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Your ref: Docket No. 52-006
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May 13, 2009

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-SPCV-12
RAI-SRP6.2.2-SPCV-13
RAI-SRP6.2.2-SPCV-14
RAI-SRP6.2.2-SPCV-17
RAI-SRP6.2.2-SPCV-18
RAI-SRP6.2.2-SPCV-19
RAI-SRP6.2.2-CIB1-20
RAI-SRP6.2.2-CIB1-21
RAI-SRP6.2.2-CIB1-22
RAI-SRP6.2.2-CIB1-23

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

Robert Sisk, Manager
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/Enclosure

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

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NRO

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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 6

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.2-SPCV-12
Revision: 0

Question:

In the calc notes referenced in RAI-SRP6.2.2-SRSB-06, the limiting break selection was based on surface area without taking into account the debris loading, which can vary by orders of magnitude depending on the surface type. Considering this and the RAIs on Min-K, miscellaneous debris, coatings, chemicals, and transport, how is it known that the selected breaks bound all other breaks in presenting the greatest challenge to the screens and core?

Westinghouse Response:

The AP1000 approach to determining the amount of latent debris that might be inside the containment and how much might transport has been revised as discussed in RAI-SRP6.2.2-SRSB-05 and RAI-SRP6.2.2-SPCV-15. The revised approach conservatively assumes that all of the latent debris inside the containment can be transported to the containment recirculation screens. In addition, it is conservatively assumed that 50% of the latent debris could be potentially transported to the IRWST screens.

In addition, with respect to other debris, the AP1000 approach is to prevent LOCA debris generation or transport to the screens.

In RAI-SRP6.2.2-SRSB-06, the break-selection criteria for AP1000 differs from that for existing plants. The break selection criterion delineated in the current Revision of TR26 is not being considered as this criterion strictly dealt with maximum proportional debris transport from various line breaks. Currently, Westinghouse assumes *all* debris is transported to the recirculation screens in a LOCA, so the break selection criteria in TR26 will be removed and a brief description will be provided to explain how the conservative assumption that all latent debris is transported to the screens.

The analyzed break locations are bounding with respect to Min-K, miscellaneous debris, coatings, chemicals, and transport because:

- For AP1000, *all latent* debris in containment is assumed to transport to the recirculation screens. In addition, 50% of all the latent debris is assumed to transport to the IRWST screens. These conservative assumptions eliminate the need (as is the case with existing plants) to evaluate different break locations causing varied amounts of debris generation and transport.
- As discussed with the NRC during the March 20, 2009 AP1000 Long-Term Cooling Debris Issues meeting, Westinghouse proposes to use high-density coatings where required which would not be subject to dissolving in the post LOCA conditions on engineering components, equipment tags, signs, etc. inside containment which are within the zone of influence for a LOCA break, or below the maximum containment

flood level. This will ensure debris generated from a LOCA associated with coatings on these components will prohibit transport to the containment recirculation screens, IRWST screens, or into a CL LOCA break that becomes submerged during recirculation. The change to the ITAAC in DCD Section 2.2.3-4 is included in APP-GW-GLE-002 Rev. 2 and addresses coatings on the above mentioned components. The change to DCD Section 6.1.1.6, 6.1.2.1.5, and Table 6.1-2 is also included in APP-GW-GLE-002 Rev. 2 and addresses the specifications on coatings applied to engineered components, equipment signs, tags, and other equipment labeling components. These changes will be incorporated in the Revision 2 update to APP-GW-GLE-002, "Impacts to the AP1000 DCD to Address Generic Safety Issue (GSI)-191," to be provided to the NRC by May 8, 2009.

- No LOCA breaks will occur that can generate debris transportable to the containment recirculation screens, IRWST screens, or into a CL LOCA break that becomes submerged during recirculation. Any Min-K that is located within the ZOI will be MRI or suitable equivalent so as not to generate debris under jet loads. The zones of influence are delineated in the DCD Section 6.3.2.2.7.1. Additionally APP-GW-GLE-002 includes a markup of Section 6.3.2.2.7.1 which clearly defines the ZOI, and explains the meaning of "suitable equivalent" with regards to MRI. The following excerpt was taken from the current revision (Rev. 17) of the DCD:

> "*Metal reflective insulation is used on ASME class 1 lines because they are subject to loss-of-coolant accidents. Metal reflective insulation is also used on the reactor vessel, the reactor coolant pumps, the steam generators, and on the pressurizer because they have relatively large insulation surface areas and they are located close to large ASME class 1 lines. As a result, they are subject to jet impingement during loss-of-coolant accidents. A suitable equivalent insulation to metal reflective may be used. A suitable equivalent insulation is one that is enclosed such that LOCA jet impingement does not damage the insulation and generate debris or one that may be damaged by LOCA jet impingement as long as the resulting insulation debris are not transported to the containment recirculation screens.*"

> "*In order to provide additional margin, metal reflective insulation is used on lines that are subject to jet impingement during loss-of-coolant accidents that are not otherwise shielded from the blowdown jet. As a result, fibrous debris is not generated by loss-of-coolant accidents. Insulation located in a spherical region within a distance equal to 20 inside diameters of the LOCA pipe break is assumed to be affected by the LOCA when there are intervening components, supports, structures, or other objects. In the absence of intervening components, supports, structures, or other objects insulation in a cylindrical area extending out a distance equal to 45 inside diameters from the break along an axis that is a continuation of the pipe axis and up to 5 inside diameters in the radial direction from the axis is assumed to be affected by the LOCA.*"

Design Control Document (DCD) Revision:

DCD Tier 1 and Tier 2 markups (Section 6.1.1.6, 6.1.2.1.5, 6.3.2.2.7.1 and Table 6.1-2) will be delineated in APP-GW-GLE-002 Rev. 2.

PRA Revision:

None

Technical Report (TR) Revision:

Revision 3 of TR26 will be revised to include explanation to eliminate break selection criteria as described above.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.2-SPCV-13
Revision: 0

Question:

a. Per the response to RAI-SRP6.2.2-SRSB-03(b), the AP1000 applies the MRI degradation characteristics from the NRC Safety Evaluation (SE) of NEI 04-07 Guidance Report. Specifically, what degradation characteristics, by percentage and size, are assumed for the AP1000 MRI?

b. The response to RAI-SRP6.2.2-SRSB-03(c) stated the maximum liquid velocity toward the sump screen is 0.072 ft/s. What is the source of this value?

c. What are assumptions on transport of degraded MRI to IRWST screen? Include the maximum liquid velocity available to move MRI toward the IRWST screen.

d. The response to RAI-SRP6.2.2-SRSB-03(e) states that there are no other materials that would become LOCA generated debris. What size ZOI was used in the supporting analysis and what piping was it applied to? Explain why cable insulation, signs, caulking, and other instrumentation don't generate debris either as particulates or as sacrificial screen area.

e. The response to RAI-SRP6.2.2-SRSB-03(g) references DCD Section 6.3.2.2.7.1 item 3, which requires MRI in a specified ZOI. Per the SE, this ZOI is conservative for MRI insulation, but non-conservative for Min-K insulation. Justify this departure from SE guidance.

f. DCD Section 6.3.2.2.7.1, Item 10 states that other potential sources of fibrous material such as ventilation filters or fiber producing fire barriers are not located in jet impingement damage zones or in the flood up regions. What is the physical definition of these jet impingement damage zones or flood up regions?

Westinghouse Response:

a. From "NEI 04-07 PRESSURIZED WATER REACTOR SUMP PERFORMANCE EVALUATION METHODOLOGY" AP1000 is classified as a highly compartmentalized containment and would be susceptible to 25% of MRI fines to be ejected into the upper containment where they would not be expected to transport due to low velocity flow from the dome rainout. NEI 04-07 SER states MRI is destroyed at 75% fines, 25% large pieces. 'Small Fines' are defined as debris able to pass through the largest openings of the gratings, trash racks, and radiological fences, which are less than a nominal 4 inches. Debris that cannot pass through these barriers is classified as large pieces.

b. The source of the maximum velocity is a calc note performed by Westinghouse on the containment recirculation screens. One of the outcomes of this calculation note is the water velocities approaching these screens. The key assumptions for calculating the maximum water velocity approaching the containment recirculation screens are:

- The maximum flow through the CR screens is with normal residual heat removal system (RNS) pump operation. Both pumps are assumed to operate without throttling with the RCS at atmospheric pressure. The pump flow is < 2400 gpm total.
- All of this flow is assumed to pass through the CR screens. For this to happen, the break location must be a hot leg break and the RNS heat exchanger must be effectively cooled. With these assumptions, the RNS quickly sub-cools the RCS and terminates steaming. With no steaming, the passive containment cooling system quickly condenses the steam in the containment and ends the flow of condensate to the IRWST. Once this occurs, the IRWST level decreases until it equalizes pressures at the piping tee between the IRWST line and the containment recirculation line and no flow leaves the IRWST. This situation is not a limiting core cooling case because of the higher injection flow rates and lower injection temperatures, but is limiting with respect to the maximum flow through the CR screens.
- The two CR screens are cross-connected with the two PXS subsystems such that there is always flow through both CR screens.
- The MRI debris will be on the containment floor at the time recirculation begins because of the long settling time between the accident and the start of recirculation (>2 hours).
- The face area of the CR screens is listed in the ITAAC as 105 ft^2/ screen. Since both screens always operate, the available area is 210 ft^2. The velocity through the screen face at the maximum flow (2400 gpm) would be 0.025 ft/sec.
- The water approaches the CR screen from two general areas. One is from the loop compartment where the CR screens are located. The other is from the other loop compartment through the corridor that interconnects the two loop compartments.
    - The water that flows through these two paths comes from the ADS stage four valves.
    - Two ADS 4 valves are located in each loop compartment.
    - With a single failure there may only be 3 ADS 4 valves operating.
    - The max flow through the corridor occurs with two ADS 4 valves open in the other loop compartment and one open in the loop compartment with the CR screens.
    - The minimum flow area approaching the CR screens from the corridor is about 49.5 ft2.
    - With 2/3's the total flow (1600 gpm) and this area, the velocity would be 0.072 ft/sec.

In summary the maximum velocities available to move MRI fines is 0.072 ft/sec (in the corridor) and 0.025 ft/sec at the screen face.

c. MRI is constructed of stainless steel. Tests reported in NUREG/CR-6808, "Knowledge Base for the Effect of Debris on Pressurized Water Reactor Emergency Core Cooling Sump Performance," demonstrate that MRI damaged by LOCA tests will settle and require more velocity to transport than will occur in AP1000. These tests indicate that a velocity of 0.2 ft/s is required to move ½" x ½" crumpled foil MRI debris; larger velocities are required to move larger MRI debris. The AP1000 will have a liquid velocity less than 0.154 ft/s available to move MRI toward the IRWST screens; note that this maximum velocity is calculated with the maximum flow rate and at the face of the pockets. The velocity drops very rapidly at distances from the face of the screens. The key assumptions in calculating this velocity include:
- Maximum flow rate through one IRWST screen to the RCS is 1548 gpm. This flow occurs during a DVI LOCA when one screen feeds an intact DVI line and the other is spilling to the containment through the break. The flow through the faulted line is not considered in this evaluation since it would be non-conservative to have debris transported to the associated screen and reduce the spill flow rate.
- The MRI will settle to the IRWST floor well away from the screens because the gutter discharge point is away from the screens and close to the IRWST floor (refer to the response to RAI-SRP6.2.2-SPCV-15 Rev. 0 part b).
- The flow area is the face area of one IRWST screen as listed in the ITAAC plus the elevation of the bottom of the screen above the tank floor (6"). The screen face area in the ITAAC is $20ft^2$ (reference DCD, Tier I, Table 2.2.3-4, item viii. The area added for the 6" elevation is > 2.4 feet. The total is the sum of the two or 22.4 feet.

In summary the maximum water velocities approaching the CR and IRWST screens are less than the minimum required to move MRI fines:

Screen	Location	Flow (gpm)	Area (ft2)	Velocity (ft/sec)	Velocity Limit (ft/sec)
CR	Screen face	2400	210	0.025	0.2
CR	Corridor	1600	49.5	0.072	0.2
IRWST	Screen face	1548	22.4	0.154	0.2

d. As discussed in the March 20th update meeting, the primary approach for preventing such materials being transported to the screens is that they will be made from materials that will settle out (steel, high density coatings) or they will be located outside the ZOI. The zone of influence for insulation is defined in DCD Section 6.3.2.2.7.2. It is proposed that this same ZOI be used for these other materials. The ZOI is:

"Insulation located in a spherical region within a distance equal to 20 inside diameters of the LOCA pipe break is assumed to be affected by the LOCA when there are intervening components, supports, structures, or other objects. In the absence of intervening components, supports, structures, or other objects insulation in a cylindrical area extending out a distance equal to 45 inside diameters from the break along an axis that is a continuation of the pipe axis and up to 5 inside

diameters in the radial direction from the axis is assumed to be affected by the LOCA."

e. No departure from NRC guidance is required. The requirements specified in the AP1000 DCD Section 6.3.2.2.7.1 item 3 specify that MRI or a suitable equivalent be used within the ZOI. The "or suitable equivalent" is defined in the DCD "is one that is enclosed such that LOCA jet impingement does not damage the insulation and generate debris or one that may be damaged by LOCA jet impingement as long as the resulting debris are not transported to the containment recirculation screens".. The Min-K will be enclosed in stainless steel and seal welded such that it will not be damaged and generate debris.

f. The response to question d. defines the applicable LOCA jet ZOI. The maximum containment floodup elevation is being added to the DCD in section 6.3.2.2.7.1, item 3 (refer to APP-GW-GLE-002, Revision 2).

Design Control Document (DCD) Revision:

DCD Rev. 17 Section 6.3.2.2.7.1 will be changed to quantify the containment maximum floodup elevation. The proposed markups to the DCD can be found in APP-GW-GLE-002 Rev. 2

PRA Revision:

None

Technical Report (TR) Revision:

APP-GW-GLE-002 Rev. 2 has been revised to include the specified DCD changes denoted above.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.2-SPCV-14
Revision: 0

Question:

a. The basis for the latent debris composition (85% particulate, 5% coatings, 10% fiber by volume) was found in a calc note referenced in the response to RAI-SRP6.2.2-SRSB-05(a). Because this basis is not consistent with SE recommendations, describe the methodology in docketed communication and substantiate the technical basis.

b. The response to RAI-SRP6.2.2-SRSB-05(b) stated the reference plants were chosen based on their cleanliness programs. From operating experience, plants with similar cleanliness programs reported a wide range of walk down latent debris. Why were only these three plants selected to be representative and why were other operating plants rejected as being representative? What physical characteristics of the selected plants justify their use as reference plants for the AP1000?

c. The amount of debris in the "bounding" and "sensitivity" cases discussed in the response to RAI-SRP6.2.2-SRSB-07(a) is larger than the amount tested in the head loss experiments. Justify how the debris loads in these cases are demonstrated to be acceptable.

d. The response to RAI-SRP6.2.2-SRSB-07(a) includes the following: "This is about 50% more debris than is typically seen in operating plants based on walk down data." Please explain the source of this statement, as it does not appear to be consistent with publicly available information on latent debris.

e. The staff has reviewed the information in the calc-notes referenced in RAI-SRP-6.2.2 SRSB-07(b). In order to make a finding that the calculations are reasonable and bounding, additional docketed information is required. Please provide methodology of latent debris evaluation including treatment of vertical surfaces and sacrificial area. Provide details regarding walk downs from sample plants on debris collection methodology including number of samples per surface type, statistical analysis of samples, characterization of surface types, scale accuracy, efficiency factors, treatment of inaccessible areas and plant condition during survey. Document conservatisms or explain why results are bounding. When methodology differs from SE recommendations, justify the approach used.

f. Identify the types, locations, and quantities of insulation used inside containment outside of the ZOI.

Westinghouse Response:

a. As noted in the Revision 1 response to RAI-SRP6.2.2-SRSB-05, Westinghouse is proposing to increase the total latent debris to 150 lb with 8 lb of fiber which has the potential to transport to the screens. The response RAI-SRP6.2.2-SRSB-05, Revision 1 provides the justification for this amount of latent debris and fiber.

b. As noted in the Revision 1 response to RAI-SRP6.2.2-SRSB-05, Westinghouse is proposing to increase the total latent debris to 150 lb with 8 lb of fiber which has the potential to transport to the screens. The response RAI-SRP6.2.2-SRSB-05, Revision 1 provides the justification for this amount of latent debris and fiber.

c. As noted in the Revision 1 response to RAI-SRP6.2.2-SRSB-05, Westinghouse is proposing to increase the total latent debris to 150 lb with 8 lb of fiber which has the potential to transport to the screens. Testing assuming this amount of debris is currently on-going and will be provided to the NRC in Revision 1 to WCAP-16914, "Evaluation of Debris Head Loss Tests for AP1000 Recirculation and IRWST Screens," and Revision 1 to WCAP-17028, "Evaluation of Debris Loading Head Loss Experiments Across AP1000 Fuel Assemblies," by June 15, 2009. Additionally, APP-GW-GLR-079 (TR 26), Revision 4, "AP1000 Verification of Water Sources for Long-Term Recirculation Cooling Following a LOCA," will be updated with the revised debris composition.

d. Please see Revision 1 response to RAI-SRP6.2.2-SRSB-05, which provides a table of walkdown data. Please note Westinghouse is proposing to increase the total latent debris to 150 lb with 8 lb of fiber which has the potential to transport to the screens; therefore this statement no longer applies.

e. As noted in the Revision 1 response to RAI-SRP6.2.2-SRSB-05, Westinghouse is proposing to increase the total latent debris to 150 lb with 8 lb of fiber which has the potential to transport to the screens. Information on walkdown data is also provided in Revision 1 to RAI-SRP6.2.2-SRSB-05. This resident debris and fiber is assumed to all be transportable to the containment recirculation screens. 60% of the debris is assumed to be transportable to a submerged break location. The 60% value for debris is based on the flow distribution discussion provided in the Revision 1 response to RAI-SRP6.2.2-SRSB-10.

f. The AP1000 DCD has requirements that require that MRI or a suitable equivalent be used within the ZOI (see DCD section 6.3.2.2.7.2). This prevents a LOCA jet from damaging insulation and generating debris that could be transported to the screens. As a result, the insulation used outside the ZOI is not important to safety.
Currently non-MRI insulation permitted within containment that is below the maximum flood up region and outside the ZOI are:

Nuclear grade fiber glass blanket and rigid cellular glass insulation systems are permitted. However, fiber glass blanket insulation systems shall not be used in areas where their dislodgement may compromise drainage into the containment sump system.

Additionally, the insulation design specs indicate the majority of insulation in containment will be MRI or equivalent as most of the RCS piping are within the ZOIs and below the maximum containment flood elevation.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

WCAP-16914 Rev. 1, WCAP-17028 Rev. 1, APP-GW-GLR-079 Rev. 4 Proposed document Revisions will tentatively be completed by 5/22/09.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.2-SPCV-17
Revision: 0

Question:

a. In order for COL applicant to demonstrate their cleanliness program is consistent with the evaluation discussed in DCD subsection 6.3.8.2, add the following to the DCD: bounding quantities of the fiber and particulate components of latent debris transported to either screen, bounding quantities for each type of insulation or other potential sources of fiber producing materials in a physically defined ZOI and flood up region, bounding quantities for each type of other miscellaneous debris (signs, tags, tape) in a physically defined ZOI and flood up region, bounding quantities of each type of coating and chemical precipitating materials, limits on storage of material or other large debris inside containment, bounding flow rates through recirculation and IRWST screens.

b. How will the items identified above be incorporated into COL Information Item 6.3.8.1?

c. How will the items identified in (a) be included in ITAAC?

d. DCD states the screen mesh is at least 0.125", while TR26 uses a 0.0625" mesh in the downstream evaluation. Clarify the design mesh size and explain how it will be included in ITAAC.

e. DCD Section 6.3.2.2.7.2 states a trash rack on the IRWST gutter prevents large debris from clogging the gutter. What grid size is used on this trash rack and how will this be included in ITAAC?

f. The ITAAC cited in the response to RAI-SRP6.2.2-SRSB-03(f) requires that a metal reflective insulation or equivalent be used on specific components. It seems that this ITAAC only addresses a portion of the insulation ZOI. How will the remainder of the ZOI be included in the ITAAC?

g. The response to RAI-SRP6.2.2-SRSB-05(b) references sample plants that could be used as models for COL applicants' containment cleanliness programs. What key aspects of these cleanliness programs are relevant and how will this be communicated to COL applicants.

Westinghouse Response:

a. The COL item (6.3.8.1) revision is specified in APP-GW-GLE-002 Rev. 2. The revision specifies total latent debris to be ≤150lbs. and the portion of the total that can be fiber is specified to be ≤8 lbs. RAI-SRP6.2.2-SPCV-12 addresses the physical definition of the

ZOI quoting the DCD *verbatim.* RAI-SRP6.2.2-SPCV-16 part (a) addresses the approach velocities for the containment recirculation screens

b. See answer to (a).

c. It is not appropriate for an ITAAC to address a COL program, so the cleanliness program aspects of item (a) will not be addressed in an ITAAC. An ITAAC will be created to address signs and tags that are permanently installed in the plant. The ITAAC (Table 2.2.3-4 Item x) will require these items to be made of materials that will settle out or specified to be outside of the ZOI and below the maximum flood elevation (109.42 ft).

d. The design mesh size is 0.0625". DCD sections (6.3.2.2.7.2 & 6.3.2.2.7.3) will be updated to specify screen mesh size ≤0.0625".

e. The trash rack is a screen with a mesh size of 0.45" ± 0.05". The gutter runs continuously around the containment which makes it about 400 feet long. The only debris that might challenge this screen is expected to be MRI insulation generated by LOCA jets which would be limited in amount and location. Considering the long length of the gutter, such debris would only potentially prevent an insignificant fraction of the water (400ft x (4/12)ft x (3/12)ft = 33.33 ft^3) from entering the gutter. The 33.33ft^3 volume reduction associated with complete blockage of both IRWST gutter collection box discharge piping corresponds to an IRWST level of approximately 0.013 ft (this assumes the best estimate IRWST floor surface area of 2578.6 ft^2). The impact of such blockage would be to divert a small portion of this water to the containment recirculation screens. Due to the much larger size of these screens there would be no adverse impact on long-term cooling performance. As a result it is not proposed to provide an ITAAC on this screen at this time.

f. The ITAAC (Table 2.2.3-4 Item ix) will be revised to add a statement that MRI or equivalent insulation will also be required in the ZOI.
   - The DCD (Section 6.3.8.1) will be modified to include requirements on cleanliness programs. The minimum requirements are specified but not limited to: Total latent debris will be limited to 150 lb.
   - Total latent fiber debris will be limited to 8 lb with cleanup of specific fiber delineated as "priority".
   - Maintenance tools and scaffolding will not be stored inside containment if they can add to physical or chemical debris. AP1000 has implemented several features to assist with this requirement.
     1) Installed platforms to decrease necessity of temporary scaffolding.
     2) Eliminated many pieces of equipment inside containment.
     3) RCPs have no planned maintenance.
     4) Storage area is provided just outside containment.

These minimum requirements will be implemented through FME controls coincident with Containment Inspections.

g. Item (f) clearly specifies the requirements on total latent debris, and where in the DCD it will be delineated. The key aspects of cleanliness programs are labeled 1-4 in response (f). These aspects will be implemented through application of FME controls and containment inspections.

Design Control Document (DCD) Revision:

Westinghouse will provide updates to the ITAAC Table 2.2.3-4 items 8c-ix, Design Control Document (DCD) Section 6.1.2.1.2 and Section 6.3.8.1 to address the effect of potential debris generating miscellaneous items such as equipment tags, signs, etc. and quantify restrictions and expectations of the cleanliness programs.

PRA Revision:

None

Technical Report (TR) Revision:

DCD Tier 1 and Tier 2 markups will be delineated in APP-GW-GLE-002 Rev. 2. This will be formally transmitted to the NRC by 5/13/09.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.2-SPCV-18
Revision: 0

Question:

Summarize the evaluation of the flow paths from the postulated break locations and condensation paths to identify potential choke points in the flow field upstream of the IRWST screen.

Westinghouse Response:

The only water that returns to the IRWST that has safety importance is the steam condensate return from the inside of the containment vessel which flows down to the IRWST gutter. The sequence where this water return is most important is in non-LOCAs when the PRHR HX is operating. In the long term, the gutter flow maintains the IRWST water level which maintains the PRHR HX heat sink.

In a LOCA, the gutter function is less important. The containment gutter is located against the containment shell at an elevation just below the operating deck. The gutter extends all around the containment circumference. The gutter has a rough screen on top of it to prevent large debris that could possibly cause flow obstruction resulting in gutter spillover. Having some water spill out of the gutter is not significant. The water will then end up in the lower portion of the containment where it will then enter the containment recirculation screens when IRWST injection shifts to recirculation injection. As a result, core cooling is maintained in either case.

The IRWST gutter is approximately 408 feet long based on the containment inside diameter of 130' (APP-MV50-Z0-001 Rev. 6) and the assumption that the gutter runs along the entirety of the inner containment circumference. Currently the gutter is sized to 4 inches wide by 3 inches high. As previously calculated in RAI-SRP6.2.2-SPCV-17 this corresponds to a volume of approximately 34.00 ft^3. This corresponds to an IRWST water level change $\leq$0.015ft. Thus, the contribution of the volume in the IRWST gutter as it pertains to long term cooling is insignificant. Once again, for this scenario to actualize both gutter collection box discharge piping has to become clogged causing the IRWST gutters to fill completely up and overflow.

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-SRP6.2.2-SPCV-19
Revision: 0

Question:

The response to RAI-SRP6.2.2-SPCV-11 states that the screen is able to withstand the affect of large debris, and item C-1.1.1.6 in the AP1000 RG 1.82 Assessment Matrix states that the screens are designed to withstand a significant head loss. What specific analysis is available to support these statements?

Westinghouse Response:

The AP1000 screen design has been installed on many operating plants in the United States. The design as applied to the operating plants has been analyzed to meet the applicable loads (seismic, thermal/hydraulic, and debris).

The AP1000 screens are an engineered component that will be purchased from a vendor; as such no AP1000 specific structural analysis has been performed. The approach velocities for the AP1000 screens are significantly lower than operating plants which have used the same screen design. However, there is a current ITAAC (Table 2.2.3-4 item 2.a) that requires the AP1000 screens to be designed and constructed in accordance with the ASME code requirements. The design specifications for the screens include, but are not limited to the following:

The screens are classified as Seismic Category I and must meet the requirements of U.S. NRC Regulatory Guide 1.29 (Reference 2.2.15). The Supplier shall supply equipment with supports per the intent of ASME Section III, Subsection NF (Reference 2.2.1). The screen assemblies shall be designed to maintain structural integrity and to function under normal, upset, emergency, and faulted conditions. There shall be no loss of function during and after normal, upset, emergency, and faulted conditions. When exposed to the specified conditions, the screens shall remain structurally sound and be capable of functioning as intended within this specification.

The following was taken directly from the design spec APP-MY03-ZO-001 Rev. 0

IRWST and containment recirculation screens supplied to this Specification are designated as AP1000 Equipment Classification Code Letter C as specified on the Screen Data Sheet Report contained in Appendix A. Accordingly, the equipment shall conform to ANS Equipment Safety Class SC-3 (Nuclear Safety Class).

Table 1, "Correlation of AP1000 Equipment Classification with Industry and Regulatory Standards," relates the AP1000 Equipment Classification Code Letter to the various industry and regulatory requirements.

TABLE 1
CORRELATION OF AP1000 EQUIPMENT CLASSIFICATION WITH INDUSTRY AND REGULATORY STANDARDS

AP1000 Code Letter	ANS Safety Class (SC)	RG 1.29 (Ref. 2.2.15) Seismic Requirements	Principal Construction Code	RG 1.26 (Ref. 2.2.13) Quality Group	QA Requirements
C	3	I(1)	Manufacturer Std.	Group C	10 CFR 50 Appendix B(2)

Notes:

1. Seismic Category I is applied to those safety-related structures, systems, and components that must remain functional during and after a safe shutdown earthquake (SSE) according to Regulatory Guide 1.29.
2. 10 CFR 21 (Ref. 2.2.19) applies.

The design specification also identifies what components and features have to be tested and what design parameters have to be tested, but are too numerous to list here. If additional information is required please be explicit with information request as the design specification contains 58 pages.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

RAI Response Number: RAI-SRP6.2.2-CIB1-20
Revision: 0

Question:

Please discuss how coatings applied to engineered components address the positions of Regulatory Guide 1.82. These coatings do not appear to be addressed in the AP1000 Regulatory Guide 1.82, Revision 3 Assessment. The Assessment states nonsafety coatings are assumed to be stripped off by LOCA jets and are required to have a minimum density (Item C-1.3.2.4), but this density verification (ITAAC) and the assumption of failure do not apply to the coatings on engineered components. In addition, these coatings do not appear to be included in any failure, transport, or head loss analysis or testing.

In RAI-SRP6.2.2-CIB1-03, the staff asked how unqualified coatings were being addressed for the AP1000 compared to operating reactors. The second item in the response to RAI-SRP6.2.2-CIB1-03 suggests the response does not need to address coatings on engineered components. DCD Section 6.1.2.1.5 rationalizes excluding these coatings from consideration based on several qualitative factors. There appears to be considerable uncertainty and an absence of verification associated with the factors:

- The total surface area of low density coatings on engineered components is stated to be small but is not quantified.
- The argument that coatings on engineered components are less subject to failure during accidents appears to be based on engineering judgment rather than operating experience or test data.
- The quality of the coating application is stated to be better than for field applied coatings. While this may be correct, it does not appear to be meaningful for addressing RG 1.82 concerns. The NRC staff guidance states that 100 percent of unqualified OEM coatings should be assumed to fail unless the licensee knows the specific coating type and has failure test data for that coating.
- The types of coatings that will be used on engineered components are unknown. The DCD speculates that high-density, dry powder coatings will be used, but there is no mechanism for verifying the type, quality, or density of the coatings.
- According to the DCD, the “majority” of engineered components will be located where the coating debris will settle out “well away” from the recirculation screens. The terms in quotations are not defined nor is there a verification mechanism.
- The statement that a portion of these coatings could fail, delaminate, and transport to the recirculation screens without affecting recirculation appears to be based on judgment rather than quantitative analysis or testing.

Westinghouse Response:

As discussed with the NRC during the March 20, 2009 AP1000 Long-Term Cooling Debris Issues meeting, Westinghouse proposes to use high density coatings on all engineering components inside containment which are within the Zone of Influence or transportable to the screens or a submerged break location. In addition, the ITAAC in DCD Section 2.2.3-4 will be revised to address coatings on engineered components and DCD Section 6.1.2.1.5 will be revised to change the words regarding coatings applied to engineered components. These changes will be incorporated in the Revision 2 update to APP-GW-GLE-002, "Impacts to the AP1000 DCD to Address Generic Safety Issue (GSI)-191," to be provided to the NRC by May 8, 2009.

Design Control Document (DCD) Revision:

Westinghouse will provide updates to the Design Control Document (DCD) Section 2.2.3-4 and Section 6.1.2.1.5 to address coatings on engineered components within the ZOI of a design basis accident.

PRA Revision:

None

Technical Report (TR) Revision:

DCD Tier 1 and Tier 2 markups will be delineated in APP-GW-GLE-002 Rev. 2.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.2-CIB1-21
Revision: 0

Question:

Given that aluminum is the most significant element for chemical precipitation in the AP1000, and the apparent uncertainty about what pieces might have to be made of aluminum, please describe how you determined 53 pounds is considered sufficient to bound these pieces. How do you intend to ensure that the chemical effects analysis is valid for an as-built plant (i.e., ensure the amount of aluminum is 53 pounds or less)? It is the staff's understanding that no aluminum is expected to be exposed to the sump liquid based on the design, since the only known sources are the excore detectors that will be enclosed in stainless steel (with an ITAAC for verification.) TR 26 stated an arbitrary amount of aluminum (53 pounds) was included in the chemical effects analysis for conservatism. However, the response to RAI-SRP6.2.2-CIB1-17 states that the 53 pounds of aluminum is "considered sufficient to bound small pieces that may have to be made of aluminum." This statement implies a degree of uncertainty about the amount of aluminum in containment and therefore about the choice of 53 pounds as a bounding value.

Westinghouse Response:

Aluminum is used as the principal structural material for the cans enclosing and supporting the electronic and nuclear / gas components of the AP1000 Ex-Core Detectors. These detectors are arrayed around the periphery of the reactor vessel outside the thermal insulation layer. The detectors themselves will be enclosed in sealed stainless steel cans which in turn is located at the appropriate elevation near the core midplane by positioning in a cylindrical steel tube. Since the Ex-Core Detectors are fully encapsulated in stainless steel, the aluminum is not susceptible to flooding and corrosive attack by sump liquid following a LOCA.

Aluminum is prohibited from use in equipment inside containment by requirements in the equipment design specifications. If, during procurement, a vendor of any equipment inside containment thinks that there is a need for aluminum, they are required to notify Westinghouse of this exception. If the amount is small and there is no reasonable alternative then it will be permitted and the amount of aluminum will be tracked so that the total amount of aluminum limit will be known.

Westinghouse is in the process of increasing the design basis limit of the aluminum to 60 lb to provide additional margin. The AP1000 was designed to allow 53 lbs of aluminum. This value was increased by approximately 10% to provide additional margin and allow for uncertainty. This revised value will be used in the following document revisions: APP-GW-GLR-079, "AP1000 Verification of Water Sources for Long-Term Recirculation Cooling Following a LOCA," WCAP-16914, "Evaluation of Debris Head Loss Test for AP1000 Recirculation and IRWST Screens," WCAP-17028, "Evaluation of Debris Loading Head Loss Experiments Across AP1000 Fuel Assemblies," APP-GW-GLE-002, "Impacts to the AP1000 DCD to Address Generic Safety

Issue (GSI)-191," and APP-PXS-M3C-050 Determination of Surface Areas and Masses for AP1000 Post-LOCA Debris Calculations." The last reference is the aluminum tracking calc, and prescribes the details associated with the amount and traceability of aluminum in containment.

Design Control Document (DCD) Revision:

DCD Revision material will be provided in APP-GW-GLE-002, Rev. 2 which will include a discussion on the amount of aluminum (Section 6.1.2.1 of the DCD).

PRA Revision:

None

Technical Report (TR) Revision:

APP-GW-GLR-079, Revision 4 will incorporate the 60 lb of aluminum in the technical report. APP-GW-GLE-002, Rev. 2 will increase the total allowable amount of aluminum susceptible to corrosion in the adverse chemical environment present in the post LOCA environment in containment (Section 6.1.2.1 of the DCD).

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.2-CIB1-22
Revision: 0

Question:

Please discuss how your technical analysis of chemical effects includes the possibility that nonsafety coatings on engineered components could dissolve and produce material that affects head loss. The staff requested this information for coatings in RAI-SRP6.2.2-CIB1-18. The response referred to coatings listed in DCD Table 6.1-2, which does not include nonsafety coatings on engineered components.

Westinghouse Response:

As discussed with the NRC during the March 20, 2009 AP1000 Long-Term Cooling Debris Issues meeting, Westinghouse proposes to use high-density coatings which would not be subject to dissolving in the post LOCA conditions on engineering components inside containment which are within the Zone of Influence or transportable to the screens or a submerged break location. The change to the ITAAC in DCD Section 6.1.2.1.2 is included in APP-GW-GLE-002 Rev. 2 and addresses coatings on engineered components. The change to DCD Section 6.1.2.1.5 is also included in APP-GW-GLE-002 Rev. 2 and addresses the specifications on coatings applied to engineered components. These changes will be incorporated in the Revision 2 update to APP-GW-GLE-002, "Impacts to the AP1000 DCD to Address Generic Safety Issue (GSI)-191," to be provided to the NRC by May 8, 2009.

Design Control Document (DCD) Revision:

DCD Tier 1 and Tier 2 markups are provided in APP-GW-GLE-002 Rev. 2.

PRA Revision:

None

Technical Report (TR) Revision:

DCD Tier 1 and Tier 2 markups are provided in APP-GW-GLE-002 Rev. 2.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP6.2.2-CIB1-23
Revision: 0

Question:

Provide the following information regarding the evaluation of ex-vessel downstream effects for the AP-1000:

a. The responses to RAI-SRP6.2.2-CIB1-01, -07, -08, and -10 provide information based on the assumed debris loading. Provide any necessary reevaluation of the downstream ex-vessel components for wear and plugging for any revision made to the debris loading downstream of the screen.

b. Identify those downstream ex-vessel components not yet designed or selected as a part of the AP1000 standard design that must be evaluated for wear and plugging by COL applicants.

c. For the components identified in part (b) above, provide a COL information item whereby the adequacy of the components will be evaluated.

d. RAI-SRP6.2.2-CIB1-01 part (d) requested that the applicant address the capability of RNS isolation valves to close and not leak excessively under debris laden conditions after the RNS has been functioning. The applicant's response states that the closure of the containment isolation valves is included in the evaluation of wear, abrasion, and erosion. However, it is not clear whether the valves might leak excessively after being actuated for these conditions, either due to wear of the valve internals or due to debris being caught in the valve seats. Provide an evaluation of the valve leakage after closure.

e. The response to RAI-SRP6.2.2-CIB1-13 addresses the effects of dissolved gases in the ex-vessel downstream flowpath, but it is not clear whether the evaluation considers the effects of larger amounts of gas coming out of solution at higher accident temperature operating conditions. Also, it does not address the effects of gaseous chemicals or gases formed as a result of chemical reactions. Please provide this information.

Westinghouse Response:

a. Westinghouse is currently revising APP-PXS-M3C-056 to reflect the change in the AP1000 assumed debris load.

b. Components related to containment and RNS isolation function have all been designed and evaluated to determine extent of wear and plugging associated with design-basis debris loading, and is acceptable per APP-RNS-M3C-202 Revision 1, with the updated debris-loading considerations.

c. This question is not applicable, because all necessary components that effect recirculation flows have been evaluated for plugging and performance with regards to design-basis debris loading.

d. Calculation APP-RNS-M3C-202 Revision 1 specifically addresses the RNS containment isolation valves. This evaluation will include the effect of wear, abrasion, debris loading, and erosion. The results of the evaluation conclude RNS isolation valves will close and not leak excessively under debris-laden conditions after the RNS has been functioning.

e. By the selection of insulation and materials in the design, the AP1000 has eliminated, or minimized the materials that may chemically react with the coolant recirculating from the pool formed from post-accident conditions on the reactor containment building floor. Minimizing the generation of chemical products will consequentially also limit any generation of gaseous by-products from these chemical reactions. It is noted that using the spreadsheet developed for and associated with WCAP-16530-NP-A conservatively predicts the production of no more than about 60 kg (about 132 lb_m) of the corrosion products over a 30-day period. This chemical production is small compared to current operating plants, which may generate upwards of about 910 kg (about 2000 lb_m) over the same 30 day time period. Since the rate of chemical production is small, the resulting production of gaseous byproducts from corrosion, if any, are also small.

   It is also noted that the rate that coolant from the containment sump is recirculated is also small. So if bubble formation occurs, the bubble will rise to the surface of the pool and be released to containment. Furthermore, the low recirculation flow rates also minimize the pressure drop within the recirculation piping. The small pressure drop through the piping also works to minimize the potential for gas to collect and form in the piping during PXS operation.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None