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Westinghouse Electric Corporation
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ET-NRC-93-3798
NSRA-APSL-93-0009
Docket No. STN-52-003

January 19, 1993

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

ATTENTION: DR. THOMAS MURLEY

SUBJECT: NRC REQUESTS FOR ADDITIONAL INFORMATION ON THE AP600 TESTING PROGRAM DATED SEPTEMBER 1, 1992

REFERENCE: LETTER, R. C. PIERSON (NRC) TO LIPARULO (W), "RESULTS OF THE STAFF'S PRELIMINARY REVIEW OF THE PROPOSED TESTING TO BE CONDUCTED AT THE SPES-2 FACILITY," DATED SEPTEMBER 1, 1992

Dear Dr. Murley:

Please find attached with this letter information in response to the reference request for additional information (RAI). The requested information is related to the testing to be conducted by Westinghouse at the SPES-2 facility in support of the AP600 design.

The Westinghouse Electric Corporation copyright notice is also attached.

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

N. J. Liparulo, Manager
Nuclear Safety & Regulatory Activities

/nja

Attachment

cc: P. Boehnert, ACRS
F. Hasselberg, NRC
M. Modro, INEL
G. Rhee, NRC

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Attachment to Westinghouse Letter ET-NRC-93-3798

Response to September 1, 1992 Request for Additional Information Regarding the Proposed Testing to be Conducted at the SPES-2 Facility

GENERAL COMMENTS

The NRC staff reviewed a SPES-2 test matrix provided to them in June 1992 (Westinghouse letter ET-NRC-92-3713, N. J. Liparulo to Dr. T. Murley, dated June 25, 1992, "Slides From the June 1, 1992 AP600 Presentation on Integral Systems Testing"). Further review of this matrix by Westinghouse has resulted in changes. The revised matrix was discussed in a meeting with NRC on December 10, 1992 and provided in Westinghouse letter ET-NRC-92-3785 (N. J. Liparulo to Dr. T. Murley dated December 17, 1992, "Presentation Material from December 9-10, 1992 Westinghouse/NRC Meeting on AP600 Test Program"). The revised matrix adds a small break test with the interactions of the non-safety CVCS and residual heat removal systems, as well as a third steam generator tube rupture test. The double-ended guillotine break of the pressurizer/CMT balance line between the check valve and the pressurizer has been dropped from the matrix. The reason for dropping this test is that the inadvertent ADS tests, which will be performed as a part of the hot preoperational tests, will be very similar to this particular test, since both are pressurizer vapor space break tests.

(1) **NRC Request**

The NRC staff requests that Westinghouse address the 11 specific concerns ... which were identified in a January 1992 (Crutchfield to Tritch, January 30, 1992) letter. In its letters of June 22, and July 21, 1992, the staff requested additional information regarding the AP600 testing program."

Westinghouse Response

The Westinghouse response to the January 30, 1992 letter was provided in a letter from Mr. S. R. Tritch to Mr. D. Crutchfield dated February 14, 1992 (Westinghouse letter ET-NRC-92-3663, "Responses to 'AP600 Design - Issues To Be Resolved By High-pressure, Full-height Integral Testing'").

The Westinghouse response to the June 22, 1992 letter was provided in a letter from Mr. N. J. Liparulo to Dr. T. Murley dated January 19, 1993 (Westinghouse letter ET-NRC-93-0007, "NRC Request for Additional Information Related to AP600 Design").

The Westinghouse response to the July 21, 1992 letter was provided in a letter from Mr. N. J. Liparulo to Dr. T. Murley dated January 19, 1993 (Westinghouse letter ET-NRC-93-3799, "NRC Requests For Additional Information on the AP600 Testing Program dated July 21, 1992").

(2) **NRC Request**

The staff noted that Westinghouse selected a 2 inch break of a "core make-up tank (CMT)-side" cold leg as the limiting break size in terms of passive safety system response. However, analyses performed for the NRC have indicated that, in general, smaller breaks pose a greater challenge to the passive systems. Westinghouse has indicated that the minimum break size for which inventory loss through the break will exceed the capacity of non-safety system makeup is approximately 3/8 inch. Therefore, the staff requests that Westinghouse consider performing a test, modeling a break of about this size, which evaluates only the response of safety systems.

Westinghouse Response

There is a test in the test matrix which is specified as an approximately 1 inch cold leg break, to investigate the behavior of a smaller break. In the SPES-2 facility, as the break size decreases the transient becomes longer and the excess heat losses and metal heat release may begin to mask the true transient behavior. Analysis of this SPES-2 facility response for smaller breaks, approximately 1/2 inch diameter, will be investigated using RELAP-5 MOD 3 V80 to ensure that a test will provide meaningful results. If it appears that a smaller break size can be performed in the facility and yield meaningful thermal-hydraulic data, this test will replace the approximately 1 inch cold leg break currently in the test matrix.

Since the SSAR analysis was submitted, Westinghouse has analyzed a 1/2 inch cold leg break case with NOTRUMP. In comparing the 1/2 inch case to the 1 inch cold leg case, the RCS minimum inventory is lower with the 1 inch case, thus making the 1 inch CLB case more limiting. This is the basis for the 1 inch CLB case currently in the test matrix.

(3) **NRC Request**

In addition, the staff noted that the most limiting single active failure selected for all of the SPES-2 tests is the failure of one 4th stage automatic depressurization system (ADS) train. Since the availability of the large volume of water in the in-containment refueling water storage tank (IRWST) depends ultimately on depressurizing the reactor coolant system to approximately containment pressure, the staff concluded that this is a reasonable assumption. However, a quantitative assessment of a range of possible single failures to show that the one chosen is, in fact, the most limiting for the entire range of simulated accidents was not provided. The staff requests that such an assessment be performed, to ensure that the indicated single failure is the most limiting one.

Two direct vessel injection line breaks are included in the test matrix: a double-ended guillotine break of one line and a 2 inch break in one of the direct vessel injection lines. The double-ended guillotine break is classified in the matrix as an intermediate break due to the size of the direct vessel injection line (8 inch nominal diameter). Westinghouse considers this accident to be one of the most severe tests of the passive safety systems because it disables an entire train of emergency core cooling and results in a substantial loss of reactor coolant inventory. The limiting single failure is again specified as failure of one 4th stage ADS train to open.

The staff has reviewed the evaluation of the double-ended guillotine break and concluded that an analytical study should be performed to determine the worst case location for the double-ended guillotine direct vessel injection break.

The analyses discussed in the AP600 SSAR assume that this break occurs at the direct vessel injection nozzle on the reactor vessel. While this location probably maximizes inventory loss from the reactor coolant system, the core make-up tank (CMT) and accumulator can pressurize the direct vessel injection line and delay IRWST drainage for several minutes. Other locations, for which loss of IRWST fluid begins earlier in the accident, may prove to be more severe, due to reduction in IRWST inventory prior to initiation of IRWST injection.

Westinghouse Response
The purpose of the SPES-2 tests is to provide a data base to validate the SSAR codes for passive systems. The planned DVI tests, which include a double-ended guillotine break and a 2-inch break should provide sufficient validation for this break location. The staff question on a different break location can then be best answered by plant analysis. Westinghouse will perform AP600 plant analysis examining the possibility of a worst break location along the DVI line. However, for the purposes of code validation, the two DVI line tests selected in the SPES-2 test matrix should be sufficient to validate our computer codes.

(4) **NRC Request**
The 2 inch break in a direct vessel injection line should result in some degradation (but not a complete loss) of the performance of the affected emergency core cooling system (ECCS) train. However, the same limiting single failure is chosen for this test (failure of one 4th stage ADS train to open). The staff requests that Westinghouse analyze non-double-ended guillotine breaks larger than 2 inch in the direct vessel injection line and other credible single failures. A break smaller than a double-ended guillotine rupture but larger than 2 inches may result in substantial loss of reactor coolant inventory while slowing the leakage rate from the CMT. With regard to limiting failures, the staff believes that when one train of the ECCS is disabled, any failure that might degrade or eliminate part of the remaining passive safety systems prior to reaching 4th stage ADS actuation (such as failure to open of an intact-side CMT check valve or failure of an earlier stage ADS valve) could be more limiting.

Westinghouse Response
The purpose of the SPES-2 tests is to provide a data base for SSAR computer code verification, therefore, the two DVI line tests which are planned (the complete DVI line guillotine and the two-inch break) bracket the break sizes and should be sufficient to verify the SSAR analysis codes for this particular break location. Also since all valves including the check valves use parallel lines, a failure of a single check valve will not eliminate a system such as the CMT.

(5) **NRC Request**
The staff concludes that the set of small/intermediate break LOCA's, which involve pressure balance line breaks, appears adequate. These tests should provide a demanding test of the ability of the analysis codes to predict the asymmetries. The staff requests that Westinghouse (1) analyze break sizes other than 2 inch for the cold leg balance line break to see if more severe asymmetries or system degradation is predicted; and (2) perform a more comprehensive evaluation of the limiting single failure.

Westinghouse Response

As stated in the response to question 3, the purpose of the SPES-2 tests is to provide a data base to validate the SSAR computer codes. As such, the planned tests bracket the break sizes that could be postulated for the cold leg balance line and should be sufficient to validate the code for this break location. The staff request for additional calculations to find a more limiting condition for this break location are more directed at the AP600 SSAR analysis, not the SPES tests. The SPES tests for this break location and the resulting comparisons to the SSAR codes should be sufficient to validate the computer codes.

(6) **NRC Request**

Two proposed tests in the test matrix are designed to simulate a single steam generator tube rupture. The staff has concluded, based on the operating history of current generation plants, that the likelihood of a single SGTR is much greater than the probability of other design basis accidents. In addition, the response of the AP600 design to a single or multiple SGTR is unique compared to conventional plants, particularly when no credit is taken for operator action or non-safety-related equipment. Therefore, the staff requests that Westinghouse analyze and conduct testing for the most limiting, credible multiple SGTR event, determine the most limiting single failure for both single and multiple SGTR events, and include the most limiting single failure as part of the test conditions.

Westinghouse Response

The SSAR analysis considered the design basis SGTR without active systems to investigate the control and response of the plant as well as the radiological consequences of the postulated transient. The worst single failure was found to be the failure of a steam generator relief valve to be stuck open, to maximize the postulated radiological releases. This particular single failure has no meaning for a test facility like SPES-2.

Again, the purpose of the SPES-2 tests is to provide data to assess and verify the SSAR analysis codes. There are three SGTR tests planned for the SPES facility. Two tests will examine the design basis SGTR; one test with only passive systems, and one test with the availability of active systems. Also, a beyond design basis multi-tube rupture (3 tubes) test is being planned for the SPES-2 tests. This test would be performed on a best estimate basis in which credit will be taken for non-passive safety systems.

(7) **NRC Request**

The staff reviewed the proposed test to simulate a main steam line break and requests that Westinghouse determine whether there is a limiting single failure that could cause either faster CMT draining or additional CMT injection and result in reduction of the margin to ADS actuation. If such a single failure is determined to exist, it should be included in the conditions for the test to simulate a main steam line break.

Westinghouse Response

As indicated earlier, the steamline break test in SPES-2 is to provide a data base to confirm the SSAR analysis codes; not to find the worst possible set of conditions for a steamline break. The basis we are using for the SPES-2 test is the SSAR calculation for a full double-ended guillotine break which gives a very rapid cool down such that the margin to ADS activation is minimized.

The experiment would model the SSAR steamline break conditions which are also specifically chosen to minimize primary side shrinkage and minimize the margin to ADS actuation.

(8) **NRC Request**

The inadvertent ADS actuation tests in the shakedown phase of the test program do not appear in the formal test matrix. The staff has concluded that there is sufficient technical basis for including inadvertent actuation of ADS in the final test matrix. Therefore, the staff requests that Westinghouse include the inadvertent ADS actuation tests in the overall program for SPES-2. In addition, the staff requests that Westinghouse provide additional information, commensurate with that for the tests included in the SPES-2 matrix, so that the staff can more fully evaluate these tests, with respect to assumptions, safety/non-safety systems utilized, and single failure considerations.

Westinghouse Response

Since the SPES-2 test facility has known excessive metal heat due to the full height, full pressure simulation; the depressurization of the test facility may not occur over a time scale consistent with the AP600 plant. Therefore, it is planned to provide increased flow area for the fourth and if necessary, the third stage ADS valves on the SPES-2 test to compensate for the excess metal heat in the facility. We will be comparing the AP600 plant calculations with inadvertent ADS to the SPES-2 test facility response to size the valves. RELAP-5 MOD 3 V80 and/or NOTRUMP will be used for these calculations. The INEL AP600 plant model will also be used to maintain consistency with the INEL AP600 plant calculation.

The inadvertent ADS tests in SPES-2 will use the same testing approach as the matrix tests including the data quality assurance and reporting. Since these tests will establish the valve sizing for the remainder of the SPES-2 test series, they are the final tests of the hot functional test series.

These tests will be reported to the staff in a manner consistent with the other SPES-2 tests.

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