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DCP/NRC1148
NSD-NRC-97-5449
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Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: T. R. QUAY

SUBJECT: CORRECTED REQUEST FOR ADDITIONAL INFORMATION ON AP600 NOTRUMP VERIFICATION AND VALIDATION (RAI 440.721e)

Reference: Letter From Brian A. McIntyre to T. R. Quay, "Response to Request for Additional Information on AP600 NOTRUMP Verification and Validation (RAI 440.721e)," dated September 17, 1997.

Dear Mr. Quay:

The above reference provided the Westinghouse response to a request for additional information on the AP600 NOTRUMP Verification and Validation, part (e) of RAI 440.721. However, the question listed on the response was not part (e). Enclosed, please find a new copy of part (e) of RAI 440.721, which contains the correct question. Note that the response has not changed.

Please contact Ms. Susan V. Fanto at 412/374-4028 if you have any questions on this material.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

jml

Enclosure

cc: W. C. Huffman, NRC (w/Enclosure)
N. J. Liparulo, Westinghouse (w/o Enclosure)

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ENCLOSURE 1 TO DCP/NRC1148

RAI 440.721(e)

Question 440.721e (OITS - 5650)

(e) Explain the significance and justify the bases for any differences in the Nodalization between the two integral test facilities (OSU and SPES) and the AP600.

Response:

NOTRUMP nodalization differences among the test facility models and the AP600 SSAR plant model are a consequence of the geometries of the units. The differences in geometry which lead to different fluid node/flow link nodalizations are discussed in detail below.

The differences in PRHR heat exchanger nodalization among the SPES-2, Oregon State University (OSU) and AP600 SSAR NOTRUMP models are the result of atypicalities of the test facilities. The SPES-2 PRHR model (Reference 440.721(e)-1, Figure 7.2-2) employs four nodes to represent the full-height vertical length single tube within the IRWST, and the AP600 SSAR nodalization also uses four nodes in the vertical tube section of the PRHR heat exchanger. The horizontal length of the SPES-2 tube is very short relative to the AP600 design, so a single node in each of the SPES-2 heat exchanger horizontal sections is sufficient. The OSU facility, on the other hand, is 1/4 height scale relative to the AP600. As a result, as shown in Figure 8.2-2 of Reference 440.721(e)-1, the OSU PRHR modeling of two nodes in the vertical segment of the heat exchanger tubes is adequate to capture the liquid thermal/ gravity effects in the PRHR. In contrast, because the horizontal PRHR tube segments are consistent with (on a scaled basis) the actual AP600 design, the simulation of the OSU PRHR is made consistent with the horizontal noding of the AP600 SSAR, namely four nodes in the inlet horizontal and one in the exit horizontal segment, to validate the AP600 SSAR horizontal noding as found in Reference 440.721(e)-2, Figure 4-1.

Atypicalities of the SPES-2 facility are the reason for other differences in the SPES-2 NOTRUMP noding from that of the OSU and AP600 NOTRUMP models. Specifically, the additional piping segments used in SPES-2 to connect the hot legs and the reactor coolant pumps with the steam generator inlet and outlet plena are modeled with separate fluid nodes (nodes 110, 17, 120 and 27 in Figure 7.2-2). The equivalent nodes are unnecessary in the AP600 and OSU models. In addition, the SPES-2 downcomer is comprised of annular and tubular sections; it is modeled with three fluid nodes rather than one as used in the OSU and AP600 noding to capture the different geometric parameters. Also, to properly represent the SPES-2 piping from the accumulator to the DVI entrance pipe a fluid node is added which is not present in the OSU and AP600 modeling.

The AP600 and OSU NOTRUMP nodalizations are very similar, as befits a facility designed to specifically represent the AP600 geometry. To preserve a one-foot core node length among the three models, the OSU core has four nodes rather than the 12 nodes used in the SPES and AP600 models. Otherwise, except for the PRHR and ADS piping nodal differences specified above, the OSU and AP600 NOTRUMP models are almost identical; the exception to this is the added nodes used in the

modeling of the AP600 DVI line relative to the OSU simulation. Nodes are added to the DVI line to model a revised AP600 piping layout near the entrance to the reactor vessel from that which was simulated in the OSU facility tests.

The noding in NOTRUMP downstream of the ADS Stage 1/2/3 valves in the SPES and OSU simulations is specified according to the mass collection systems of the test facilities. Separate flow links are employed for the ADS Stage 1, Stage 2 and Stage 3 valves. The basis for the nodalization of the ADS Stage 1/2/3 valves and piping in the AP600 SSAR analysis is the VAPORE facility test simulations (Reference 440.721(e)-1, Section 5). VAPORE is a full-scale model of the AP600 sparger located under water in a simulated IRWST and of the piping connecting it to the ADS Stage 1/2/3 valve discharge. The VAPORE simulation uses separate nodes for the sparger body and sparger arms, a single flow path for the Stage 1/2/3 valves, and it also includes six nodes to model the piping from the ADS valve exit to the sparger inlet. The AP600 SSAR nodalization uses the same separate nodes for the sparger body and arms and the same single, lumped flow path for the ADS flow paths as VAPORE; five nodes are used to model the piping between the ADS valve exit and the sparger inlet because of the small differences in piping layout from the VAPORE configuration. The noding used upstream of the ADS Stage 1/2/3 valve location in the VAPORE simulation is specific to the test facility design. The SPES-2, OSU and AP600 NOTRUMP models each have a single node between the pressurizer and the ADS valve location.

Another difference in the SPES-2 NOTRUMP modeling from the other two applications is the ambient heat loss modeling described in Reference 440.721(e)-1. The high surface/volume ratio of the SPES-2 facility components and piping made detailed modeling of the heat losses with added metal nodes and heat links important in simulating the SPES-2 tests with NOTRUMP. The OSU NOTRUMP simulations used the metal node and heat link modeling approach used in the AP600 SSAR NOTRUMP analyses.

References:

440.721(e)-1: WCAP-14807, Revision 2, "NOTRUMP Final Validation Report for AP600," Proprietary, June 1997.

440.721(e)-2: WCAP-14601, Revision 1, "AP600 Accident Analyses- Evaluation Models," Proprietary, June 1997.

SSAR Revision: NONE