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Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: T. R. QUAY

SUBJECT: WESTINGHOUSE RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION ON THE AP600

Dear Mr. Quay:

Enclosed are three copies of the Westinghouse responses to NRC requests for additional information on the AP600 topics. Responses to RAIs 440.272, 440.273, 440.274, 440.276, 440.277, 440.309 and 440.324 on the LOFTRAN computer code are included in this transmittal. A response to RAI 410.291 on the SSAR Section 10 is also included.

The NRC technical staff should review these responses as a part of their review of the AP600 design. These responses close the eight RAIs.

Please contact Brian A. McIntyre on (412) 374-4334 if you have any questions concerning this transmittal.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

/nja

Enclosures

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Question 410.291

In Revision 4 of Section 10.4.9.1.2 of the SSAR, Item G, Westinghouse changed the statement to state that the startup feedwater system uses the condensate storage tank as a water supply source and deleted the statement "uses either the plant deaerator or the condensate storage tank as a water supply source" and replaced "deaerator" with "condensate storage tank" in all other related statements. However, Section 10.4.9.2.2 of the SSAR (Revision 4) states, in part, that the startup feedwater pumps take suction from either the deaerator storage tank or condensate storage tank. Explain the inconsistency in the design changes between the two sections of the SSAR.

Response:

In Revision 6 of the SSAR, sections 10.4.9.2.1 and 10.4.9.2.2 have been revised to be consistent with the first bullet of section 10.4.9.1.2. The main feedwater system and the startup feedwater system are parallel systems. The main feedwater system draws water from the deaerator tank and delivers it to the main feed rings within the steam generators. The startup feedwater system draws water from the condensate storage tank and delivers it to the startup feedwater nozzle on the steam generators. They have a manual cross-connect between their respective pumps and control valves (See SSAR Figure 10.4.7-1, sheet 3 of 4). This will allow the main feed pumps to supply water from the deaerator tank to the startup feedwater nozzles on the steam generators. A check valve (in addition to the normally closed isolation valve) in the cross-connect prevents the startup feedwater pumps from supplying water from the condensate storage tanks to the main feed header and steam generator main feed rings.

SSAR Revision: NONE

Question 440.272

Re: WCAP-14234 (LOFTRAN CAD)

How is the coverage fraction calculated between the steam generator and the fee'line during flow out the feedline, for a feedline break, with the mixture level in the two region node? Please explain.

Response:

LOFTRAN does not calculate a coverage fraction between the steam generator and feedline. Fluid discharge characteristics for mixture in the node are calculated based on input values of blowdown quality versus steam genera' r water mass.

SSAR Revision: NONE

Question 440.273

Re: WCAP-14234 (LOFTRAN CAD)

Can LOFTRAN accurately calculate steam generator level using mass inventory? Will LOFTRAN be assessed against any integral facility experimental data for steam generator level, since steam generator level response will be extremely important for RCS trip timing? Please provide the assessments and explain.

Response:

It is not necessary for LOFTRAN to calculate an actual steam generator level using the predicted steam generator mass inventory. For those non-LOCA events that rely on steam generator level signals to initiate plant protection functions, a steam generator model using the NOTRUMP computer code (Reference 440.273-1) is employed to correlate steam generator mass predictions with indicated steam generator level. The NOTRUMP computer code is a general one dimensional network code from which the spatial detail of a problem is modeled by elemental control volumes and interconnected paths. The process of using NOTRUMP to correlate steam generator mass with indicated level is an iterative one that uses LOFTRAN to analyze the plant transient and thereby define the primary system boundary conditions that affect the steam generator response.

By using NOTRUMP and LOFTRAN iteratively, bounding, event specific steam generator masses are defined that are used in the LOFTRAN model to actuate various plant protection functions. This application of the NOTRUMP code to the non-LOCA analyses is not unique to the AP600. The same methods have been applied by Westinghouse and accepted by the USNRC for licensing basis analyses at many operating Westinghouse plants (See Reference 440.273-2). The specific transient steam generator conditions predicted by NOTRUMP for the AP600 are typical of those predicted for the same accidents at operating plants.

References:

440.273-1 Meyer, P. E., "NOTRUMP - A Nodal Transient Small Break and General Network Code," WCAP-10079-P-A (Proprietary) and WCAP-10080-A (Nonproprietary), August 1985.

440.273-2 Lang, G. E. and Cunningham, J. P., "Report on the Consequences of a Postulated Main Feedline Rupture," WCAP-9230 (Proprietary), January 1978.

SSAR Revision: NONE

Question 440.274

Re: WCAP-14234 (LOFTRAN CAD)

On page 1-6 it is stated that auxiliary feed flow can be input as a function of flow versus time. Can the flow be input as a function of the steam generator pressure? Won't this be the case in the real plant? Please Explain.

Response:

On page 1-6 it is stated that auxiliary feedwater flow is simulated as a constant flow versus time after actuation. LOFTRAN does contain an option that allows auxiliary feedwater flow to be simulated as a variable flow based on pressure in any steam generator. This latter input option provides the ability to use a more realistic simulation of the auxiliary feedwater. However, the AP600 safety analysis does not employ this option. Instead, for the events that assume startup feedwater[1] actuation, a conservatively bounding flow rate is assumed. While the use of a single bounding value does produce slightly more limiting results for the safety analysis, it also greatly simplifies the interactions required to confirm that the safety analysis is conservative, relative to the plant design.

SSAR Revision: NONE

[1] As discussed on page 2-5 of WCAP-14234, the AP600 plant does not contain an auxiliary feedwater system. Instead, the plant employs a comparable non-safety related (control grade) system known as the startup feedwater system. The startup feedwater system uses pumps to provide feedwater to the steam generators for decay heat removal. Since the system is non-safety related, it is not credited in the safety analysis to mitigate the consequences of design basis transients. However, since the plant control system could actuate startup feedwater during certain events, it is modeled for those transients that would be made more severe by the startup feedwater system providing additional inventory to the steam generators.

Question 440.276

Re: WCAP-14234 (LOFTRAN CAD)

Please clarify whether double ended steam and feedline breaks are modelled with LOFTRAN for the AP-600 applications. Please provide the noding arrangements and discharge coefficients for modelling these breaks.

Response:

For the steam system piping failure event (SSAR Section 15.1.5) and the feedwater system pipe break event (SSAR Section 15.2.8) double-ended ruptures are modelled. The secondary side of the steam generator is represented by a single node. A simplified schematic of the secondary system is shown in Figure 440.276-1. In LOFTRAN, pipe breaks are not modelled using discharge coefficients. The Moody critical flow model (Reference 440.276-1) with no friction losses is used for the computation of break flow. The double-ended break flow areas for the steam system piping failure and the feedwater system pipe break are 1.4 square feet and 1.12 square feet, respectively.

Reference

440.276-1 Moody, F. J., "Maximum Flow Rate of a Single Component, Two-Phase Mixture," Transactions of the ASME, Journal of Heat Transfer, February 1965.

SSAR Revision: NONE

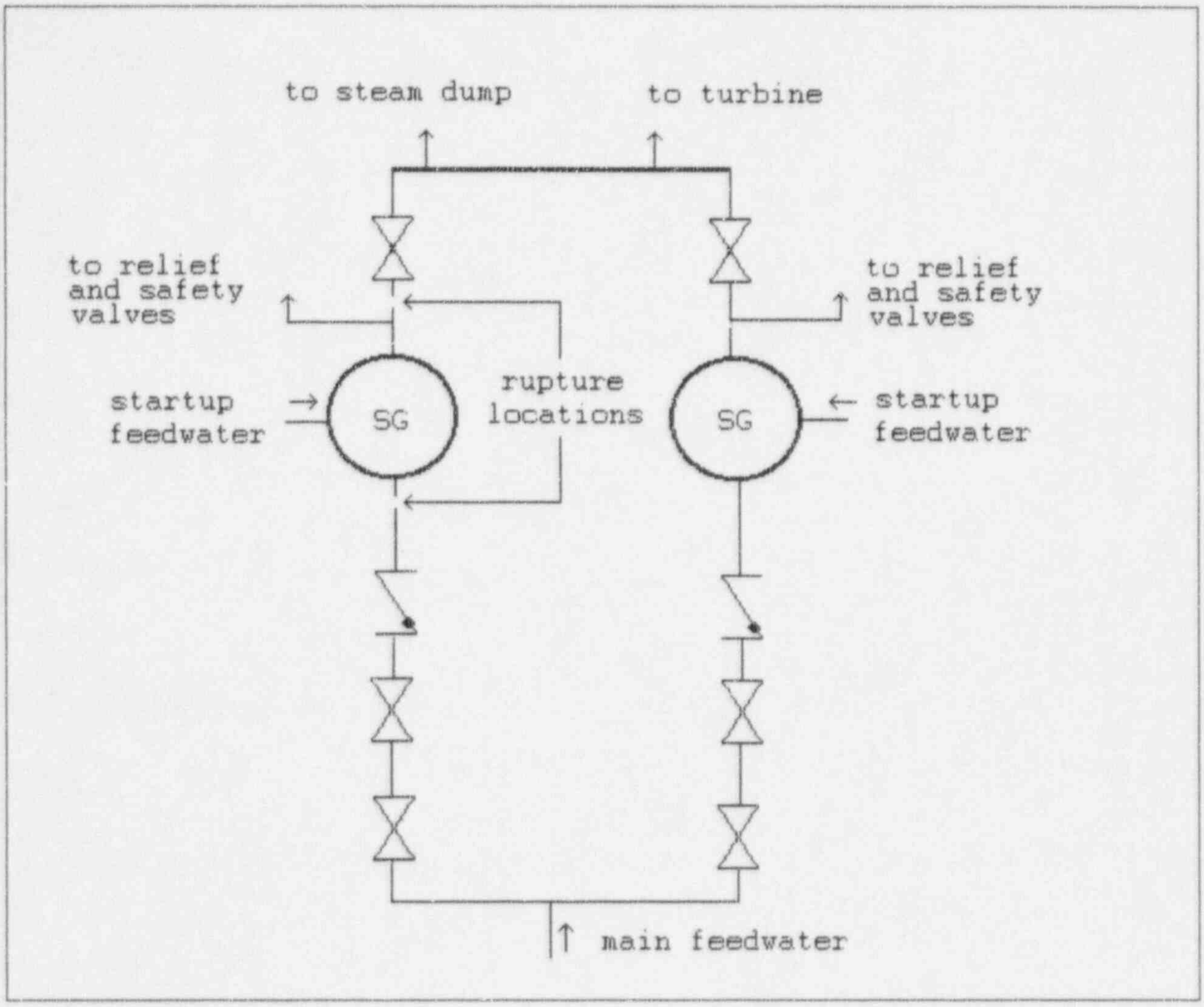

Figure 440.276-1: Schematic of Secondary System

Question 440.277

Re: WCAP-14234 (LOFTRAN CAD)

Page 1-4. It is stated that "the code calculates pressure drops around the loops based on flow rate and input loss coefficients". How does LOFTRAN insure that the local pressure drops calculated from the momentum equation are correct? Since the local pressure drops do not have a local compressibility constraint, please demonstrate mathematically that the calculated local pressures will have the right magnitude and are always positive.

Response:

Please see the responses to Questions 440.268 and 440.264.

SSAR Revision: NONE

Question 440.309

Re: WCAP-14234 (LOFTRAN CAD)

Is wall friction calculated in the head vent line and lumped in with form losses in the momentum equation? Is this done for laminar, transition, and the turbulent flow regimes?

Response:

The friction calculated in the head vent line is lumped in with the form losses for the flow calculation performed using the orifice equation. The frictional loss coefficients in the head vent line and the flow coefficient C for the orifice are calculated based on turbulent flow conditions. The overall dimensional flow resistances including form losses for each section of the reactor head vent relief path are then used as input parameters. The head vent flowrates remain in the turbulent regime for all applications of this model.

SSAR Revision: None

Question 440.324

Re: WCAP-14234 (LOFTRAN CAD)

Please explain and document the basis for the PIRT used in WCAP-14234

Response:

The PIRT found on pages 2-23 and 2-24 in WCAP-14234 is a duplicate of the PIRT found on pages 1-5 and 1-6 of WCAP 14307 (Reference 440.324-1). An equivalent question to the one above has already been answered with regard to the PIRT of WCAP-14307. Therefore, the answer to the current question can be obtained by reviewing the response provided in RAI 440.447.

SSAR Revision: NONE