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Your ref: Docket No. 52-006
Our ref: DCP/NRC2469

May 13, 2009

Subject: AP1000 Response to Request for Additional Information (SRP 9)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 9. 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-SRP9.2.1-SBPA-05 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,

D. A. Lindgren /FOR

Robert Sisk, Manager
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/Enclosure

1. Response to Request for Additional Information on SRP Section 9

D063
NRO

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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 9

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP9.2.1-SBPA-05
Revision: 1

Question:

Tier 2 of the DCD, Sections 9.2.1.1.2 and 9.2.1.2.3.3, reflects an increase in the maximum allowed SWS cooling water temperature being supplied to the CCS heat exchangers during normal power operation, from a value of 31.7 °C (89 °F) to 34.2 °C (93.5 °F). This is not the same as the maximum SWS supply temperature of 31.4 °C (88.5 °F) that is specified in Tier 2 of the DCD, Section 9.2.1.2.3.4, for plant cooldown/shutdown. This change is not discussed or explained in the information provided, and it is not clear how the SWS can perform its defense-in-depth and RTNSS functions if the SWS supply temperature exceeds the limit that is assumed for shutdown cooling.

Describe in Tier 2 of the DCD the basis and justification for the proposed increase in the maximum allowed normal operating SWS supply temperature and how the specified temperature limit is assured to be satisfied by COL applicants during plant operation. Include consideration of additional provisions that should be included in IPSAC 2.4, as appropriate.

Westinghouse Response:

Westinghouse increased the AP1000 maximum safety non-coincident wet bulb temperature from 81°F to 85.5°F by issuance of TR-108. In order to accommodate the Levy site environmental parameters within the AP1000 design envelope, a further increase in the value of this parameter was recently made. The revised maximum safety wet bulb temperature has now been increased to 86.1°F. The maximum normal non-coincident wet bulb temperature limit remains 80.1°F.

The AP1000 CCS heat exchanger is sized using the SWS cold water supply temperature resulting from cooling tower operation at the maximum safety non-coincident wet bulb condition, because this condition has a higher likelihood of occurring during power operation. The SWS cold water temperature is based on the predicted cooling tower approach to wet bulb (ATWB) for the SWS full power heat load. Recent information obtained from prospective cooling tower suppliers indicates that ATWB is no greater than 5.5°F for this condition at 86.1°F wet bulb.

The maximum safety wet bulb temperature value is specified for the AP1000 in Tier 1 Table 5.0-1 and Tier 2 Table 2-1. With the increased wet bulb temperature of 86.1°F and 5.5°F ATWB, expected cold water temperature is 91.6°F. It should be noted that TR-108 used a conservative value of 8°F for the SWS cooling tower ATWB to determine the cold water temperature of 93.5°F (88.5°F + 8°F) reported in that document.

The effects of the increase in the maximum safety non-coincident wet bulb temperature on the performance of safety-related and non-safety related systems are discussed in detail in TR-108

(for the increase to 85.5°F) and in forthcoming DCD impact document APP-GW-GLE-036 (for the further increase to 86.1°F). There is no deleterious effect on safety-related system performance associated with the increase of the maximum safety wet bulb temperature to 86.1°F, and the performance of non-safety (Defense In Depth and Investment Protection) systems was found to be acceptable with this increase in maximum safety ambient wet bulb temperature.

The AP1000 safety-related and Defense In Depth / Investment Protection analyses which use the maximum safety wet bulb temperature as a basis for determining performance include:

- Passive containment cooling system (DCD Section 6.2.2)
- IRWST cooling using RNS heat exchangers (DCD Sections 5.4.7.1.2.1 and 5.4.7.1.2.3)
- Normal full power operation of the Component Cooling System (DCD Section 9.2.2.1.2.1)

The low capacity chilled water system is a non-safety Defense In Depth / Investment Protection system, and uses the maximum safety dry bulb temperature of 115°F as a basis for determining performance. It is therefore not affected by the change to SWS and CCS temperature caused by the increased maximum safety wet bulb temperature.

All other design cases for the CCS and SWS, including the maximum cooling tower heat duty case (RNS cooldown of the plant beginning 4 hours after shutdown) and the various SFS pool decay heat removal cases, use the maximum normal non-coincident wet bulb temperature as a basis; the 0.1°F increase in the value of this parameter is a minimal increase and has little effect on predicted system performance.

The SWS cold water return temperature of 88.5°F for cooldown, referenced in DCD Section 9.2.1.2.3.4, was based on the use of an 8°F approach to wet bulb in the cooling tower, and the application of an additional margin on wet bulb temperature of 0.5°F (80°F + 8°F + 0.5°F = 88.5°F). For the 0.1°F increase to 80.1°F discussed in TR-108, the expected cold water temperature will be 88.6°F. An 8°F ATWB is consistent with the performance of the SWS cooling tower with the higher cooldown heat loads to be dissipated in this condition.

As noted in TR-108, there is sufficient margin in the system and component design to accept this slight increase in cold water temperature without change to the AP1000 cooldown design basis. This same conclusion applies to the use of the revised SWS cold water temperature of 88.6°F for determining the acceptability of all other analysis cases described in the DCD that rely upon the CCS and SWS for cooling of components.

References:

1. APP-GW-GLN-108, 'AP1000 Site Interface Temperature Limits', TR-108, Revision 2
2. APP-GW-GLE-036, 'Impact of A Revision to The Current Wet Bulb Temperature' Revision 0 (to be submitted)

Additional Westinghouse Response based on NRC comments at 3/18/09 meeting:

The staff asks Westinghouse to explain how [the SWS defense in depth and RTNSS] functional capabilities are assured for those periods when humidity is at its maximum. The difference in the cooling water temperature values in TR-108 stems from the use of a less conservative wet bulb temperature for the most limiting SWS defense-in-depth function (plant cooldown with concurrent spent fuel cooling). Address [the defense in depth and RTNSS] functional capabilities of the SWS over the full range of plant operating conditions. Explain the use of maximum normal versus maximum safety values - why the maximum safety (noncoincident) wet bulb temperature is specified for normal operation, and the maximum normal wet bulb temperature is specified for other cases.

Westinghouse Response:

The maximum safety non-coincident wet bulb temperature is evaluated for the normal power operation and IRWST cooling using RNS heat exchangers, due to investment protection considerations during these modes. The normal power operation mode which uses one train of CCS and SWS provides the limiting case for the CCS heat exchangers and experiences the greatest temperature increase to the component cooling water. CCS temperatures must be maintained within limits set by the design of major equipment such as the Reactor Coolant Pumps or CVS makeup pumps, even if the maximum safety non-coincident wet bulb temperature is experienced. Similarly the IRWST boiling must be avoided even during the maximum ambient temperatures, since it may result in damage to equipment within containment.

The maximum normal non-coincident wet bulb temperature is evaluated for normal cooldown with two trains of CCS and SWS operating; higher ambient temperatures will not impact safety or investment protection, and would only result in an extended cooldown. The RTNSS function of providing CCS cooling of the RNS heat exchanger during reduced inventory operation is not significantly affected by a minor increase in ambient wet bulb temperature. As long as cooling is provided by the CCS/SWS, passive safety system actuation is not required. Spent fuel cooling during refueling does not require evaluation at the maximum safety wet bulb temperatures because it is bounded by the normal power operation case. Although the spent fuel heat loads are higher during refueling, the reduction in CCS heat duty from the shutdown of other CCS users results in a lower CCS supply temperature. Since the CCS is capable of maintaining spent fuel temperature requirements under normal operation, it is assured that elevated temperature will not prohibit cooling during refueling. Similarly, the normal power operation evaluation indicates that CVS makeup pump temperature requirements are not exceeded; this case is bounding and assures makeup pump protection for all operating modes.

An error was noted in the original RAI response; the 93.5 °F SWS temperature is based on an 8 °F approach added to the maximum safety ambient wet bulb temperature of 85.5 °F, rather than 88.5 °F.

Design Control Document (DCD) Revision (Revision 0, 1):
DCD Revision 16, Tier 1 Table 5.0-1 and Tier 2 Table 2-1 (sheet 1 of 3) (Changes are already included in DCD Rev 17)

PRA Revision:
None

Technical Report (TR) Revision (Revision 0, 1):
APP-GW-GLE-036 is being submitted to supplement TR-108 and to describe the impact of the further increase in maximum safety non-coincident wet bulb temperature from 85.5°F to 86.1°F