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Your ref: Docket No. 52-006
Our ref: DCP/NRC2283

November 4, 2008

Subject: AP1000 Response to Request for Additional Information (SRP6.2.1.1)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 6.2.1.1. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in the response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

A response is provided for RAI-SRP6.2.1.1-SPCV-01 through -04 as sent in an email from Billy Gleaves to Sam Adams dated August 18, 2008. This response completes all requests received to date for SRP Section 6.2.1.1. A response for RAI-SRP6.2.1.1-SPCV-05 was provided under letter DCP/NRC2269 dated October 1, 2008.

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
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Enclosure

1. Response to Request for Additional Information on SRP Section 6.2.1.1

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K1RO

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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 6.2.1.1

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.1.1-SPCV-01
Revision: 0

Question:

APP-GW-GLR-134 Rev. 5 reduces the initial containment temperature used in the external pressure analysis in DCD Section 6.2.1.1.4 from the technical specification maximum of 120°F to a "conservatively calculated" 69°F. Provide details of the analysis that was used to calculate this new internal temperature. Include assumptions and explain why the result is conservative. In order for the staff to perform confirmatory calculations, provide the heat transfer coefficients assumed at the external and internal surfaces of the containment, baffle, and shield building, and the heat loads into the containment atmosphere. Specify whether or not operational leakage was included as a heat source.

Westinghouse Response:

It is not physically possible for the containment temperature to be 120°F during normal operation when the environment temperature is -40°F. To determine the operating temperature of the containment atmosphere, the AP1000 WGOTHIC model was used. These conditions were used as the initial conditions to determine the maximum pressure decrease transient. The WGOTHIC model is the same as is used to determine containment pressure and temperature response to accidents and normal operating conditions.

For accident analysis, the heat transfer coefficients inside and outside the containment are biased low to maximize the resulting temperature and pressure. For minimum pressure analyses, the heat transfer coefficients are biased high to minimize the temperature and pressure. For this case, nominal heat transfer coefficients are assumed since it would be inconsistent to assume a low bias to maximize the initial pressure and a high bias to minimize the transient pressure.

The following assumptions were used in this analysis

Heat source = heat losses at operating reactor power = 26167 Btu/s

External air temperature = -40°F

The heat transfer coefficients are calculated by WGOTHIC.

htc - inside containment shell = 7.73 Btu/hr-ft^2-°F

htc – outside containment shell = 2.22 Btu/hr-ft^2-°F

htc – inside baffle = 2.22 Btu/hr-ft^2-°F htc – outside baffle = 2.2 Btu/hr-ft^2-°F

htc – inside shield building = 2.2 Btu/hr-ft^2-°F

htc – outside shield building = 1.14 Btu/hr-ft^2-°F

Reference:

APP-MV50-Z0C-020, Rev. 0, Thermal Analysis of the AP1000 Containment Shell Under Cold Conditions

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.1.1-SPCV-02
Revision: 0

Question:

APP-GW-GLR-134 Rev. 5 changes the limiting event of the containment external pressure analysis of DCD Section 6.2.1.1.4 from loss of ac power during operation at low ambient conditions to inadvertent actuation of fan coolers at low ambient conditions. Explain why the change was made and which event is more conservative. Explain why the selected event is more limiting than a sudden decrease in ambient temperature.

Westinghouse Response:

A sudden decrease in ambient temperature from 120°F to -40°F was found to result in a pressure change of approximately -2.9 psid. This is not a physical possibility. Instead, an assessment was made to determine what the limiting initiating event is that results in the largest pressure reduction from operating conditions. For currently operating plants with fan coolers and containment sprays, this event is an inadvertent actuation of both of these systems. For AP1000, there is no credible way for the containment spray to actuate. Therefore, the limiting event is an inadvertent actuation of the fan coolers from operating conditions at very cold conditions. This was determined to be more limiting than the loss of ac power at cold conditions, and is consistent with what is done for operating plants.

Structural engineering determined that the event resulting in the largest pressure decrease at the coldest conditions is limiting for the containment structural analysis. It is overly conservative to combine a large step change in ambient temperature with a coincident worst-case event, so it was determined that the worst-case event coincident with the worst case ambient temperature would be sufficiently conservative.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.1.1-SPCV-03
Revision: 0

Question:

APP-GW-GLR-134 Rev. 5 revises the containment external pressure analysis of DCD Section 6.2.1.1.4 by changing the limiting event and reducing the initial containment temperature. In order for the staff to perform confirmatory calculations, provide the heat removal capability of the containment fan coolers, the heat transfer coefficients assumed at the external and internal surfaces of the containment steel vessel, baffle, and shield building, and the heat loads into the containment atmosphere. Address the fact that the WGOTHIC model described in Chapter 13 of WCAP-15846 is conservatively biased to maximize containment pressure, whereas the WGOTHIC model used in this analysis should be conservatively biased to minimize containment pressure.

Westinghouse Response:

The WGOTHIC model was updated to perform a transient analysis with an inadvertent actuation of the fan coolers as the initiating event. The fan coolers are designed to cool the containment during normal operation so that the temperature is less than the high temperature limit of 120°F. The fan coolers are most effective when there is a large temperature difference between the heat sink (chilled water system) and the containment atmosphere. The fan coolers cannot operate at containment temperatures that are colder than the chilled water. For this analysis, the fan coolers are assumed to operate at 100% capacity at 120°F, and 0% capacity at 32°F. So for an initial containment temperature of 69°F, the fan coolers are operating at 42% of full capacity which is 26167 Btu/s.

The heat transfer coefficients are similar to what was calculated for the steady state analysis:

External air temperature = -40°F

The heat transfer coefficients are calculated by WGOTHIC.

htc - inside containment shell = 7.73 Btu/hr-ft^2-°F

htc – outside containment shell = 2.22 Btu/hr-ft^2-°F

htc – inside baffle = 2.22 Btu/hr-ft^2-°F

htc – outside baffle = 2.2 Btu/hr-ft^2-°F

htc – inside shield building = 2.2 Btu/hr-ft^2-°F

htc – outside shield building = 1.14 Btu/hr-ft^2-°F

As was explained in Reference 2, the heat transfer coefficients were not biased since it would be necessary to bias low to maximize the operating containment temperature for the initial condition, and biased high to minimize the containment pressure for the transient portion of the calculation.

Reference(s):

1. APP-MV50-Z0C-020, Rev. 0, Thermal Analysis of the AP1000 Containment Shell Under Cold Conditions

2. RAI-SRP6.2.1.1-SPCV-01

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.1.1-SPCV-04
Revision: 0

Question:

The external pressure analysis in DCD Section 6.2.1.1.4 assumes a steady 48 mph wind. Provide the basis for this assumption and describe the calculations and assumptions which were made to determine the effect of wind on the external containment vessel heat transfer.

Westinghouse Response:

The AP1000 passive containment cooling system is a "wind positive" design. This means that the velocity in the cooling annulus between the containment shell and the air baffle increases as the external wind speed increases. For the analysis in DCD Section 6.2.1.1.4, a wind speed was chosen to provide a conservative estimate of the heat transfer coefficient on the external surface of the containment shell. In reality, the air velocity in the annulus is not strongly dependent on the external wind speed due to the more restrictive air inlets for the shield building to defend against aircraft crash.

Thus, the external wind speed is not a large contributor to the air velocity in the cooling annulus in the WGOTHIC model, and the external shell heat transfer coefficient is not significantly affected by this assumption.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None