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

March 23, 2011

Mr. S.K. Gambhir, Vice President, Engineering
Columbia Generating Station
Energy Northwest
MD PE04
P.O. Box 968
Richland, WA 99352-0968

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE COLUMBIA GENERATING STATION, LICENSE RENEWAL APPLICATION FOR TIME-LIMITED AGING ANALYSES OF REACTOR VESSEL NEUTRON EMBRITTLEMENT (TAC NUMBER ME3058)

Dear Mr. Gambhir:

By letter dated January 19, 2010, Energy Northwest submitted an application pursuant to Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54), to renew operating license NPF-21 for Columbia Generating Station, for review by the U.S. Nuclear Regulatory Commission (NRC or the staff). The staff is reviewing the information contained in the license renewal application and has identified, in the enclosure, areas where additional information is needed to complete the review. Further requests for additional information may be issued in the future.

Items in the enclosure were discussed with Abbas Mostala and a mutually agreeable date for the response is within 30 days from the date of this letter. If you have any questions, please contact me at 301-415-3897 or by e-mail at arthur.cunanan@nrc.gov.

Sincerely,

Arthur Cunanan

Arthur D. Cunanan, Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-397

Enclosure:
As stated

cc w/encl: Distribution via Listserv

COLUMBIA GENERATING STATION
LICENSE RENEWAL APPLICATION
REQUEST FOR ADDITIONAL INFORMATION

RAI 4.2-3

Background

The Columbia Generating Station (Columbia) reactor vessel (RV) N12 water level instrument nozzles (N12 nozzles) are in the beltline region of the RV because they are projected to experience neutron fluence greater than 1 x 10^{17} n/cm^2 (E > 1.0 MeV) at the end of the period of extended operation, corresponding to 54 effective full power years (EFPY). Based on its January 28, 2011, RAI response, the staff determined that the applicant had provided an acceptable adjusted nil-ductility reference temperature (ART) evaluation for the N12 nozzles that is valid through 54 EFPY. The staff noted that the N12 nozzles from Heat No. 219972 are the limiting RV beltline material because the 54 EFPY ART value (149 °F) exceeds that for all other RV beltline materials. Furthermore, based on the bounding values for copper and nickel content, the 40 °F initial reference temperature nil-ductility transition (RT_{NDT}) value and the 34 °F margin term value, the staff determined that the N12 nozzles from Heat No. 219972 are the limiting RV beltline material, with respect to ART, for all fluence values greater than or equal to 1 x 10^{17} n/cm^2 (E > 1.0 MeV).

Therefore, based on the limiting nature of the N12 nozzles, the staff identified a concern regarding the impact of these nozzles on the current 33.1 EFPY pressure-temperature (P-T) limit curves in the Columbia Technical Specifications (TSs). This concern was based on the fact that the P-T curve calculations documented in General Electric (GE) Report NEDO-33144, "Pressure-Temperature Curves for Energy Northwest, Columbia," April 2004, did not account for the limiting 33.1 ART value for the N12 nozzle in establishing the current TS P-T limit curves for 33.1 EFPY.

However, the GE-Hitachi Report NEDO-33178-A, "GE Hitachi Nuclear Energy Methodology for Development of Reactor Pressure Vessel Pressure-Temperature Curves," Appendix J, "Water Level Instrumentation Nozzle LEFM [linear elastic fracture mechanics] Evaluation," June 2009, was reviewed and approved by the staff by letter dated April 27, 2009. This report documents a LEFM evaluation of the water level instrument nozzles in all boiling-water reactors (BWRs) based on bounding assumptions for RV and water level instrument nozzle geometry, postulated flaw configuration, operating pressures, and thermal transients. The report documents calculations of Mode I applied stress intensity factors (K_I) due to pressure loads and thermal transients. The report also calculates bounding "T-RT_{NDT}" values for the BWR water level instrument nozzle using the acceptance criteria for total applied K_I values (including safety factors) that are based on the lower bound of the static critical (or reference) stress intensity factor, K_{IC}, curve, as specified in the ASME Code, Section XI, Appendix G.

Issue

The staff noted that the results of the LEFM analysis documented in NEDO-33178-A, Appendix J could be used to calculate P-T limit curves specifically for Columbia's N12 instrument nozzles.

ENCLOSURE

However, in order to determine how these methods can be applied for determining P-T limits specifically for Columbia's N12 nozzles, the staff determined that the applicant should provide additional information concerning the plant-specific applicability of the postulated flaw configuration used for calculating the applied K_I values, as described in the subject report.

The staff also noted that the NEDO-33178-A, Appendix J analysis postulated a 2.276 inch flaw that originates at the blend radius of the instrument nozzle and extends through the nozzle into the adjacent RV shell plate. The tip of the postulated flaw in this analysis is apparently located in the adjacent RV shell plate. Accordingly, Section 5.0 of NEDO-33178-A, Appendix J states that for BWR instrument nozzles located in the beltline region of the RV, "the ART from the adjacent [reactor pressure vessel] RPV shell material is used to create a component-specific P-T curve."

Request

a. State whether the 2.276 inch postulated flaw for the N12 nozzle, as described in the subject report, extends into and terminates in the adjacent RV shell plate material.

b. If the postulated flaw described in the report terminates in the adjacent RV shell plate material, identify the RV beltline shell plate material that surrounds this nozzle and the ART value used for determining the component-specific P-T limits for the N12 nozzles.

RAI 4.2-4

Background

In the applicant's RAI response by letter dated January 28, 2011, calculations of the 54 EFPY upper-shelf usage (USE) values for the N6 residual heat removal (RHR)/low pressure coolant injection (LPCI) nozzle forgings (SA-508, Class 2) were provided. These calculations are based on an initial USE value of 70 ft-lbs.

Issue

The applicant did not provide a basis to the 70 ft-lbs initial USE value. The staff believes that initial USE value based on a lower bounding value of Charpy USE test data for SA-508, Class 2 forging material is conservative.

Request

Provide a basis the 70 ft-lbs initial USE value and justify that the value is based on the lower bounding value of available Charpy USE test data for SA-508, Class 2 forging material, or other means.

RAI 4.2-5

Background

In its RAI response by letter dated January 28, 2011, the applicant stated that the 54 EFPY percentage decrease in USE (% USE decrease) for the N6 RHR/LPCI nozzle-to-RV welds is bounded by the equivalent margins analysis (EMA) acceptance criteria for RV shell welds from BWRVIP-74-A, "Boiling Water Reactor Vessel and Internals Project Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines."

The % USE decrease acceptance criteria in BWRVIP-74-A are based on minimum USE requirements derived from EMAs performed in GE NEDO-32205-A, "10 CFR 50 Appendix G Equivalent Margin Analysis for Low Upper-Shelf Energy in BWR-2 through BWR-6 Vessels," for shell plates and shell welds, and a conservative estimate of initial USE values based on a statistically significant set of Charpy USE data for each type of RV shell material.

The staff notes that the NEDO-32205-A EMAs developed minimum USE acceptance criteria for shell plates and shell welds. The NEDO-32205-A EMAs and minimum USE acceptance criteria are based on the ASME Code Case N-512 procedures, which are now codified in Appendix K of the ASME Code, Section XI.

The procedures include (1) the selection of an appropriate J-integral fracture resistance curve for the class of material being analyzed, (2) the calculation of J-integrals due to applied loads for RV shell components based on a postulated flaw configuration, and (3) the application of the acceptance criteria for (a) the applied J-integral at a ductile flaw extension of 0.1 inch and (b) flaw stability due to ductile tearing.

Calculations of J-integrals due to applied loads are very component specific — for example, the applied J integrals for RV shell components differ significantly from the applied J integrals for nozzles, even if the two types of components are fabricated from the same class of material.

Issue

In order to demonstrate that the BWRVIP-74-A acceptance criteria for shell welds can be used to determine the acceptability of the N6 nozzle welds, it is necessary to confirm that:

(1) The N6 nozzle weld material is of the same class as the shell weld material analyzed in NEDO-32205-A, with respect to weld filler metal, welding flux, and weld fabrication technique.

(2) The N6 nozzle weld configuration, postulated flaw configuration, and loading is identical to (or bounded by) the RV shell weld configuration, postulated flaw configuration, and loading, with respect to the applied J integral values, as calculated using ASME Code Case N-512 and Appendix K procedures.

Request

Provide justification for the use of the BWRVIP-74-A shell weld EMA acceptance criteria to determine the acceptability of the N6 RHR/LPCI nozzle welds, based on (1) N6 nozzle weld material and weld fabrication technique; and (2) the N6 nozzle weld configuration, postulated flaw configuration, and loading[1], relative to the RV shell welds.

RAI 4.2-6

Background

In its RAI response by letter dated January 28, 2011, the applicant added License Renewal Commitment Item No. 70, "TLAA – Embrittlement of Reactor Vessel," to the final safety analysis report (FSAR) supplement. The commitment states that the applicant will "[p]erform a 54 EFPY equivalent margins analysis for the embrittlement (upper shelf energy) of the reactor vessel N12 (instrumentation) nozzle forgings...[p]rior to the period of extended operation."

Issue

The staff is concerned that the N12 nozzles' USE may drop below 50 ft-lbs prior to the period of extended operation. The staff believes that a commitment to include submittal of the EMA for NRC staff review and approval either (i) at least 2 years prior to the estimated date[2] the N12 nozzles' USE would drop below 50 ft-lbs; or (ii) at least 2 years prior to the period of extended operation; whichever timeframe is earlier, is the conservative approach.

Request

The applicant needs to include in its LRA commitment that the N12 nozzle EMA will be submitted for NRC staff review and approval either (i) at least 2 years prior to the estimated date the N12 nozzles' use would drop below 50ft-lbs; or (ii) at least 2 years prior to the period of extended operation; whichever timeframe is earlier.

---

[1] If the N6 nozzle welds are located in the shell of the RV, as depicted in the ASME Code, Section XI, Figures IWB-2500-7(a) and IWB-2500-7(b), then the applied J integral values calculated in NEDO-32205-A for the RV shell welds, based on the ASME Code, Section XI, Appendix K calculation procedures, may be applicable to the N6 nozzle welds.

[2] Estimates concerning the time when the N12 nozzles' USE is expected to drop below 50 ft-lbs can be made based on (a) calculations of projected % decrease in USE based on bounding copper content and projected fluence, as specified in RG 1.99, Rev. 2; and (b) a determination of a reasonably conservative initial USE value for the N12 nozzles based on available Charpy USE test data for SA-508, Class 1 forgings (the forging specification for the N12 nozzles), or possible application of the lower bound 70 ft-lb initial USE value from Charpy test data for SA-508, Class 2 forgings, if it can be ascertained, based on metallurgical principles, that 70 ft-lb is a reasonably conservative initial USE for SA-508, Class 1 forgings.

RAI B.2.46-2

Background

The first sentence of LRA Section B.2.46 states: "The Reactor Vessel Surveillance Program manages the reduction of fracture toughness due to radiation embrittlement for the low alloy steel reactor vessel shell and welds in the beltline region."

Issue

The Columbia Reactor Vessel Surveillance Program manages the reduction in fracture toughness due to radiation embrittlement for all low alloy steel RV beltline components, including all ferritic RV beltline nozzles and nozzle-to-RV welds.

Request

The applicant needs to include all low alloy steel RV beltline components, including all ferritic RV beltline nozzles and nozzle-to-RV welds, into its Reactor Vessel Surveillance Program FSAR supplement and program description.

March 23, 2011

Mr. S.K. Gambhir, Vice President, Engineering
Columbia Generating Station
Energy Northwest
MD PE04
P.O. Box 968
Richland, WA 99352-0968

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE COLUMBIA GENERATING STATION, LICENSE RENEWAL APPLICATION FOR TIME-LIMITED AGING ANALYSES OF REACTOR VESSEL NEUTRON EMBRITTLEMENT (TAC NUMBER ME3058)

Dear Mr. Gambhir:

By letter dated January 19, 2010, Energy Northwest submitted an application pursuant to Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54), to renew operating license NPF-21 for Columbia Generating Station, for review by the U.S. Nuclear Regulatory Commission (NRC or the staff). The staff is reviewing the information contained in the license renewal application and has identified, in the enclosure, areas where additional information is needed to complete the review. Further requests for additional information may be issued in the future.

Items in the enclosure were discussed with Abbas Mostala and a mutually agreeable date for the response is within 30 days from the date of this letter. If you have any questions, please contact me at 301-415-3897 or by e-mail at arthur.cunanan@nrc.gov.

Sincerely,

/RA/

Arthur D. Cunanan, Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-397

Enclosure:
As stated

cc w/encl: Distribution via Listserv

DISTRIBUTION:
See next page

ADAMS Accession Number: ML110630360 ***Concurrence via email**

OFFICE	LA: DLR	PM: DLR/RPB1	BC: DLR/RPB1	PM: DLR/RPB1
NAME	IKing*	ACunanan	BPham	ACunanan
DATE	03/07/2011	03/09/2011	03/15/2011	03/23/2011

OFFICIAL RECORD COPY

Letter to S.K. Gambhir from Arthur D. Cunanan dated March 23, 2011

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE COLUMBIA GENERATING STATION, LICENSE RENEWAL APPLICATION FOR TIME-LIMITED AGING ANALYSES OF REACTOR VESSEL NEUTRON EMBRITTLEMENT (TAC NUMBER ME3058)

DISTRIBUTION:

HARD COPY:
DLR R/F

E-MAIL:
PUBLIC
RidsNrrDlr Resource
RidsNrrDlrRpb1 Resource
RidsNrrDlrRpb2 Resource
RidsNrrDlrRarb Resource
RidsNrrDlrRapb Resource
RidsNrrDlrRasb Resource
RidsNrrDlrRerb Resource
RidsNrrDlrRpob Resource

ACunanan
DDoyle
MThadani
WWalker, RIV
RCohen, RIV
LSubin, OGC