement prior to the period of extended operation.

A.1.2.51 Supplemental Piping/Tank Inspection

The Supplemental Piping/Tank Inspection detects and characterizes the material condition of steel, gray cast iron, and stainless steel components exposed to moist air environments. The inspection provides direct evidence as to whether, and to what extent, a loss of material due to corrosion has occurred.

Table A-1
Columbia License Renewal Commitments

Item Number	Commitment	FSAR Supplement Location (LRA App. A)	Enhancement or Implementation Schedule
49) Small Bore Class 1 Piping ~~Inspection~~	~~The Small Bore Class 1 Piping Inspection is a new activity.~~ ~~The Small Bore Class 1 Piping Inspection will detect and characterize the conditions on the internal surfaces of small bore Class 1 piping components that are exposed to reactor coolant. The Small Bore Class 1 Piping Inspection will provide physical evidence as to whether, and to what extent, the relevant effects of aging have occurred.~~ ~~The Small Bore Class 1 Piping Inspection includes visual and volumetric inspection of a representative sample of small bore Class 1 piping components. The inspection provides additional assurance that cracking of small bore Class 1 piping is not occurring or is insignificant, such that an aging management program is not warranted during the period of extended operation.~~ ~~This one-time inspection is appropriate as Columbia has not experienced cracking of small bore Class 1 piping from stress corrosion or thermal and mechanical loading. Should evidence of significant aging be revealed by the one-time inspection or through plant operating experience, periodic inspection will be considered as a plant-specific aging management program.~~	A.1.2.49	~~Within the portion of the fourth 10-year ISI interval that occurs prior to the period of extended operation.~~

Program

Insert A from Page A-61a

Insert B from Page A-61a

Amendment 7

Insert A to Page A-61

The Small Bore Class 1 Piping Program is a new aging management program.
The Small Bore Class 1 Piping Program will detect and characterize cracking of small bore Class 1 piping components that are exposed to reactor coolant. This periodic program will provide physical evidence as to whether, and to what extent, cracking due to SCC or to thermal or mechanical loading has occurred in small bore Class 1 piping components. It will also verify, by inspections for cracking, that reduction of fracture toughness due to thermal embrittlement requires no additional aging management for small Class 1 cast austenitic stainless steel valve bodies. The Small Bore Class 1 Piping Program will be a condition monitoring program with no actions to prevent or mitigate aging effects. The program will include visual and volumetric inspection of a representative sample of small bore Class 1 piping, including butt welds and socket welds.

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Implemented prior to the period of extended operation. Inspection activities will start during the fourth 10-year inservice inspection interval, then ongoing.

APPENDIX B
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Table B-1
Correlation of NUREG-1801 and Columbia Aging Management Programs
(continued)

Number	NUREG-1801 Program	Corresponding Columbia AMP
XI.M10	Boric Acid Corrosion	Not Applicable. Columbia is a BWR and does not use boric acid in any systems. The Standby Liquid Control System uses a sodium pentaborate solution (a mixture of boric acid and borax) that is not aggressive to metals.
XI.M11A	Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	Not Applicable. This program is applicable to PWR plants, Columbia is a BWR.
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Not credited for aging management. The Inservice Inspection (ISI) Program (See Section B.2.33) or the Small Bore Class 1 Piping ~~Inspection~~ Program (See Section B.2.49) is credited for pump casings and valve bodies.
XI.M13	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging and Neutron Embrittlement of Cast Austenitic Stainless Steel (CASS) Program See Section B.2.52.
XI.M14	Loose Parts Monitoring	Not credited for aging management. The Columbia loose parts detection system has been deactivated and spared in-place, as described in FSAR Section 7.7.1.12.
XI.M15	Neutron Noise Monitoring	Not Applicable. This program is applicable to PWR plants, Columbia is a BWR.
XI.M16	PWR Vessel Internals	Not Applicable. This program is applicable to PWR plants, Columbia is a BWR.
XI.M17	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion (FAC) Program See Section B.2.28.
XI.M18	Bolting Integrity	Bolting Integrity Program See Section B.2.4.
XI.M19	Steam Generator Tube Integrity	Not Applicable. Columbia is a BWR design that does not utilize steam generators.

Table B-1
Correlation of NUREG-1801 and Columbia Aging Management Programs
(continued)

Number	NUREG-1801 Program	Corresponding Columbia AMP
XI.M31	Reactor Vessel Surveillance	Reactor Vessel Surveillance Program See Section B.2.46.
XI.M32	One-Time Inspection	Chemistry Program Effectiveness Inspection See Section B.2.12. Cooling Units Inspection See Section B.2.14. Diesel-Driven Fire Pumps Inspection See Section B.2.18. Diesel Starting Air Inspection See Section B.2.16. Diesel Systems Inspection See Section B.2.17. Flexible Connection Inspection See Section B.2.27. Heat Exchangers Inspection See Section B.2.30. Lubricating Oil Inspection See Section B.2.37. Monitoring and Collection Systems Inspection See Section B.2.41. Service Air System Inspection See Section B.2.48. Supplemental Piping/Tank Inspection See Section B.2.51.
XI.M33	Selective Leaching of Materials	Selective Leaching Inspection See Section B.2.47.
XI.M34	Buried Piping and Tanks Inspection	Buried Piping and Tanks Inspection Program See Section B.2.5.
XI.M35	One-time Inspection of ASME Code Class 1 Small-Bore Piping	~~Small-Bore Class 1 Piping Inspection~~ See Section B.2.49.
XI.M36	External Surfaces Monitoring	External Surfaces Monitoring Program See Section B.2.23.

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Amendment 7

Insert A to Page B-14

Not credited for aging management. The new, plant-specific Small Bore Class 1 Piping Program is credited for aging management.

Table B-2
Consistency of Columbia Aging Management Programs with NUREG-1801
(continued)

Program Name	New / Existing	Consistent with NUREG-1801	Consistent with NUREG-1801 with Exceptions	Plant-Specific	Enhancement Required
Preventive Maintenance – RCIC Turbine Casing Section B.2.44	Existing	--	--	Yes	--
Reactor Head Closure Studs Program Section B.2.45	Existing	Yes	--	--	--
Reactor Vessel Surveillance Program Section B.2.46	Existing	Yes	--	--	--
Selective Leaching Inspection Section B.2.47	New	Yes	--	--	--
Service Air System Inspection Section B.2.48	New	Yes	--	--	--
Small Bore Class 1 Piping ~~Inspection~~ Program Section B.2.49	New	~~Yes~~ --	--	-- Yes	--
Structures Monitoring Program Section B.2.50	Existing	Yes	--	--	Yes
Supplemental Piping/Tank Inspection Section B.2.51	New	Yes	--	--	--

B.2.11 BWR Water Chemistry Program

Program Description

The BWR Water Chemistry Program will mitigate damage related to loss of material due to corrosion or erosion, cracking due to SCC, and reduction of heat transfer due to fouling of plant components that are within the scope of license renewal and contain or are exposed to treated water, treated water in the steam phase, reactor coolant, or treated water in a sodium pentaborate solution. The program manages the relevant conditions (e.g., concentrations of chlorides, oxygen, and sulfates) that could lead to the onset and propagation of a loss of material, cracking, or reduction of heat transfer through proper monitoring and control consistent with the current EPRI water chemistry guidelines. The relevant conditions are specific parameters such as sulfates, halogens, dissolved oxygen, and conductivity that could lead to, or are indicative of, conditions for corrosion or SCC of susceptible materials, as well as erosion and fouling. The BWR Water Chemistry Program is a mitigation program.

The BWR Water Chemistry Program is supplemented by separate one-time inspections of representative areas of treated water systems. One inspection is the Chemistry Program Effectiveness Inspection. This one-time inspection provides further confirmation that loss of material and cracking are effectively mitigated, or to detect and characterize whether, and to what extent, degradation is occurring. The other inspection is the Heat Exchangers Inspection. This one-time inspection provides further confirmation that reduction in heat transfer is effectively mitigated, or to detect and characterize whether, and to what extent, degradation is occurring.

Additionally, the BWR Water Chemistry Program is supplemented by the BWR Feedwater Nozzle Program, BWR Stress Corrosion Cracking Program, BWR Penetrations Program, BWR Vessel ID Attachment Welds Program, BWR Vessel Internals Program, Inservice Inspection (ISI) Program, and Small Bore Class 1 Piping ~~Inspection~~ Program to provide verification of the program's effectiveness in managing the effects of aging for reactor pressure vessel, reactor vessel internals, and reactor coolant pressure boundary components.

NUREG-1801 Consistency

The BWR Water Chemistry Program is an existing Columbia program that is consistent with the 10 elements of an effective aging management program as described in NUREG-1801, Section XI.M2, "Water Chemistry."

Exceptions to NUREG-1801

None.

B.2.49 Small Bore Class 1 Piping ~~Inspection~~ Program

Program Description

Insert A from Page B-187a

~~The Small Bore Class 1 Piping Inspection will detect and characterize the conditions on the internal surfaces of small bore Class 1 piping components that are exposed to reactor coolant. The one-time inspection will provide physical evidence as to whether, and to what extent, cracking due to SCC or to thermal or mechanical loading has occurred in small bore Class 1 piping components. It will also verify, by inspections for cracking, that reduction of fracture toughness due to thermal embrittlement requires no additional aging management for small Class 1 CASS valve bodies. The Small Bore Class 1 Piping Inspection will be an evaluation and inspection with no actions to prevent or mitigate aging effects.~~

~~This one-time inspection is applicable to small bore ASME Code Class 1 piping components less than 4 inches nominal pipe size (NPS 4), which includes piping, fittings, branch connections, and valve bodies. The Small Bore Class 1 Piping Inspection includes visual and volumetric inspection of a representative sample of small bore Class 1 piping components. The inspection provides additional assurance that either age-related degradation of small bore ASME Code Class 1 piping components is not occurring or that the aging is insignificant, such that an additional aging management program is not warranted during the period of extended operation.~~

~~Columbia has not experienced cracking of small bore Class 1 piping solely due to stress corrosion or thermal and mechanical loading, and therefore this one-time inspection is appropriate.~~

~~The inspection will include a representative sample of the small bore Class 1 piping population, and, where practical, will focus on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. The guidelines of EPRI Report 1000701, "Interim Thermal Fatigue Management Guideline (MRP-24)" will be considered in selecting the sample size and locations. Actual inspection locations will be based on physical accessibility, exposure levels, NDE techniques, and locations identified in NRC Information Notice (IN) 97-46. Volumetric examinations (including qualified destructive and/or nondestructive techniques) will be performed by qualified personnel following procedures that are consistent with Section XI of the ASME Code and 10 CFR 50, Appendix B.~~

~~Unacceptable inspection findings will be evaluated by the Columbia corrective action process using criteria in accordance with the ASME Code. The evaluation of indications will include determining the extent of condition by the expansion of the sample size when called for by the Code. Evaluation of inspection results may lead to the creation of a plant-specific AMP or may confirm that age-related degradation is either not occurring or is insignificant.~~

Insert A to Page B-187

The Small Bore Class 1 Piping Program will detect and characterize cracking of small bore, less that 4 inches nominal pipe size, Class 1 piping components (piping, fittings, branch connections, and valve bodies) that are exposed to reactor coolant. This periodic program will provide physical evidence as to whether, and to what extent, cracking due to SCC or to thermal or mechanical loading has occurred in small bore Class 1 piping components. It will also verify, by inspections for cracking, that reduction of fracture toughness due to thermal embrittlement requires no additional aging management for small bore Class 1 cast austenitic stainless steel valve bodies. The Small Bore Class 1 Piping Program will be a condition monitoring program with no actions to prevent or mitigate aging effects.

While the ASME Code does not require volumetric examination of Class 1 small bore piping, the Small Bore Class 1 Piping Program includes visual and volumetric inspection of a representative sample of small bore Class 1 piping components; the sample will include butt welds and socket welds, and will focus on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. Actual inspection locations will be based on physical accessibility, exposure levels, NDE techniques, and locations identified in NRC Information Notice 97-46. Volumetric examinations (including destructive and/or nondestructive techniques) will be performed by qualified personnel following procedures that are consistent with Section XI of the ASME Code and 10 CFR 50, Appendix B.

In scope components will be grouped into populations based on component type, material and environment. Sample size will be 10% of each population (except socket welds) with a minimum of one location and a maximum of twenty locations; the socket weld sample will include three locations. 100% of each sample will be inspected each 10-year ISI interval, with the breakdown of inspections between outages within the interval per ASME Section XI, Subsection IWB, Program B.

If a qualified non-destructive volumetric examination technique does not become available for socket welds, destructive examination will be conducted. Opportunistic destructive examination will be performed when socket welds are removed from service for other considerations, such as plant modifications. If socket welds do not become available on opportunistic bases prior to the scheduled inspections within the 10-year interval, then socket welds will be selected for planned destructive examinations.

Unacceptable inspection findings will be evaluated by the Columbia corrective action process. The evaluation of indications will include determining the extent of condition by the expansion of the sample size.

~~The Small Bore Class 1 Piping Inspection is a new one-time inspection that will be implemented prior to the period of extended operation. The inspection activities will be conducted during the portion of the fourth 10-year ISI interval that is prior to the period of extended operation.~~

~~The Small Bore Class 1 Piping Inspection will credit portions of the Inservice Inspection (ISI) Program. The Small Bore Class 1 Piping Inspection will verify the effectiveness of the BWR Water Chemistry Program in mitigating cracking of small bore piping and piping components.~~

NUREG-1801 Consistency

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~~The Small Bore Class 1 Piping Inspection is a new one-time inspection for Columbia that will be consistent with the 10 elements of an effective aging management program as described in NUREG-1801, Section XI.M35, "One-time Inspection of ASME Code Class 1 Small Bore Piping."~~

~~**Exceptions to NUREG-1801**~~

~~None.~~

Aging Management Program Elements

The results of an evaluation of each program element are provided below.

Insert B from Page B-188a

- Scope of Program
  ~~The Small Bore Class 1 Piping Inspection is a one-time inspection of a sample of ASME Code Class 1 piping and piping components less than NPS 4. The inspection will include measures to verify that unacceptable degradation is not occurring in Class 1 small bore piping and piping components (valve bodies), thereby confirming that an aging management program is not needed for the period of extended operation. See *Monitoring and Trending* below for a discussion of sample selection and inputs.~~

Insert C from Page B-188a

- Preventive Actions
  ~~The Small Bore Class 1 Piping Inspection will be an evaluation and inspection with no actions to prevent or mitigate aging effects.~~

Insert D from Page B-188a

- Parameters Monitored or Inspected
  ~~The Small Bore Class 1 Piping Inspection is a one-time inspection that will include volumetric examinations (destructive or nondestructive) performed by qualified personnel, using qualified volumetric examination techniques, and following procedures consistent with Section XI of the ASME Code and 10 CFR 50, Appendix B.~~

Insert A to Page B-188

The Small Bore Class 1 Piping Program is a new Columbia program that is plant-specific. There is no corresponding aging management program described in NUREG-1801. Unlike the aging management program described in NUREG-1801, Section XI.M35, "One-time Inspection of ASME Code Class 1 Small-Bore Piping," the Columbia Program is a periodic aging management program rather than a one-time inspection. Therefore, the program elements are compared to the elements listed in Table A.1-1 of NUREG-1800.

Insert B to Page B-188

The Small Bore Class 1 Piping Program is a periodic inspection of a sample of ASME Code Class 1 piping and piping components (valve bodies) less than NPS 4 for cracking.

Insert C to Page B-188

The Small Bore Class 1 Piping Program will be a condition monitoring program with no actions to prevent or mitigate aging effects.

Insert D to Page B-188

The Small Bore Class 1 Piping Program is a periodic program that will include visual and volumetric examinations (destructive or nondestructive) for cracking. Examinations will be performed by qualified personnel, using qualified examination techniques and following procedures consistent with Section XI of the ASME Code and 10CFR50, Appendix B.

- Detection of Aging Effects

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~~This inspection will perform volumetric examinations on selected weld locations. Columbia has not experienced cracking of small bore Class 1 piping due to stress corrosion or thermal and mechanical loading, and therefore this one-time inspection is appropriate. Columbia has found cracking due to fatigue and growth of construction flaws of small bore piping. See *Operating Experience* below for discussion of site operating experience to date and lack of stress corrosion or thermal and mechanical loading induced cracks.~~

- *Monitoring and Trending*

Insert B from Page B-189a

~~The inspection will include a representative sample of the small bore Class 1 piping population, and, where practical, will focus on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. The guidelines of EPRI Report 1000701, "Interim Thermal Fatigue Management Guideline (MRP-24)" will be considered in selecting the sample size and locations. Actual inspection locations will be based on physical accessibility, exposure levels, NDE techniques, and locations identified in NRC Information Notice 97-46. Volumetric examinations (including qualified destructive and nondestructive techniques) will be performed by qualified personnel following procedures that are consistent with Section XI of the ASME Code and 10 CFR 50, Appendix B.~~

~~Unacceptable inspection findings will be evaluated by the Columbia corrective action process. The Small Bore Class 1 Piping Inspection will require an increased sample size in response to unacceptable inspection findings. Evaluation of inspection results may lead to the creation of a plant-specific aging management program or may confirm that age-related degradation is either not occurring or is insignificant.~~

- Acceptance Criteria

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~~Unacceptable inspection findings will be evaluated by the Columbia corrective action process using criteria in accordance with the ASME Code. The evaluation of indications will include determining the extent of condition by the expansion of the sample size when called for by the Code. Evaluation of inspection results may lead to the creation of a plant-specific aging management program or may confirm that age-related degradation is either not occurring or is insignificant.~~

- Corrective Actions

This element is common to Columbia programs and activities that are credited with aging management during the period of extended operation and is discussed in Section B.1.3.

Insert A to Page B-189

The Small Bore Class 1 Piping Program will perform visual and volumetric inspection of a representative sample of small bore Class 1 piping components, including butt welds and socket welds, and will focus on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. Actual inspection locations will be based on physical accessibility, exposure levels, NDE techniques, and locations identified in NRC Information Notice 97-46.

In scope components will be grouped into populations based on component type, material and environment. Sample size will be 10% of each population (except socket welds) with a minimum of one location and a maximum of twenty locations; the socket weld sample will include three locations. 100% of each sample will be inspected each 10-year ISI interval, with a breakdown of inspections between outages within the interval per ASME Section XI, Subsection IWB, Program B. Inspections will start during the fourth 10-year interval, which begins prior to the period of extended operation.

Volumetric examinations (including destructive and nondestructive techniques) will be performed by qualified personnel following procedures that are consistent with Section XI of the ASME Code and 10 CFR 50, Appendix B. If a qualified non-destructive volumetric examination technique does not become available for socket welds, destructive examination will be conducted. Opportunistic destructive examination will be performed when socket welds are removed from service for other considerations, such as plant modifications. If socket welds do not become available on opportunistic bases prior to the scheduled inspections within the 10-year interval, then socket welds will be selected for planned destructive examinations.

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Unacceptable program findings will be evaluated, tracked, and trended by the Columbia corrective action program. Extent of condition will be determined by the expansion of the sample size as called for by the ASME Code, Section XI, Subsection IWB-2400.

Insert C to Page B-189

Acceptance criteria will be in accordance with the ASME Code, Section XI, Subsection IWB-3100. The evaluation of indications will include determining the extent of condition by the expansion of the sample size as called for by the ASME Code, Section XI, Subsection IWB-2400.

- Confirmation Process
  This element is common to Columbia programs and activities that are credited with aging management during the period of extended operation and is discussed in Section B.1.3.

- Administrative Controls
  This element is common to Columbia programs and activities that are credited with aging management during the period of extended operation and is discussed in Section B.1.3.

- Operating Experience

Insert A from Page B-190a

~~Based on review of plant-specific and industry operating experience, the identified aging effects require management for the period of extended operation. The Small Bore Class 1 Piping Inspection provides confirmation of material conditions near the period of extended operation as additional assurance that existing inspections, via the Inservice Inspection (ISI) Program, and control of water chemistry, via the BWR Water Chemistry Program, provide adequate management.~~

~~Industry operating experience:~~

~~NUREG-1801 is based on industry operating experience through January 2005. Recent industry operating experience has been reviewed for applicability. Future operating experience is captured through the normal operating experience review process, which will continue through the period of extended operation.~~

~~Industry operating experience will be considered when implementing this one-time inspection. Plant operating experience for this activity will be gained as it is implemented near the period of extended operation, and will be factored into the activity. As such, operating experience assures that implementation of the Small Bore Class 1 Piping Inspection will confirm material condition relative to the effects of aging such that applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.~~

~~Columbia operating experience:~~

~~A review of Columbia operating experience identified other piping being examined by the same techniques and small bore piping that has experienced cracking due to fatigue.~~

~~The Small Bore Class 1 Piping Inspection is a new one-time inspection activity for which plant operating experience has shown only one occurrence of stress corrosion cracking, and that as one of several contributors to fatigue cracking. The evaluations and examinations to be performed by this activity will use qualified volumetric examination techniques or destructive examination~~

Insert A to Page B-190

The site corrective action program and an ongoing review of industry and plant-specific operating experience, continued through the period of extended operation, will be used to ensure that the Small Bore Class 1 Piping Program identifies cracking before loss of function of the small bore piping.

Industry operating experience:

Industry operating experience will be considered when implementing the Small Bore Class 1 Piping Program. The evaluations and examinations to be performed by this program will use qualified volumetric examination techniques or destructive examination techniques with demonstrated capability and a proven industry record to detect cracking in piping weld and base metal. As such, industry operating experience assures that implementation of the Small Bore Class 1 Piping Program will identify cracking such that applicable components will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

Columbia operating experience:

A review of Columbia operating experience identified other piping being examined by the same techniques and small bore piping that has experienced cracking due to fatigue. Plant operating experience for this program will be gained as it is implemented near the period of extended operation, and will be factored into the program.

Several cracks due to vibration induced fatigue or construction flaws occurred in small bore piping during the early years of plant life. Design changes were instituted to reduce vibration and sources of cyclic loading. The occurrence of these small bore leaks has decreased in recent years showing the effectiveness of the actions being taken. No instances of stress corrosion cracking or low cycle fatigue cracking as the sole failure mechanism were identified. A single instance of small bore Class 1 piping failure related to stress corrosion cracking was found in 1993, which also involved other contributing factors that led to fatigue cracking. The weld was removed and configuration was changed to address the vibration and cyclic loading considerations. No other instances of stress corrosion cracking of small bore Class 1 piping have been identified.

~~techniques with demonstrated capability and a proven industry record to detect cracking in piping weld and base metal.~~

~~Several cracks due to vibration induced fatigue or construction flaws occurred in small bore piping during the early years of plant life. Design changes were instituted to reduce vibration and sources of cyclic loading. The occurrence of these small bore leaks has decreased in recent years showing the effectiveness of the actions being taken. No instances of stress corrosion cracking or low cycle fatigue cracking as the sole failure mechanism were identified. A single instance of small bore Class 1 piping failure related to stress corrosion cracking was found in 1993, which also involved other contributing factors that led to fatigue cracking. The weld was removed and configuration was changed to address the vibration and cyclic loading considerations. No other instances of stress corrosion cracking of small bore Class 1 piping have been identified.~~

~~The Small Bore Class 1 Piping Inspection will be developed based on relevant plant and industry operating experience. The site corrective action program and an ongoing review of industry operating experience will be used to ensure that the one-time inspection confirms material condition such that the existing program (ISI) is demonstrated to be effective in managing the identified aging effects, or a new aging management program will be developed.~~

Required Enhancements

program

Not applicable, this is a new ~~activity~~.

Conclusion

Insert A from Page B-191a

~~The Small Bore Class 1 Piping Inspection will verify that cracking due to stress corrosion and mechanical loading, and cracking due to reduction of fracture toughness are not occurring or are insignificant, such that an aging management program is not required during the period of extended operation. The Small Bore Class 1 Piping Inspection will provide reasonable assurance that the aging effects are not occurring such that components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.~~

Insert A to Page B-191

The Small Bore Class 1 Piping Program will monitor the extent of cracking in small bore piping through the period of extended operation. The Small Bore Class 1 Piping Program will provide reasonable assurance that cracking is identified and repaired such that components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

Table C-11

BWRVIP-74-A **BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal**	
Applicant Action Item Text	**Plant-Specific Response**
(3) 10 CFR 54.22 requires that each LR application include any technical specification changes (and the justification for the changes) or additions necessary to manage the effects of aging during the period of extended operation as part of the LR application. In its Appendix A to the BWRVIP-74 report, the BWRVIP stated that the technical specification changes resulting from neutron embrittlement will be made at the appropriate time prior to the end of the current license. Those LR applicants referencing the BWRVIP-74 report for the RPV components shall ensure that the inspection strategy described in the BWRVIP-74 report does not conflict or result in any changes to their technical specifications. If technical specification changes do result, then the applicant should ensure that those changes are included in its LR application.	No technical specification changes are required for the inspection strategy described in the BWRVIP-74-A report. Technical specification changes due to embrittlement, i.e. Pressure-Temperature Limits, will be submitted prior to the expiration of the currently approved limits, as discussed in LRA Section 4.2.
(4) The staff is concerned that leakage around the reactor vessel seal rings could accumulate in the VFLD lines, cause an increase in the concentration of contaminants and cause cracking in the VFLD line. The BWRVIP-74 report does not identify this component as within the scope of the report. However, since the VFLD line is attached to the RPV and provides a pressure boundary function, LR applicants should identify an AMP for the VFLD line.	The reactor vessel flange leak detection (VFLD) lines are in the scope of license renewal. See the scoping and screening results in the LRA for the Reactor Coolant System Pressure Boundary (piping and fittings, flange leak detection lines, Section 2.3.1.3 and Table 3.1.2-3). Refer to Section 3.1.2.2.4 of the LRA for further information, and also see item 3.1.1-19 in LRA Table 3.1.1. Cracking of these lines is managed by the Small Bore Class 1 Piping ~~Inspection.~~ Program This aging management program is described in Appendix B of the LRA.