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Your ref: Project Number 740
Our ref: DCP/NRC2083

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52-06
52-14
52-15

Subject: AP1000 Long Term Core Cooling Testing/Analysis

Based on our discussions with the NRC on December 11 and 14, 2007, Westinghouse agreed to provide additional information to address several NRC concerns with Technical Report 26, revision 2. This letter discusses those plans which will:

1. Provide additional details on the screen designs. This information will be provided by 3/1/08.

2. Demonstrate by test that screen design(s) can meet the AP1000 screen pressure loss limits. This testing has been completed; the evaluation report will be provided by 3/1/08.

3. Demonstrate by evaluations and analysis that downstream effects do not adversely affect the performance of the AP1000 passive core cooling system (PXS) components or the coolability of the core. This evaluation will be provided by 3/31/08.

4. Evaluate the ITAAC provided for the AP1000 screens. This evaluation will be provided by 3/31/08.

5. Demonstrate by evaluations and analysis that there is adequate margin between the calculated / expected screen pressure losses and the safety limits for core cooling. This activity will establish design limits for the screen pressure losses. This evaluation will be provided by 4/30/08.

In the January 18, 2008 letter from NRC (D. B. Matthews) to Westinghouse (W. E. Cummins) accepting the AP1000 Design Certification Amendment application for review, NRC indicated there was insufficient design detail for the containment sump and recirculation screen designs. The letter indicated that the review schedule was dependent upon Westinghouse submittal of complete design information for the screens. The information discussed in this letter is expected to provide complete design information for staff review. The schedule commitments in the letter should permit scheduling of the NRC review. Westinghouse requests written confirmation that the sump and recirculation screens are included in the review schedule for the Revision to the AP1000 certification.

D085
D063
NRO

1. Additional Screen Design Detail:

The AP1000 DCD currently includes the following information relevant to these screens:

- Detailed P&IDs for the Passive Core Cooling System showing how the screens are connected to the ECCS (DCD Fig 6.3-2)
- Building drawings showing screen locations (DCD Fig 6.3-6, -7, -8, -9)
- Screen design descriptions and design requirements (DCD Section 6.3.2.2.7)
- Screen design parameters (DCD Table 6.3-2)
- Containment equipment insulation design requirements (DCD Section 6.3.2.2.7.1 item 3)

Additional screen design detail has been provided in TR-147 which will be referenced from the DCD. This TR will be revised to include additional detail to allow the NRC to determine the acceptability of the AP1000 LTC.

2. Screen Testing:

Tests were performed in January 2008 to demonstrate that a screen design can be used for the containment recirculation and the Incontainment Refueling Water Storage Tank (IRWST) injection screens in the AP1000 that will have acceptable pressure losses.

The testing used a section of screen that would be used in both the containment recirculation screens and the IRWST screen applications. AP1000 post LOCA conditions were used to establish the flow rates, velocities and debris amounts used in the tests. The flow rates through the test screen section were scaled to bound the front face velocities that both screen applications would see during accident conditions. The debris used in the testing included resident fiber and particles as well as chemical precipitants based on the AP1000 design. Three tests were conducted. In the first test the resident fiber and particles were scaled based on the screen front face area and the chemical precipitants were scaled to achieve the same concentrations that would be seen post accident in the AP1000. In the other two tests the amounts of debris and chemicals were increased to levels above the AP1000 design basis amounts to demonstrate that there were no cliff effects. In all three tests a contiguous fiber bed did not form and the pressure losses were the same as the clean screen tests.

A report will be prepared describing the screen design tested and the test facility / methods / results. This report will be referenced in the DCD. These test results demonstrate that there is essentially no increase the screen head loss due to post LOCA debris loading because of the large screen areas, low flow rates and low debris loadings.

3. Down Stream Effects:

TR-26, revision 2, provides a description (pages 16-18) of the evaluation that Westinghouse is performing for downstream effects. These evaluations include:

- Ex-Vessel Downstream Effects Evaluation – This evaluation is discussed on page 16 of TR-26. The methods from WCAP-16406-P will be used to evaluate the effect on plugging and erosion of inline components (valves, pipe, ...). The applicability of this WCAP to AP1000 is addressed in TR-26. Note that the simple passive system recirculation flow path eliminates most of the equipment that may be adversely affected by debris because the AP1000 PXS does not include any pumps, throttle valves or orifices. This characteristic combined with the relatively light loading of debris in the containment suggests that there would be no adverse affects due to debris bypassed by the recirculation screens.

- In-Vessel Downstream Effects Evaluation – This evaluation is discussed on page 17 of TR-26. The methods from WCAP-16793-P will be used to evaluate the potential for deposition of chemical products on the fuel cladding and the consequential effects on clad temperature. The applicability of this WCAP to AP1000 is addressed in TR-26. Note that the small amount of post-LOCA chemical effects associated with the AP1000 compared to current PWRs, it is expected that the chemical deposition of post-LOCA chemical effects on fuel cladding for the AP1000 will be less than those predicted in the sample calculation of WCAP-16793-NP.

TR-26 will be revised to include this evaluation. Note that the potential for fiberous / particle debris entering the reactor and causing flow blockage has already been evaluated in TR-26.

4. Screen ITAAC:

Tier I of the AP1000 DCD provides several ITAACs related to the Containment Recirculation and IRWST screens. These ITAACs are found in ITAAC Table 2.2.3-4 item 8.c) vii) and viii). Item vii) addresses the plates located just above the screens that prevent debris from entering the water close to the screen inlet. Item viii) addresses the minimum screen surface areas.

ITAAC item viii) will be reviewed and as necessary, changes will be proposed to Tier I of the DCD. TR-26 will be revised as necessary to include any proposed ITAAC changes.

5. Core Cooling Margin:

Westinghouse will provide an evaluation of the impact of increased screen pressure loss caused by debris accumulating on the Incontainment Refueling Water Storage Tank (IRWST) injection line screens, the containment recirculation screens, and the core inlet structures / components. This evaluation will include calculating the impact on post LOCA containment recirculation flow rates and on cooling of the core.

- A substantial pressure loss across the screens due to debris accumulation will be assumed; this pressure loss will be selected to provide reasonable margin to the pressure loss measured across the screens during the testing performed in item 2.
- The impact of these increased pressure losses on post LOCA recirculation flow rates will be calculated.
- The impact, if any, of the degraded recirculation flow rates on core cooling will be calculated.

The objective of this evaluation is to demonstrate that there is adequate long-term core cooling margin to remove decay heat and maintain a coolable geometry as identified in 10 CFR 50.46. It is anticipated that the AP1000 with its large screen designs and relatively low debris loadings will allow the use of relatively low screen design pressure loss limits which will result in LTC performance that is very similar to that currently provided in DCD section 15.6.5.4C.

A new TR will be used to transmit this information. This TR will include a DCD markup to address the allowable screen pressure loss.

Westinghouse would welcome the opportunity to discuss this letter with the staff.

Very truly yours,

W E Cummins

W. E. Cummins
Vice President
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