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January 31, 2011
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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
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South Texas Project
Units 3 and 4
PROJ0772
Response to Request for Additional Information

Reference: Request for Additional Information re: South Texas Project Nuclear Operating Company Topical Report (TR) WCAP-17065P, Revision 0, "Westinghouse ABWR Sub-compartment Analysis Using GOTHIC", November 1, 2010

This letter addresses the following RAI questions from the reference:

RAI-4
RAI-6
RAI-7

There are no commitments in this letter.

If you have any questions on this response, please contact Scott Head at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

TO10
NRO

STI 32816529

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 1/31/2011

Mark McBurnett
Senior Vice President, Oversight and Regulatory Affairs
Nuclear Innovation North America LLC

jet

Attachments:

1. RAI-4
2. RAI-6
3. RAI-7

cc: w/o attachment except*
(paper copy)

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RAI-4

QUESTION:

SRP 6.2.1.2 requires that a nodalization sensitivity study be performed so that there is no substantial pressure gradient within a node. The applicant chose to perform a sensitivity study on the control structure building steam tunnel. In order for the staff to verify that the nodalization sensitivity study was in accordance with guidance 1) the current sensitivity study should be further performed to verify that the pressure increases will eventually converge to an upper limit and 2) perform a second sensitivity study in the reactor building steam tunnel to support the applicant's conclusion that volume would not be subject to the same inertia effects as the control structure building steam tunnel and that the pressure in the room would eventually reach the stagnation pressure of the broken pipe.

RESPONSE:

1) In order to address the first item, the current sensitivity study was expanded to verify that the pressure increases will eventually converge to an upper limit. Two noding sensitivity studies were performed in addition to those performed in Reference 1. Table 4-1 shows the impact on peak pressure of increasing the number of nodes in the control building. The peak pressures show convergence near the 8 to 10 node range.

Table 4-1 Peak Pressure as a Function of Number of Nodes

Number of Nodes	Peak Pressure (psia)
1	23.60
2	23.81
5	23.87
8	23.90
10	23.90

2) A noding sensitivity study was performed on the reactor building steam tunnel. In addition to the lumped volume case, the analysis was performed for node cases of 3, 5 and 10 in the break node of the reactor building steam tunnel. The results show that the inertia effects in the reactor building steam tunnel are comparable to those seen in the control building sensitivity studies. The reactor building steam tunnel noding study found that a pressure wave exists that results in pressure oscillations throughout the various nodes used in the study. These oscillations produce localized pressure changes based on the location of the wave and size of the node; therefore, they do not represent the average pressure observed along the entire length of the walls in the reactor building tunnel, which is the pressure sought in these analyses. The reported pressure for the reactor building portion of the tunnel is based on the midpoint of the pressure waves observed in GOTHIC, and converges to a pressure of around 23.8 psia for the 5 and 10 node cases. This pressure is lower than that

observed in the control building steam tunnel sensitivities, which converges to a pressure of 23.9 psia.

Additional studies were performed to show that when the break volume is modeled using a distributed parameter modeling approach, the pressure of the break cell approaches the stagnation pressure of the broken pipe. This was performed in GOTHIC using the Control Volume > Subdivide feature. Two sensitivity studies were performed to show the impact of this, and the pressures in the break node were on the order of several hundred psi for both cases.

The calculation which was performed to support this response is available for NRC review.

Reference

1. WCAP-17065-P, "Westinghouse ABWR Subcompartment Analysis Methodology Using GOTHIC," April 2010.

RAI-6

QUESTION

In Appendix A of the applicant's report on the ABWR subcompartment methodology using GOTHIC, the applicant provides input data. The applicant should confirm which case Table A-1, Table A-2; and Table A-3 correspond to in the applicant's analysis. The staff noted that the forward and reverse loss coefficients change with each case. Please explain the discrepancy between the ABWR DCD loss coefficients and the cases provided in Table A-1, Table A-2, and Table A-3. Also provide an explanation for how the applicant arrived at the values it used for each volume in the analysis for each case in Table A-1, Table A-2, and Table A-3 and the relationship to the volume data provided in the ABWR DCD.

RESPONSE

Table A-1, "DCD Volume Benchmark Input Table" provides the input data to the "DCD Volume Model" described in Reference 1, Section 5, Item 1. Note that a typographical error was discovered in that item description. The text should read "These models are based on the volume data provided in the DCD. DCD flow path loss coefficients are used for flow paths including the additional mechanical losses given in the DCD." Therefore, the word "without" should be removed from the second sentence in this bullet. Reference 1 will be revised to correct this typographical error.

Table A-2, "Calculated Volume Benchmark Input Table" provides the input data to the "80% Calculated Volume Model with Additional Losses" described in Reference 1, Section 5, Item 3. Table A-2 also provides the input data to the "80% Calculated Volume Model without Additional Losses" described in Reference 1, Section 5, Item 2, except that the loss coefficients are reduced by 1.7 for the following vent paths: CBST to TBST1, TBST1 to TBST2, CBST to TB, and TBST2 to TB.

Table A-3, "Steam Tunnel Analysis Model Input Table" provides the input data to the Reference 1, Section 6 representative steam tunnel analysis model.

The loss coefficients used in the ABWR DCD subcompartment analysis are shown in Tier 2, Table 6.2-4 of the ABWR DCD. In addition, Table 6.2-4a indicates that an additional "Mechanical Loss Coefficient" is used to account for the losses in some rooms for the ABWR DCD analysis. These loss coefficients, which are defined in the ABWR DCD, are used as the form losses for the Table A-1 Model (DCD Volume Benchmark) and the Table A-2 Models (80% Calculated Volume Benchmarks). Because the values in the ABWR DCD are only considered to be form losses, the Table A-1 and Table A-2 loss coefficients must then be increased to account for friction losses using Equation 2-3 of Reference 1. This is why the loss coefficients shown in the ABWR DCD do not exactly match the Table A-1 and Table A-2 values.

The loss coefficients in Table A-1 differ from those in Table A-2 due to a difference in the equivalent lengths used in the friction loss calculations for the analyses applicable to those tables. Because the room volumes change from Table A-1 to Table A-2, the corresponding flow areas also change. This change in flow areas causes a change to the inputs used in the equivalent length calculation, which is shown as Equation 2-4 of Reference 1. This accounts for the small difference between the ABWR DCD loss coefficients and those used for the benchmark analyses.

Because the representative steam tunnel configuration used in Section 6 of Reference 1 is different from that used in the ABWR DCD analyses, the loss coefficients in the ABWR DCD are not used. Instead, new loss coefficients were calculated using the approach defined in Section 2.3 of Reference 1.

The room volume input used in the Table A-1 model (DCD Volume Benchmark) is the same as that used in Table 6.2-3 of the ABWR DCD. The volumes used in the Table A-2 models (80% Calculated Volume Benchmark) were calculated by scaling the dimensions from available ABWR DCD drawings. The volumes used in the representative steam tunnel model are based on preliminary drawings of the representative steam tunnel and turbine building.

Reference

1. WCAP-17065-P, "Westinghouse ABWR Subcompartment Analysis Methodology Using GOTHIC," April 2010.

RAI-7

QUESTION:

The applicant benchmarked the GOTHIC subcompartment methodology against the ABWR DCD subcompartment analysis in Section 5. However, the applicant does not explain the differences observed between the ABWR DCD results and those in GOTHIC. Please explain the possible differences that could be causing the variation in pressure trends and peak pressure time.

RESPONSE:

The differences between the GOTHIC benchmark results and the ABWR DCD results can only be explained based on engineering judgment, because Westinghouse does not have access to the DCD analyses, which were performed by GE. It is judged that the primary reason for the difference in results is the treatment of inertia in GOTHIC versus the GE SCAM code, which was used in the ABWR DCD. SCAM is an older code, which is limited in its capability to address inertia. It is believed that the ABWR DCD analyses attempted to account for inertia using higher loss coefficients. In GOTHIC, the inertia length is explicitly modeled. Informal sensitivity studies have shown that, when inertia is not considered, GOTHIC compares favorably with the ABWR DCD results.