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COLEMAN,D.W. Washington Public Power Supply System
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SUBJECT: Forwards response to NRC 990511 RAI re license request for amend to secondary containment & SGTS TSs.Results of addl benchmark of GOTHIC computer code performed to demonstrate modeling capability of drawdown response,encl.

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June 10, 1999
GO2-99-107

Docket No. 50-397

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Gentlemen:

Subject: **WNP-2, OPERATING LICENSE NPF-21**
REQUEST FOR AMENDMENT TO SECONDARY CONTAINMENT AND STANDBY GAS TREATMENT SYSTEM TECHNICAL SPECIFICATIONS (SUPPLEMENTAL INFORMATION)

Reference: Letter, dated May 11, 1999, J Cushing (NRC) to JV Parrish (SS), "Supplemental Request for Additional Information (RAI) for the Washington Public Power Supply System Nuclear Project No. 2 (WNP-2) (TAC NO. M96928)"

In the reference, the staff requested that additional information be provided to support review of our pending request for an amendment to secondary containment and standby gas treatment system Technical Specifications.

The additional information is included as Attachment 1. Attachment 2 consists of the results of an additional benchmark of the GOTHIC computer code that was performed to demonstrate its modeling capability of the drawdown response of secondary containment. Should you have any questions or desire additional information regarding this matter, please call me or PJ Inserra at (509) 377-4147.

Respectfully,

D.W. Coleman

DW Coleman
Manager, Regulatory Affairs
Mail Drop PE20

Attachments

A001

cc: EW Merschoff - NRC RIV
JS Cushing - NRR
NRC Sr. Resident Inspector - 927N
DL Williams - BPA/1399
PD Robinson - Winston & Strawn

Question 1: The WNP-2 drawdown analysis takes credit for 40 percent mixing of leakage from primary containment within secondary containment prior to processing by the standby gas treatment (SGT) system (Note (a) to Table 1 of Attachment 2 of the October 15, 1996 submittal).

a. Describe the calculation that was done with GOTHIC to derive the 40 percent mixing fraction. Was the same model (noding, penetrations, flow paths, ventilation systems in operation) used for the mixing study as for the actual drawdown analysis?

Response:

The GOTHIC computer code was not used to derive a percent-mixing fraction. As stated in Attachment 2 of our original submittal, we credited 40 percent mixing within secondary containment for purposes of calculating offsite dose consequences. This differs from the original design basis in that no mixing was credited inside secondary containment. The basis for justifying the value of 40 percent is an evaluation that used the GOTHIC computer code. The method for calculating the effects of mixing assumes 40 percent of the secondary containment free air volume is available for mixing and holdup of radioactive isotopes prior to release by means of the standby gas treatment system. [1]

The 40 percent mixing assumption is substantiated by results of the secondary building modeling using the GOTHIC computer code, with tracer xenon gas modeling, as discussed in further detail in our response to Question 3 in our December 1997 RAI response letter.[2] The 40 percent mixing volume assumption has been shown to be valid because of the passive design features at WNP-2.

The model used for the mixing analysis included a range from 0 - 40 percent mixing within secondary containment. This is the same model that was used for the drawdown analysis except that, in the drawdown analysis, the main floor areas were not subdivided into east-west sections or north-south sections. The secondary containment volume involved in the mixing analysis conservatively does not include the free air volume

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1 Letter GO2-96-199, dated October 15, 1996, PR Bemis (SS) to NRC, "Request for Amendment to Secondary Containment and Standby Gas Treatment System Technical Specifications"

2 Letter GO2-97-218, dated December 4, 1997, DW Coleman (SS) to NRC, "Request for Amendment to Secondary Containment and Standby Gas Treatment System Technical Specifications (Additional Information)"

above the refueling floor on the 606-foot elevation. This same model, except with fewer heat loads, was also the one used for the benchmark activity that is discussed in the response to Question 9 in our April 1999 RAI response letter.[3]

b. Demonstrate, by describing the flow paths available for any leakage from the primary containment to secondary containment exhaust paths, that there will be adequate mixing prior to release, that is, there will be no flow directly to the exhaust path that can remain unmixed. (Such flow is sometimes referred to as slug flow or stream flow.) In particular, address those penetrations which contribute the most to L_a.

Response:

As stated in Attachment 2 of our original submittal, the GOTHIC model for secondary containment was modified to allow injection of a tracer gas (xenon) and follow it as it disperses throughout secondary containment. The amount of tracer gas injected was equivalent to the allowable leakage of 0.5 percent by weight per day (L_a). The location selected for primary to secondary containment leakage was varied to account for the various penetration locations. The analysis showed that mixing occurred throughout the secondary containment and was independent of the elevation of the injection point of the tracer gas.

This subject is also discussed in further detail in our response to Question 3 of our December 1997 RAI response letter. As stated in the response, the model used twenty building nodes and established flow paths horizontally on each floor and vertically between floors in the building. It accounted for factors such as applicable heat loads and heat removal rates, fuel pool heatup and evaporation, emergency lighting loads, and physical air flow pathways.

The following describes the principal leakage path from primary containment. When the standby gas treatment system is in operation, the leakage from primary containment mixes with the secondary containment volume and is drawn to the vertical hatch on the south side, or to the vertical stairwells on the southeast or northwest corners.

3 Letter GO2-99-067, dated April 12 , 1999, DW Coleman (SS) to NRC, "Request for Amendment to Secondary Containment and Standby Gas Treatment System Technical Specifications (Additional Information)"

Case studies were conducted at various elevations and similar response characteristics were observed for the xenon gas concentrations at the standby gas treatment system. These elevations represented the majority of leakage paths from primary to secondary containment.

Question 2: Describe how the service water temperature is included in the GOTHIC calculation.

a. How does the assumed winter value of 77°F compare with previously measured service water temperatures?

Response:

The service water temperature was 75°F for the GOTHIC analysis input to the cases discussed in the table associated with the response to Question 8 of our April 1999 RAI response letter. The drawdown analysis discussed in our original submittal used 77°F, the most conservative value for the limiting winter case. By comparison, the standby service water temperature is typically below 45°F during the winter.

b. What is the sensitivity of the drawdown time to the service water temperature?

Response:

The drawdown time is not sensitive to changes in standby service water system temperature. Many different cases were considered in the calculation to determine which of the input parameters to the short-term model had a significant impact on the drawdown time. Two cases were analyzed where only the temperature input value was changed (i.e., from 40°F to 75°F). According to the parametric results, the time for drawdown to 0.25-inches vacuum water gauge was 495 seconds (8.25 minutes) for the 40°F input value and 575 seconds (9.58 minutes) for the 75°F value.

For comparison, selected drawdown times were also provided in our response to Question 8 of our April 1999 RAI response letter. In the letter we stated that, for all of the various atmospheric conditions considered, the winter cases yielded longer drawdown times than the summer cases. The limiting case is when the atmospheric temperature is 0°F with no wind, assuming a standby service water system spray pond temperature of 75°F, Division 2 electrical power (i.e., Division 1 fails), and one train of the standby gas treatment system in operation. The drawdown time for this case is 632 seconds (10.53 minutes).

We also stated in the letter that the most limiting drawdown analysis presented in our original submittal is based on a more conservative assumption of 50% room cooler efficiency (versus our administrative limit of 65%) and a standby service water system temperature of 77°F (versus 75°F). This resulted in a more conservative drawdown time of 711 seconds (11.85 minutes).

Question 3 The drawdown calculations assume an initial secondary containment humidity of 0 percent because the drawdown time is "somewhat" longer than with humid (less dense) air. However, NRC Information Notice 88-76 states that the effect of outside air temperature on reactor building delta-P increases as the humidity increases in the reactor building.

a. Show that assuming 0% humidity bounds the effect of outside temperature.

Response:

The winter season comprises the limiting design condition at WNP-2. The outside humidity levels at the plant are such that the pressure effect as displayed in the table of Information Notice 88-76 is generally positive rather than negative. That is why the conditions of zero degrees and zero humidity are generally worse for secondary containment drawdown than high wind conditions. In other words, the zero percent humidity leads to a good approximation of actual plant conditions. Humidity has a negligible affect on drawdown time.

For a graphical representation, please refer to the figures on pages 23 and 24 in the NRC letter that provided a summary of a February 6, 1995 meeting where we discussed our proposed change to the containment

design criteria and the amendment request.[4] These figures, which were part of our presentation to the staff, show the pressure transient analysis and containment response during winter and summer cases (for wind and no-wind conditions).

Question 4 The GOTHIC analysis assumes a flow split of 60 percent/40 percent between the upper and lower elevations. Why was this particular flow split selected?

Response:

Physical constraints of the plant determined the two paths. The proportion was based on a rough computation of the sum of the door leakage area (grade elevation), versus a sum of the seams area (above the refuel floor elevation). These values were weighted slightly more in a conservative direction for both sets of weather conditions. The flow split is 60 percent/40 percent, with the higher leakage value located in the position that results in the longest drawdown times.

This is discussed in further detail in Attachments 1 and 4 of our original submittal. As stated in the attachments, the 60 percent/40 percent leakage split conservatively places the greatest potential for leakage in the location which results in the longest drawdown time for each of the summer and winter meteorological conditions. A series of tests were also conducted during the 1990 refueling outage to characterize leakage. As expected, the empirical results of these tests indicated that the higher leakage was at the upper siding seams (above the refuel floor elevation).

Question 5 How is heat transfer from the primary to secondary containment modeled? What temperature is assumed for the primary containment?

Response:

Containment is modeled as a slab in our GOTHIC benchmark model, using thermal conductors to transfer heat. The thermal characteristics of layers of steel, air gaps and concrete were also modeled. Primary containment temperature is assumed to be 140°F. As a comparison, normal average drywell temperature is maintained below 135°F.

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4 Letter, dated March 6, 1995, JW Clifford (NRC) to Washington Public Power Supply System, "Summary of Meeting on Post-Accident Containment Response"

Question 6 Describe how wind and outside temperature conditions are modeled in the GOTHIC calculations.

Response:

The outside pressures are calculated manually and input as constants in the various boundary conditions. The temperatures are also constant conditions. The exception is the benchmark model against plant data, which used a data table of outside temperatures for model input and used other temperature data as output to the graphs.

Question 7 The GOTHIC analysis assumes that P_a is maintained for 30 days. Discuss the conservatism of this assumption. Provide a sensitivity analysis to demonstrate the conservatism of this assumption.

Response:

As stated in the response to Question 4 of our April 1999 RAI response letter, the maximum allowable leakage from primary to secondary containment is 0.5 wt%/day, which is approximately 4 scfm at P_a. This is considered negligible when compared to a standby gas treatment system flow rate of 5000 cfm and the large secondary containment volume when used for the drawdown analysis. Therefore, the GOTHIC computer model is not sensitive to P_a.

However, the leakage as a result of P_a is accounted for in the radiological analysis.

Question 8 Page 5 of 14 of the October 15, 1996, submittal states that the proposed change would increase the drawdown time from 120 seconds to 20 minutes and establish acceptable drawdown as a function of secondary containment differential pressure and SGT flow rate. A curve of acceptable region for secondary containment differential pressure and SGT flow rate is derived. The October 15, 1996 submittal states that the SGT flow rate must be greater than or equal to 5000 cfm within 2 minutes.

a. What is the purpose of this criterion (5000 cfm in 2 minutes)? How is it used?

Response:

Following a two-minute delay post-accident, the secondary containment drawdown analysis credits one standby gas treatment train operating at a minimum flow rate of 5000 cfm. This 5000 cfm flow capacity is the

primary factor in establishing the drawdown time (GOTHIC model) to 0.25-inches vacuum water gauge.

The criterion of a successful standby gas treatment system flow rate of 5000 cfm in two minutes is used to establish whether the plant is performing within the confines of the analysis.

Question 9 An equation of flow into the secondary containment as a function of the pressure drop is given in the October 15, 1996, submittal (Page 19 of 20, Attachment 3B). This curve provides regions of acceptable and unacceptable performance of the SGT. It appears that this curve is derived completely from analysis and normalized so as to give 0.25 inch water gauge at 2240 cfm. The equation appears to be based on such difficult-to-quantify items as leakage through seams in the secondary superstructure and leakage through closed doors. What confidence is there that this equation represents the behavior of the WNP-2 secondary containment and SGT system? What confidence is there that, as the condition of secondary containment leakage paths may change with time that this equation will continue to be valid?

Response:

We have confidence in the behavior of the equation prediction matching the measured results, because the equation was developed from plant data. Evaluating the change in time is the purpose of the ongoing surveillance program in the plant; it ensures that the plant is not degraded or compromised over time.

Reactor building leakage is best characterized by an equation that uses both linear and quadratic terms. The equation constants provided in our original submittal were derived using actual drawdown test data, normalized to a differential pressure of 0.25-inch vacuum water gauge at a leakage (standby gas treatment system flow) rate of 2240 cfm. Because opening of holes in secondary containment generally results in quadratic losses and the widening of seams is generally linear, only the constant for the square root term was increased to normalize the actual plant leakage rate to the allowable leakage rate of 2240 cfm. Increasing the square root constant is more conservative than increasing the linear term constant. Therefore, we have confidence that the equation will continue to be valid in the event that secondary containment leakage paths change with time.

Performance of the Technical Specification drawdown testing, and associated trending of leakage rates, provides assurance that secondary containment integrity has not degraded. Review of completed drawdown test data since 1990 shows a decline in secondary containment leakage rates from 1259 cfm to the current value of 622 cfm. This improved leakage rate is due primarily to the modifications associated with the ongoing penetration seal and Thermo-Lag rework projects, and enhanced control of the secondary containment barrier impairment process.

Question 10 Explain why the bypass leakage is being increased from 0.74 to 18 scfm (sic).

Response:

The leakage is being increased from 0.74 to 18 scfh to allow for conservatism and additional leakage. A new value was computed at containment conditions of 5 cfh, and then converted to standard conditions of 18 scfh. The value conservatively bounds bypass leakage tests performed at WNP-2 to ensure penetration functionality.

Additional detail pertaining to the modeling of secondary containment bypass leakage in our radiological model for the loss-of-coolant accident and the associated relationship to 18 scfh will be provided in our forthcoming response to a supplemental request for additional information. As discussed with the staff, a mutually agreeable date of July 16, 1999 was established for responding to the latest request for additional information.

Introduction

To further assist the staff in its review of our proposed amendment request pertaining to secondary containment and standby gas treatment system Technical Specifications, an additional benchmark of the GOTHIC computer code was performed. This attachment provides the results of a benchmark assessment of the modeling capability of the GOTHIC computer code using the drawdown pressure response of secondary containment to evaluate the model conservatism.

The benchmark assessment was specific to the pressure response present in secondary containment under the initial building conditions with normal ventilation. The model results were compared to actual plant data collected during the most recently completed drawdown surveillance test (June 1998).

Methodology

The model was developed from the secondary containment long-term drawdown model that was used for the analysis that supported our original submittal. For this benchmarking effort, modifications were made to the model to establish the surveillance test conditions for the drawdown test. The changes from the winter benchmark model (April 1999 RAI response letter) include setting the initial and boundary conditions, adding the standby gas treatment system, deleting unneeded equipment, and adding heaters for equipment in operation. The pressure drawdown response time results were compared to plant surveillance data.

Results

The table of secondary containment pressure drawdown results is presented as follows.

Cases	SGT Flow [cfm]	Drawdown Time [sec]	Leakage [cfm]
Plant Surveillance	5378	31	574
Model Test	5378	50	570

The plant data from the secondary containment drawdown surveillance indicates it only takes 31 seconds to draw down the building pressure. The GOTHIC computer model result is 50 seconds when leakage and standby gas treatment system flows approximately match the test data. This means that the model is consistent with the plant and also yields more conservative results.