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Your ref: Docket No. 52-006
Our ref: DCP_NRC_002823

March 18, 2010

Subject: AP1000 Response to Request for Additional Information (SRP 6)


Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 6. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in this response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following RAI(s):

RAI-SRP6.2.2-SRSB-25 R1

Questions or requests for additional information related to the content and preparation of this response should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,


Robert Sisk, Manager
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/Enclosure

1. Response to Request for Additional Information on SRP Section 6

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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 6

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Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.2-SRSB-25
Revision: 1

Question:

During the NRC staff audit (in the Westinghouse office, September 17 and 18, 2009) of the AP1000 long-term cooling sensitivity analysis associated with APP-PXS-GLR-001, Revision 1, "Impact on AP1000 Post-LOCA Long Term Cooling of Postulated Containment Sump Debris," the staff identified the following items, which required follow-up actions.

- a. In CN-LIS-04-40/APP-SSAR-GSC-681, Appendix B-3, there appears to be an inconsistency in that the sump water temperature input to the WCOBRA/TRAC long-term cooling analysis was lower than the output from the WGOthic containment analysis after 9,300 seconds. Clarify the apparent inconsistency.
- b. The WGOthic calculation of the containment conditions was performed based on the assumption of the fan coolers in operation, which resulted in the lower containment pressure, as well as lower sump water temperature. While lower containment pressure is conservative for the long-term cooling analysis, lower sump water temperature may be non-conservative. Provide an evaluation to demonstrate the assumption of the fan coolers in operation is limiting for the long-term cooling analysis.
- c. The head loss of the IRWST screen debris blockage would result in potential hold-up of water in the IRWST and reduced water level in the sump and the PXS room. This phenomenon was not accounted for in the long-term cooling sensitivity analysis. Provide an evaluation and/or reanalysis of the sensitivity case #3 (with the head loss of 14 inches for the IRWST and recirculation screens and 15 feet for the core fuel assembly inlet) with the consideration of water holdup in the IRWST.

Westinghouse Response:

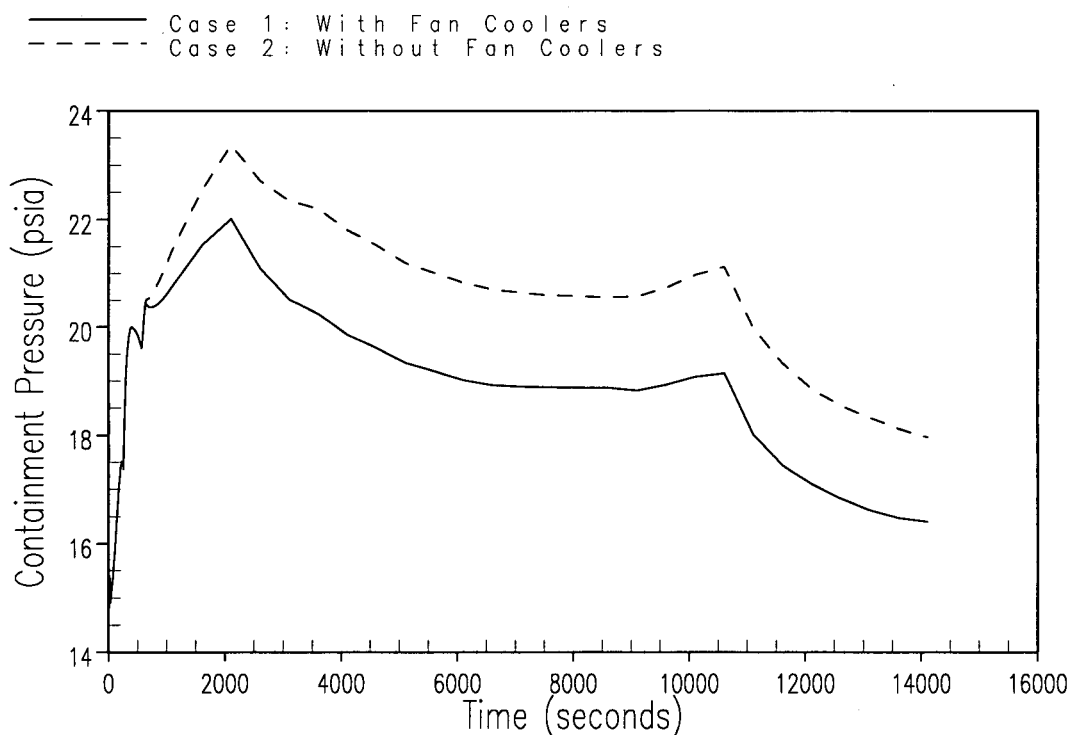
- a. The subject WGOthic containment analysis case was executed using corrected revised input documented in APP-SSAR-GSC-682 Rev. 1, and this case predicts sump water temperatures within 1F of the corresponding values presented in CN-LIS-04-40/APP-SSAR-GSC-681, Appendix B-3 after 9300 seconds. The boundary conditions for WCOBRA/TRAC that result from this WGOthic case are minimally different from those referenced in CN-LIS-04-40/APP-SSAR-GSC-681, Appendix B-3, and applied in the sensitivity cases of APP-PXS-GLR-001, Revision 1. The minimal differences do not affect the conclusions of APP-PXS-GLR-001, Revision 1.

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- b. APP-SSAR-GSC-682 Rev. 1 discusses the effects on temperature and pressure associated with the containment response with and without fan coolers in operation. From Figure 1 (taken from APP-SSAR-GSC-682 Rev. 1) the differences in containment pressure are displayed. The case with fan coolers in operation clearly depicts a lower containment pressure which has already been established as conservative for the LTCC analyses.

Figure 1: Containment Pressure with and without Fan Coolers in Operation



Additionally Figure 2 depicts the west loop compartment temperature differences associated with and without fan coolers in operation. Figure 3 lists the east loop compartment temperature differences. From Figures 2 & 3 it can be seen the temperature difference is between 2-4 °F. This magnitude of temperature difference does not impact flow as much as the approximate 2 psi pressure reduction associated with fan coolers in operation. This is why Revisions 14, 15, 16, and 17 of the DCD LTCC analyses incorporate operation of fan coolers in containment as it has previously been determined to be the bounding scenario for containment response with respect to LTCC.

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Figure 2: West Loop Compartment Temperature with and without Fan Coolers in Operation

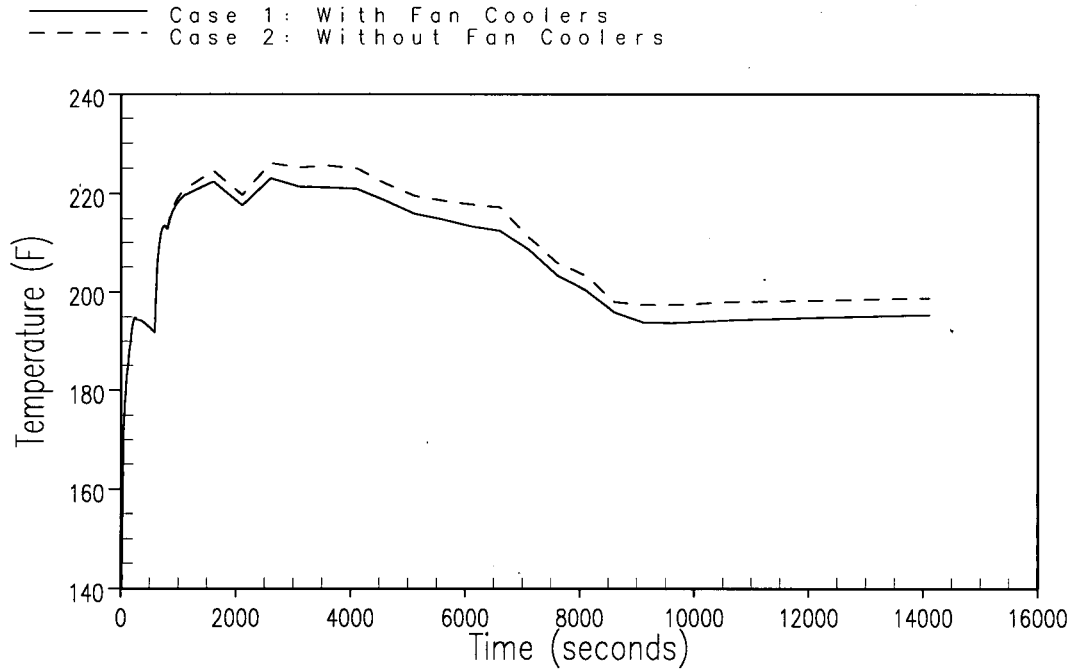
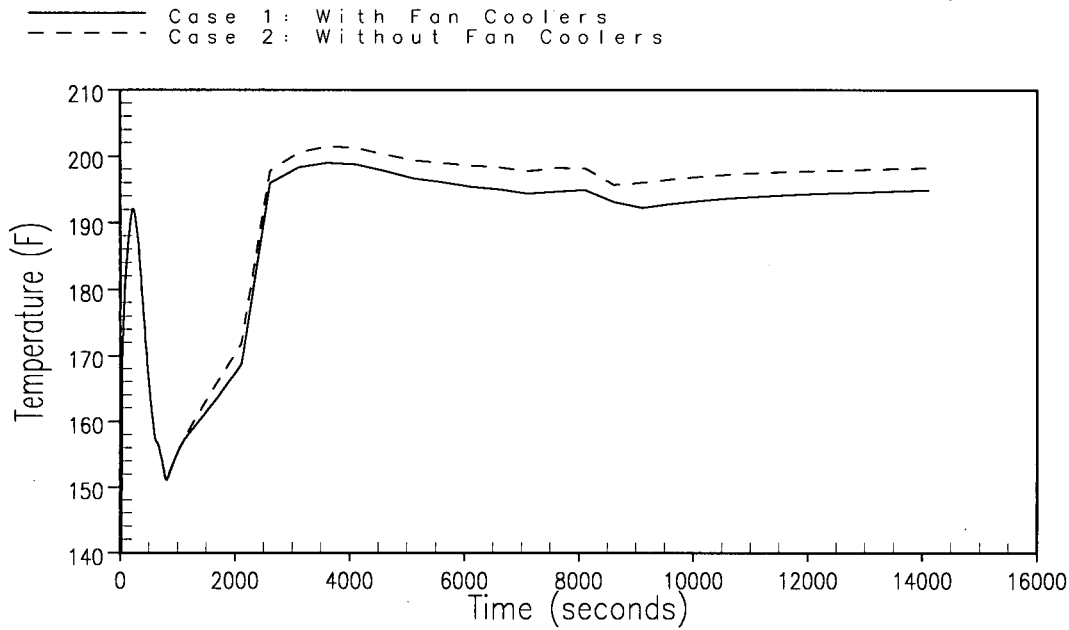


Figure 3: East Loop Compartment Temperature with and without Fan Coolers in Operation



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- c. The LTCC sensitivity case 3 water level was at approximately 107.8' to represent the initial containment flood level at the beginning of recirculation. This is more than 4 feet above the bottom of the IRWST and covers the whole IRWST screen surface area. Whether or not there is head loss across the IRWST, this level will not change. The screen head loss will effect the pressure available to drive PXS flow. There will be no water hold up resulting from debris loading across this screen.

For the wall to wall flooding case with the PXS rooms flooded after approximately 14 days the containment flood level reduces to 103.7'. This is at the bottom of the IRWST. RAI-SRP6.2.2-SPCV-23 provides a detailed explanation and a corresponding calculation for the quantified reduction in core flow resulting from reducing the containment flood elevation to increase the level in the IRWST to ½ the IRWST screen height.

RAI-SRP6.2.2-SPCV-23 also provides a detailed explanation of the effects of the collapsed liquid level above the core, reduced containment flood elevation, and reduced core flow rate as it applies due to this "hold up" of water in the IRWST. Additionally, the above mentioned RAI provides sufficient justification that no adverse impact to LTCC results from this condition.

Additional Question: (Revision 1)

During the NRC staff audit (in the Westinghouse office, September 17 and 18, 2009) of the AP1000 long-term cooling sensitivity analysis associated with APP-PXS-GLR-001, Revision 1, "Impact on AP1000 Post-LOCA Long Term Cooling of Postulated Containment Sump Debris," Revision 0 of this RAI addressed the initial follow up actions. Revision 1 will address the below mentioned additional follow up actions regarding Revision 0 issuance of this RAI.

- a. Why was a new WGOthic calculation necessary?
- b. Where the original calculation was used and if it was replaced with the new calculation in all instances, such as all DCD analysis.
- c. If the new calculation was used as boundary conditions in other WCOBRA/TRAC calculations, please identify any differences in results using the different boundary conditions.

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Additional Westinghouse Response: (Revision 1)

- a. The following excerpt from APP-SSAR-GSC-682 Rev. 1 specifies the necessity to re-perform the analyses in APP-SSAR-GSC-682 Rev. 0:

- “ 1. The calc-note number for Reference 2 was incorrect.
2. The wrong WGOthic files were attached to the calc-note.”*

From the excerpt contained above the correct “Reference 2” refers to CN-CRA-1-71 “Long Term Cooling Containment Response.” The Westinghouse corrective actions process was used to document the errors and to track the issue to resolution. Revision 1 of APP-SSAR-GSC-682 was written to satisfy an action item in the corrective actions process. One of the original WGOthic files that should have been attached to Rev. 0 of APP-SSAR-GSC-682 could not be found and was recreated.

Additionally, the WGOthic calculation was redone to perform the *quantitative* evaluation to determine whether fan coolers in operation or fan coolers not operable provides the limiting conditions for this transient to satisfy the conditions of question B in Rev. 0 of this RAI.

- b. From the Westinghouse Response to part A of Rev. 0 of this RAI:

“The subject WGOthic containment analysis case was executed using corrected revised input documented in APP-SSAR-GSC-682 Rev. 1, and this case predicts sump water temperatures within 1F of the corresponding values presented in CN-LIS-04-40/APP-SSAR-GSC-681, Appendix B-3 after 9300 seconds. The boundary conditions for WCOBRA/TRAC that result from this WGOthic case are minimally different from those referenced in CN-LIS-04-40/APP-SSAR-GSC-681, Appendix B-3, and applied in the sensitivity cases of APP-PXS-GLR-001, Revision 1. The minimal differences do not affect the conclusions of APP-PXS-GLR-001, Revision 1.”

Cases 1-3 in APP-PXS-GLR-001 (All Revisions) and the DCD analysis depicted in Section 15.6.5.4C used the boundary conditions presented in APP-SSAR-GSC-681 Rev. 0. However, APP-SSAR-GSC-682 Rev. 1 re-performed these analyses according to the methodology contained in WCAP-15846, and the difference in the respective boundary conditions is listed in Table 1. Table 1 shows the calculated percent difference of the thermo-physical properties just prior to recirculation (density and enthalpy) for water in a sub-cooled environment (20psia) related to the values used in Appendix B-3 for Sump Temperature from APP-SSAR-GSC-681 Rev. 0 as compared to the values found in APP-SSAR-GSC-682 Rev. 1. From Table 1 the differences in the values are all less than 1% for all relevant thermo-physical properties. Based on the magnitude of the percent differences displayed in Table 1,

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Westinghouse has determined the impact to be insignificant and does not effect the conclusions of the above mentioned analyses.

Table 1: Thermo-physical Property Comparison (* denotes values from APP-SSAR-GSC-682 Rev. 1)

	681 Rev. 0	682 Rev. 1*							
Time	Temp	Temp*	%diff	Enthalpy (Btu/lbm)	Enthalpy* (Btu/lbm)	%diff	Density (lbm/ft ³)	Density (lbm/ft ³)*	%diff
9114.61	194.389	193.047	0.690	162.511	161.163	0.829	60.254	60.286	0.052
9615.64	194.349	193.467	0.454	162.471	161.585	0.545	60.255	60.276	0.034
10091.50	194.601	193.813	0.405	162.724	161.932	0.487	60.249	60.268	0.031
10617.10	194.945	194.089	0.439	163.069	162.210	0.527	60.241	60.261	0.033
11142.60	194.948	194.307	0.329	163.072	162.429	0.395	60.241	60.256	0.025
11593.00	195.016	194.476	0.277	163.141	162.598	0.332	60.240	60.252	0.021
12118.50	195.097	194.653	0.227	163.222	162.776	0.273	60.238	60.248	0.017
12644.30	195.171	194.814	0.183	163.296	162.938	0.220	60.236	60.244	0.014
13094.90	195.233	194.943	0.149	163.359	163.067	0.178	60.235	60.241	0.011
13620.60	195.303	195.091	0.108	163.429	163.216	0.130	60.233	60.238	0.008

- c. The containment boundary conditions applied in WCOBRA/TRAC Sensitivity Cases 4 through 11 presented in APP-PXS-GLR-001 Rev. 4 are based on the new WGOthic calculation. Since these cases were performed solely using these containment boundary conditions, there are no differences that exist to be identified.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None