UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 24, 2017

Mr. Mark E. Reddemann
Chief Executive Officer
Energy Northwest
P.O. Box 968 (Mail Drop 1023)
Richland, WA 99352-0968

SUBJECT: COLUMBIA GENERATING STATION – RELIEF REQUEST FOR ALTERNATIVE 4ISI-05 APPLICABLE TO THE FOURTH 10-YEAR INSERVICE INSPECTION PROGRAM INTERVAL (CAC NO. MF7358)

Dear Mr. Reddemann:

By letter dated February 17, 2016, as supplemented by letter dated August 3, 2016, Energy Northwest (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, requirements for system leakage testing of the reactor pressure vessel (RPV) flange leak-off lines at Columbia Generating Station (CGS).

The proposed alternative in Relief Request 4ISI-05 is to perform the system leakage test of the RPV flange leak-off lines at CGS, using the pressure developed when the refueling cavity is filled to the normal refueling water level in lieu of the pressure required by ASME Code, Section XI, paragraphs IWB-5221 and IWC-5221. Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(z)(2), the licensee requested to use the proposed alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC authorizes the licensee's proposed alternative for system leakage testing of the RPV for the duration of the fourth 10-year inservice inspection interval at CGS ending on December 12, 2025.

All other ASME Code requirements for which relief was not specifically requested and approved in the subject request for relief remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions regarding this matter, please contact the NRC project manager, John Klos, at (301) 415-5136 or via e-mail at John.Klos@nrc.gov.

Sincerely,

Robert J. Pascarelli, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-397

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ALTERNATIVE 4ISI-05 REGARDING PRESSURE TESTING OF

REACTOR PRESSURE VESSEL FLANGE LEAK-OFF LINES

ENERGY NORTHWEST

COLUMBIA GENERATING STATION

DOCKET NO. 50-397

1.0 INTRODUCTION

By letter dated February 17, 2016, as supplemented by letter dated August 3, 2016 (Agencywide Documents Access and Management System Accession Nos. ML16054A797 and ML16216A697, respectively), Energy Northwest (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," requirements for system leakage testing of the reactor pressure vessel (RPV) flange leak-off lines at Columbia Generating Station (CGS).

The proposed alternative in Relief Request 4ISI-05 is to perform the system leakage test of the RPV flange leak-off lines at CGS, using the pressure developed when the refueling cavity is filled to the normal refueling water level in lieu of the pressure required by ASME Code, Section XI, paragraphs IWB-5221 and IWC-5221. Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(z)(2), the licensee requested to use the proposed alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

2.0 REGULATORY REQUIREMENTS

The regulations in 10 CFR 50.55a(g)(4), "Inservice inspection standards requirement for operating plants," require that ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests, conducted during the first 10-year interval and subsequent intervals, comply with the requirements in the latest edition and addenda of Section XI of the ASME Code, incorporated by reference in 10 CFR 50.55a(a), 12 months prior to the start of the 120-month interval, subject to the conditions listed therein.

The regulation in 10 CFR 50.55a(z), "Alternatives to codes and standards requirements," states, in part, that the Director of the Office of Nuclear Reactor Regulation may authorize an alternative to the requirements of 10 CFR 50.55a(b) through (h) given that the licensee demonstrates one of the two justifications. First, per 10 CFR 50.55a(z)(1), the licensee must demonstrate that the proposed alternative would provide an acceptable level of quality and safety. For the second possible justification for an alternative to be authorized, described in 10 CFR 50.55a(z)(2), the licensee must show that following the ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff concludes that regulatory authority to authorize an alternative to the ASME Code requirement, as requested by the licensee exists. Accordingly, the NRC staff has reviewed and evaluated the licensee's request pursuant to 10 CFR 50.55a(z)(2).

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected

- Code Class 1 RPV Flange Leak-off Piping nominal pipe size (NPS) ¾ inch and 1 inch
- Code Class 2 RPV Flange Leak-off Piping NPS ¾ inch

3.2 Applicable Code Requirement:

The Code of Record for the CGS fourth 10-year inservice inspection (ISI) interval, which began December 13, 2015 and is scheduled to end on December 12, 2025, is the ASME Code, Section XI, 2007 Edition through 2008 Addenda.

ASME Code, Section XI, IWB-2500, "Examination and Pressure Test Requirements," Table IWB-2500-1, Code Category B-P, Item No. B15.20 requires that all Class 1 pressure retaining components be subject to a system leakage test with a Visual Examination, VT-2 once per inspection interval. Subparagraph IWB-5221(a) requires that the system leakage test be conducted at a pressure not less than the pressure corresponding to 100 percent rated reactor power.

ASME Code, Section XI, IWC-2500, Table IWC-2500-1, Code Category C-H, Item No. C7.10 requires that all Class 2 pressure retaining components be subject to a system leakage test with a Visual Examination, VT-2 each inspection period. Paragraph IWC-5221, "Pressure," requires that the system leakage test be conducted at the system pressure obtained while the system, or portion of the system, is in service performing its normal operating function or at a system pressure developed during a test conducted to verify system operability.

3.3 Reason for Request:

As summarized in the licensee's application dated February 17, 2016, the RPV flange leak-off piping is separated from the reactor pressure boundary by one passive membrane, which is an O-ring (inner), located on the vessel flange. A second O-ring (outer) is located on the opposite side of the tap in the vessel flange. Failure of the inner O-ring is the only condition under which the leak-off line is pressurized. Therefore, the line would not be pressurized during the Class 1 system pressure test following a refueling outage.

The configuration of this system precludes system pressure testing while the vessel head is removed because the configuration and size of the vessel tap and the high test pressure requirement prevents the tap in the flange from being temporarily plugged or connected to other piping. The opening in the flange is smooth walled, making the effectiveness of a temporary seal very limited.

Failure of a high pressure temporary seal could possibly cause the device used for plugging to be ejected into the reactor vessel.

The licensee stated, in part, in its letter dated February 17, 2016, that:

> The configuration also precludes pressure testing with the vessel head installed because the seal prevents complete filling of the piping, which has no vent available. The top head of the vessel contains two grooves that hold the O-rings. The O-rings are held in place by a series of retainer clips that are housed in recessed cavities in the flange face. If a pressure test was performed with the head on, the inner O-ring would be pressurized in a direction opposite to what it would see in normal operation. This test pressure would result in a net inward force on the inner O-ring that would tend to push it into the recessed cavities that house the retainer clips. The thin O-ring material would very likely be damaged by this inward force.
>
> Purposely failing or not installing the inner O-ring in order to perform a pressure test would require replacing the new outer and possibly the new inner O-ring each time the test is conducted. This would result in additional time needed during the outage and additional radiation exposure to personnel associated with the removal and reinstallation of the RPV head.

It is possible to pressurize the Class 2 portion only by closing a valve (MS-V-753) and pressurizing with an external source at the test connection point. This portion of the RPV flange leak-off line consist of less than two feet of ¾ inch piping. Performing this task each inspection period would require an additional dose of 64 millirem each period versus performing a combined Class 1 and Class 2 examination once per interval in accordance with this request.

3.4 Proposed Alternative and Basis for Use

In its letter dated February 17, 2016, the licensee proposes to perform a Visual Examination, VT-2 of the Class 1 and Class 2 portions of the RPV flange leak-off line with the components subject to static pressure head with the RPV head removed and the refueling cavity filled to its normal refueling water level for at least 4 hours. The minimum head pressure in the leak-off line would be 24.5 feet of water.

Further, the licensee stated, in part in its letter dated February 17, 2016, that,

> This proposed [alternative] is identical to that presented in ASME Code Case N-805. This Code Case has not yet been approved by the NRC and is not yet identified in the current revision of Regulatory Guide 1.147, "In-service Inspection Code Case Acceptability, ASME Section XI, Division 1"....

The licensee proposes to perform this test once at or near the end of the inspection interval for both the Class 1 and Class 2 portions of the line. Once per interval testing is consistent with IWB-5222(b) requirements and reduces the dose received during testing of the Class 2 portion.

3.5 NRC Staff Evaluation

The NRC staff has evaluated the proposed alternative 4ISI-05 pursuant to 10 CFR 50.55a(z)(2). The NRC staff focused on whether compliance with the specified requirements of 10 CFR 50.55a(g), or portions thereof, would result in hardship or unusual difficulty, and if there is a compensating increase in the level of quality and safety despite the hardship.

The NRC staff determined that it would result in hardship if the IWB-5221(a) requirement for leak testing of the RPV head flange seal leak-off line piping is imposed upon the licensee. This hardship is due to the existing design and configurations of reactor vessel flange and flange leak-off line, which makes system leakage testing of the leak-off line piping at a pressure corresponding to 100 percent rated reactor power either before or after the RPV head is removed unusually difficult. This is because the testing would require either temporary modifications or permanent design changes as described above. These modifications could introduce foreign materials into the reactor, either through ejection of a temporary seal or welding and grinding activities in close proximity to the RPV, which would introduce a plant Foreign Material Exclusion program concern. Personnel carrying out these tasks would incur additional radiation dose, which would be an as-low-as-reasonably-achievable (ALARA) program concern. To conduct the required system testing with the RPV head in place, the licensee would have to install new test connections and valves to existing piping to be able to externally pressurize the leak-off piping and provide a vent path. Personnel performing these tasks and conducting testing would be exposed to additional dose, which would be an ALARA program concern. Furthermore, when the head is on if the subject piping was externally pressurized for the purpose of conducting the ASME Code required leak testing of the leak-off piping, the inner O-ring seal may fail due being pressurized in the opposite direction than its designed purpose. Requiring the RPV head to be removed and reinstalled to perform the pressure test by purposely failing or not installing the O-ring would also result in additional radiation exposure to personnel involved with the removal and reinstallation of the RPV head, which would be an ALARA program concern. Therefore, the NRC staff determines that the above items constitute a hardship in this case.

The NRC staff determines that the licensee's proposed system leakage test of the RPV leak-off piping will subject the system to the highest pressure that can be obtained without design modifications to existing configurations of both the vessel flange face and the flange leak-off piping. Specifically, the leak-off line piping will be pressurized by the proposed static pressure head (24.5 feet) developed from the refueling water level above the reactor vessel flange during the vessel cavity floodup, and will be examined by the IWA-5240 required VT-2 visual examinations after attaining the proposed test pressure for at least four hours. Any evidence of leakage, from an existing flaw in the piping and its associated connections, would be detected by the VT-2.

With respect to the Class 2 portion of the RPV flange leak-off piping, the NRC staff determines that performing the pressure testing once per interval in accordance with the proposed alternative is consistent with the requirements of IWB-5222(b). IWB-5222(b) applies to the Class 1 pressure retaining boundary, which is not pressurized when the system valves are in the position required for normal reactor startup and requires pressure testing of these portions of Class 1 systems pressurized and examined at or near the end of the inspection interval.

The NRC staff determined that the licensee has sufficient leakage detection capabilities (i.e., detection of increase in drywell temperature and pressure, detection of an increase in drywell floor drain leakage, containment radiation monitors as well as monitoring of drywell fission products) that provides warning to the control room operator in the unlikely event of a through wall leak in the RPV flange seal leak-off line piping concurrent with leak or failure of the RPV flange inner seal. If the proposed alternative was not effective in identifying a through-wall leak, originating from an existing flaw in the subject piping, the plant's existing leakage detection capability will be able to identify the leakage during normal operation and the licensee will be required to implement appropriate corrective actions. Furthermore, the licensee stated that CGS has no history of O-ring leakage or degradation in vessel flange leak-off piping.

Should the inner O-ring and leak off piping no longer be capable of withstanding the pressure, and the leakage rates do not meet technical specification requirements, shutdown of the reactor would be required. There is reasonable assurance that any problems in the subject piping would be detected through these measures. NRC staff concludes that requiring compliance with the IWB-5221 system pressure test requirements results in a hardship or unnecessary difficulty without a compensating increase in the level of quality and safety. Therefore, the NRC staff concludes that the proposed system leakage testing using the static head pressure from normal refueling water levels is adequate to provide reasonable assurance of structural integrity and leak tightness of the RPV flange seal leak-off line piping.

On the basis of the above evaluation, the NRC staff concludes that the licensee's proposed alternative 4ISI-05 is acceptable for the fourth 10-year ISI interval of CGS.

4.0 CONCLUSION

As set forth above, the NRC staff concludes that the licensee's proposed alternative 4ISI-05 provides reasonable assurance of the structural integrity and leak tightness of the RPV head flange leak-off piping, and that complying with the specified ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(z)(2) and, therefore, authorizes the use of proposed alternative 4ISI-05 at CGS for the fourth 10-year ISI interval, which commenced on December 13, 2015, and will end on December 12, 2025.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Keith M. Hoffman

Date: January 24, 2017

COLUMBIA GENERATING STATION – RELIEF REQUEST FOR ALTERNATIVE 4ISI-05 APPLICABLE TO THE FOURTH 10-YEAR INSERVICE INSPECTION PROGRAM INTERVAL (CAC NO. MF7358) Dated January 24, 2017

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