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P.O. Box 968 • Richland, WA • 99352-0968

March 16, 2005
GO2-05-054

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 ADDRESSING CHEMISTRY ISSUES ASSOCIATED WITH THE ALTERNATIVE SOURCE TERM LICENSE AMENDMENT REQUEST**

Reference: Letter dated, September 30, 2004, DK Atkinson (Energy Northwest) to NRC, "License Amendment Request – Alternative Source Term"

Dear Sir or Madam:

On February 17, 2005, Energy Northwest conducted a teleconference with representatives of the NRC Staff to discuss a request for additional information (RAI) associated with the Staff's review of the Energy Northwest Alternative Source Term (AST) License Amendment Request (LAR). The information discussed in this teleconference is provided in the attachment to this letter. The information provided should facilitate the completion of the Chemical Engineering Branch's review of the AST LAR.

No commitments are made in this submittal. If there are any questions regarding the attached additional information, please contact Mike Brandon at (509) 377-4758.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 16, 2005.

Respectfully,

WS Oxenford
Vice President, Technical Services
Mail Drop PE04

Attachment: Response to Request for Additional Information

cc: BS Mallett – NRC RIV
BJ Benney – NRC NRR
NRC Senior Resident Inspector/988C
RN Sherman – BPA/1399
WA Horin – Winston & Strawn

A001

NRC Question 1:

In the LOCA analysis portion of the LAR, credit is taken for drywell spray for the first 24 hours of the event, relative to scrubbing the drywell atmosphere. Table 4.4-6 of Attachment 1 to the LAR lists removal rates (lambda values) for various times after the initiation of the event. In Table 2 of Attachment 2 to the LAR comments are provided regarding Regulatory Guide 1.183 Appendix A Section 3.3. Please provide a more detailed discussion of the comments related to App. A Section 3.3 of RG 1.183. Include all assumptions and calculations used to determine the decontamination factor (DF), lambda values (as reported in LAR Table 4.4-6), and reduction in lambda values (10% reduction after DF= 50). Also, provide a more detailed analysis for the assumption that elemental iodine is removed at the same rate as particulate.

Energy Northwest Response:

The determination of the drywell spray lambda is found in Calculation NE-02-04-05, Section 5.5.2 Containment Spray, *Aerosol Removal Rates.* Part of this discussion is proprietary (that related to flow rate and fall height corrections), so the proprietary version must be consulted (Item 1, Attachment 6 of the September 30, 2004 submittal).

In Appendix E of the same calculation, the basis for establishing 2.44 hours as the time to reduce the particulate spray lambda by a factor of 10 (in accordance with SRP 6.5.2) is presented. Cs137 is used as a marker to determine when the DF of 50 is reached (because the half-life of Cs137 is long, the total activity of Cs137 remains essentially constant). Specifically, the results are as follows:

- Total Cs137 in DW and WW at t = 2.44 hours = 8.97E4 Ci
- Total Cs137 released = 5.05E3 Ci/MWt x 3556 MWt x 0.25 = 4.49E6 Ci
- Fraction remaining at 2.44 hours = 8.97E4/4.49E6 = 0.02 (corresponding to a DF of 50)

Treating elemental iodine removal at the same rate as particulate and with the same ultimate DF is a continuation of similar NRC-accepted AST applications (e.g., Perry – SER issued March 26, 1999). Suspended particulate provides adsorption sites for elemental iodine. It has been shown that when particulate and gaseous iodine exist in a confined space, the gaseous iodine will behave as particulate.

A 2004 EPRI Technical Report, "Iodine Behavior Within Confinement," stated the following (item 4 in Chapter 2 of the report):

"The presence of reactive aerosols within containment vessels at gram/cubic meter concentrations is a very effective sink for both HI and I_2 such that these iodine species, which may exist as vapors initially, soon behave as particulates, since the transport properties of particulates are different from those of vapors, this finding has important implications for models or computer codes, which seek to predict the time-dependent behavior of iodine within containment during severe accidents."

<u>NRC Question 2:</u>

Surveillance requirement SR 3.1.7.1 requires a minimum available volume of 4,587 gallons of sodium pentaborate solution. This volume is not considered in your determination of the suppression pool pH after SLC injection. Since the margin in the 30 day suppression pool pH calculation is only 0.3 (minimum pH=7.0, calculated pH=7.3) the relatively small volume of water in the SLC tank may have a noticeable impact on the calculated pH value. Please recalculate the final suppression pool pH considering the volume added by the SLC tank.

<u>Energy Northwest Response:</u>

The dilution of the buffer by about 0.5% has no discernable effect. Both the buffer and the strong acid are diluted, and the net result is no change in pH. Additional discussions are provided below relative to the conservatisms in the margin shown in the pH calculation. Given this level of conservatism, a recalculation was not performed.

<u>NRC Question 3:</u>

The suppression pool pH analysis in the LAR assumes 100% of the available sodium pentaborate is injected from the SLC system. The analysis states that a 100% injection will result in a final (30 day) pH value of 7.3. Calculations were also performed to determine that at least 95% of the available sodium pentaborate must be injected to achieve a final pH value above the 7.0 threshold. This means that if any more than 5% of the available SLC volume fails to inject into the reactor vessel because of leakage from the system or because it remains in the piping between the SLC pumps and the reactor vessel the post LOCA sump pH will not remain above 7 for the full 30 days. Columbia Generating Station Technical Specification (TS) Bases B3.1.7 states that only the quantity of the solution that is above the pump suction shutoff level in the borated solution tank is considered available for injection. This ensures that the minimum required volume of solution leaves the tank, however it is not conservative to assume that 100% of this volume reaches the reactor vessel. How are the systems configured to ensure that at least 95% of the sodium pentaborate solution is injected?

<u>Energy Northwest Response:</u>

The Columbia Generating Station AST LAR assumes 100% of the sodium pentaborate as originally credited for an Anticipated Transient Without Scram (ATWS) is injected. The Cold Shutdown Boron Weight (4,062.8 lbm sodium pentaborate) was conservatively assumed as the full amount of sodium pentaborate injected in the AST LOCA analysis. The volume (gallons) of sodium pentaborate solution corresponding to the Cold Shutdown Boron Weight is 3,370 gallons. This minimum Cold Shutdown Boron Volume is the current design basis for a conservative margin of sodium pentaborate solution available in the storage tank compared with the assumed volume delivered to the reactor vessel in the ATWS analysis. Energy Northwest maintained this same level of conservatism in the AST LOCA analysis.

The SLC system is designed to deliver a minimum of 4,587 gallons of sodium pentaborate solution to the reactor pressure vessel. In the AST analysis, Energy Northwest assumed 3,370 gallons was injected, which is approximately 73% of the sodium pentaborate solution that is available at the minimum level required by Technical Specifications. More sodium pentaborate would be available assuming other design levels:

- Low level net volume of 4,587 gallons (required by Technical Specifications)
- Low level alarm point of 4,682 gallons
- Low level gross volume of 4,822 gallons
- High level alarm point of 4,950 gallons
- Overflow level net volume of 5,150 gallons

The low level net volume (4,587 gallons) does not include 235 gallons of liquid between the tank bottom and the zero indicated level (below the pump suction shutoff level). The sodium pentaborate in the 235 gallons of liquid below the pump suction shutoff was considered lost and does not contribute to the 3,370 gallons assumed injected by SLC.

The SLC piping between the SLC tank and the reactor vessel is mostly 1.5" diameter. The length of the SLC injection lines is less than 300'. The volume of the SLC piping between the SLC tank and the reactor vessel, including a short section of the High Pressure Core Spray line just prior to entering the reactor vessel, is approximately 122 gallons. This volume of sodium pentaborate would not actually be injected into the reactor vessel. The 122 gallons of sodium pentaborate solution captive in the SLC injection line was not considered and not deducted from the 3,370 gallons of sodium pentaborate used in the pH calculation. This was considered acceptable given the other conservatisms noted above.

NRC Question 3 - continued:

What is a realistic value for the volume of sodium pentaborate solution injected?

Energy Northwest Response:

As stated above, Energy Northwest conservatively based the AST LOCA pH calculation on the previously approved volume of injected sodium pentaborate solution in the ATWS analysis (3,370 gallons). The minimum available volume (i.e., the minimum ensured by TS) for injection is 4,587 gallons. After deducting the approximate122 gallons that would remain in the SLC piping and not reach the reactor vessel, 4,465 gallons would be a conservative realistic value for the amount of sodium pentaborate solution injected. This is approximately 32% more sodium pentaborate solution than Energy Northwest assumed in the pH calculation. If one assumed a more realistic value, based on the low level alarm value, an additional 95 gallons would be available for injection.

NRC Question 3.A):

As part of your analysis please address the following items.

Perform analyses to conservatively estimate the volume of sodium pentaborate solution that will remain in the piping or be lost to potential leakage (not reach the suppression pool). Include an analysis of the potential for sodium pentaborate to come out of solution in the storage tank or at any point in the path to the suppression pool.

Energy Northwest Response:

As noted above, the SLC piping between the SLC tank and the reactor vessel is mostly 1.5" diameter. The length of the SLC injection line is less than 300'. The volume of the SLC piping between the SLC tank and the reactor vessel is approximately 122 gallons. This volume of sodium pentaborate would not actually be injected into the reactor vessel. This volume was ignored as it was considered small relative to the overriding conservatisms in estimating the volume of sodium pentaborate solution injected.

Loss of sodium pentaborate solution because of leakage from the system was not considered credible due to the SLC system design and testing requirements. The SLC system is an augmented quality system supported by Technical Specification testing and maintenance requirements. The SLC components and piping are included in IST and ISI programs, environmentally qualified to LOCA and seismic conditions, and included in the Maintenance Rule program. Testing requirements include quarterly pump and valve operability tests. Also, during refueling outages one loop injection is flow tested. The refueling outage tests include piping leak tests, testing of safety/relief valves, and testing of the containment isolation check valves in accordance with the IST program. No SLC system boundary leakage has been reported as the result of SLC system leakage testing. ISI visual inspections performed with the system at pressure have not noted any leakage.

The potential for sodium pentaborate to come out of solution was not considered credible due to SLC system design, solution temperature requirements, and area room temperatures during a LOCA. The saturation temperature of this solution is 63 degrees F at the low concentration (13.6%) and approximately 70 degrees F at the high concentration (15%). An electrical resistance heater system provides a heat source, which maintains the solution temperature at 81 degrees F (automatic operation) to 91 degrees F (automatic shutoff) to prevent precipitation during storage. The SLC pump suction piping is insulated and supplied with an electrical heat trace. The resistance heater and heat trace are powered from an emergency diesel backed bus (Division 2). In the unlikely event of a loss of Division 2 power (including the emergency diesel generator) concurrent with a design basis LOCA, the SLC tank solution would be greater than the boron saturation temperature at time zero and would not be expected to cool prior to SLC tank injection under accident conditions which cause the temperature in the reactor building in the vicinity of SLC tank to increase above 100 degrees F.

NRC Question 3.B):

Recalculate the 30 day pH value for the suppression pool based on the results of question (A) above.

Energy Northwest Response:

As noted in response to question 3 and 3(A) above, loss of sodium pentaborate solution because of leakage from the system was not considered credible due to the SLC system design and testing requirements. Also, the potential for sodium pentaborate to come out of solution was not considered credible due to SLC system design, solution temperature requirements, and area room temperatures during a LOCA.

A conservative value for the volume of sodium pentaborate solution injected would be approximately 32% greater than was assumed in the Energy Northwest AST LOCA pH calculation. Given this level of conservatism, a recalculation was not performed.

NRC Question 3.C):

Re-analyze assumption 6, regarding plating out of boron in the reactor vessel, considering the results of question (A) above. Does a reduction in the quantity of sodium pentaborate transported to the reactor vessel change validity of the original assumption?

Energy Northwest Response:

The plateout of boron on hot surfaces (upon spraying sodium pentaborate into a hot reactor coolant system) is not sensitive to small changes in the amounts injected.

This observation follows from the facts that (1) while a fraction of the boric acid and oxides of boron will react with the hot surfaces, (2) a significant portion of the boron will be in the form of borate salts. These two facts provide the key to understanding the lack of sensitivity to the absolute quantity of sodium pentaborate injected. While the boric acid tends to sequester by reacting chemically if sprayed onto a hot surface, the borate salts do not. This actually increases the starting pH which, per the stated justification for the assumption, more than compensates for the loss of boron due to chemical sequestering. Even with a small reduction in the amount of sodium pentaborate injected, the acid-to-salt ratio remains the same, the starting pH remains the same; and, therefore, the overall impact on the assumption justification would be negligible. Thus, the RAI 3A concern regarding the amount of boron that remains in the pipe volume (a different phenomenon from chemical sequestering) does not affect the boric acid plateout analysis.