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Your ref: Docket No. 52-006
Our ref: DCP_NRC_002946

July 8, 2010

Subject: AP1000 Response to Proposed Open Item (Chapter 3)

Westinghouse is submitting the following responses to the NRC open item (OI) on Chapter 3. This proposed open item 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 proposed Open Item:

OI-SRP3.9.3-EMB2-08 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
Licensing and Customer Interface
Regulatory Affairs and Strategy

/Enclosure

1. Response to Proposed Open Item (Chapter 3)

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NRO

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ENCLOSURE 1

AP1000 Response to Proposed Open Item (Chapter 9)

AP1000 DESIGN CERTIFICATION REVIEW

Response to SER Open Item (OI)

RAI Response Number: OI-SRP3.9.3-EMB2-08
Revision: 1

Question: (Revision 0)

The staff reviewed the design specification and other supporting documents associated with Containment Recirculation Screens and found several issues that are incompletely addressed in the design specification.

a) According to the design specification, the Supplier will provide additional design details, design drawings, and requirements. Therefore, the engineering drawings (envelope drawings) of the screen assemblies were not available at the time of site audit or at the Rockville office. Provide these engineering drawings of the screen assemblies for review by the staff.

b) The loading conditions and combinations are incompletely presented in the documents reviewed by the staff. Provide the following: (i) design and service level A-D loads and load combinations, (ii) fatigue evaluation, and (iii) the origin and the basis of using ±5 psi pressure loading on the IRWST screen from sparger discharge.

c) While it is possible to design containment cleanliness programs to sustain low latent debris inventory in containment, justify the latent debris mass value used for the screen pressure drop component of the structural load on the IRWST and sump screens. Additionally, justify that the flow rate through the screen is conservatively calculated.

Additional Question: (Revision 1)

The following items are addressed as a result of the audit April 19, 20, and 21, 2010.

1. Confirm the applicability of the 5 psi sparger loading on IRWST screen design,

2. Resolve the question about how the 0.25 psi pressure drop loading will be added to the 5 psi loading for the screens.

3. Address sloshing in the IWRST tank as a result of a seismic event. Determine if these loads on the screen need to be included.

Westinghouse Response: (Revision 0)

a) Supporting documents for the IRWST and Containment Recirculation Screens that include design details, design drawings and additional design requirements are as follows:

The design specification, IRWST & Containment Recirculation Screens for Passive Core Cooling System Design Specification, APP-MY03-Z0-001 Rev. 2 has been revised since the NRC review.

The following envelope drawings are available for your review:

APP-MY03-V0-001, Rev. 0, "Containment Recirculation Screen Envelope Drawing"
APP-MY03-V0-002, Rev. 0, "Containment Recirculation Screen Layout Drawing"
APP-MY03-V0-003, Rev. 0, "Containment Recirculation Screen Weir Envelope Drawing"
APP-MY03-V0-004, Rev. 0, "Containment Recirculation Screen Cartridge Envelope Drawing"
APP-MY03-V0-005, Rev. 0, "Containment Recirculation Screen Mounting Frame 200, 201 Assembly Drawing"
APP-MY03-V0-006, Rev. 0, "Containment Recirculation Screen Mounting Frame 200 Envelope Drawing"
APP-MY03-V0-007, Rev. 0, "Containment Recirculation Screen Mounting Frame 201 Envelope Drawing"
APP-MY03-V0-008, Rev. 0, "Containment Recirculation Screen Suction Box North Plenum Envelope Drawing"
APP-MY03-V0-009, Rev. 0, "Containment Recirculation Screen Suction Box South Plenum Envelope Drawing"
APP-MY03-V0-100, Rev. 0, "IRWST Screen Envelope Drawing"
APP-MY03-V0-101, Rev. 0, "IRWST Screen Layout Drawing"
APP-MY03-V0-102, Rev. 0, "IRWST Screen Cartridge Envelope Drawing"
APP-MY03-V0-103, Rev. 0, "IRWST Screen Mounting Frame Envelope Drawing"

b) Loading conditions and combinations

i) The loading conditions and combinations are presented in the screen design specification, APP-MY03-Z0-001, Rev. 2, Appendix B, "Loading Conditions and Criteria Structural Integrity Qualification."

ii) IRWST and Containment Recirculation Screens are classified as AP1000 Equipment Class C (Safety Class 3). The structural elements of the screen assemblies are designed and constructed to the criteria of the ASME boiler and pressure vessel Code, Section III, Subsection NF. The screen modules are fabricated of perforated stainless sheet metal and are constructed to a manufacturer's standard. Safety Class 3 equipment, including the screens, do not typically require fatigue evaluation. There are no requirements identified in the design specification requiring the Supplier to perform fatigue evaluation. DCD Table 3.2-3 and Subsection 6.3.2.2.7 are revised as shown below to describe the equipment classification and construction code.

iii) The origin and basis of using +/- 5 psi pressure loading on the IRWST screen is from Reference APP-GW-C1-001, Rev. 1, "AP1000 Civil / Structural Design Criteria," Page 73 of 81 which states the following:

"ADS Hydrodynamic Load (ADS_1) - This ADS transient is associated with blowdown of the primary system through the spargers when the water in the IRWST is cold and the tank is at ambient pressure. Condensation during sparger discharge results in high frequency pressure oscillations, primarily in a frequency range of 40 to 60 Hertz. Member forces in the walls of the IRWST are bounded by a case with a uniform pressure of 5 psi applied to the walls. The IRWST shall be designed for a uniform pressure of 5 psi applied to the walls. This pressure shall be taken as both positive and negative due to the oscillatory nature of the hydrodynamic loads."

The Civil/Structural Design Criteria is a design basis document that is prepared, approved, and controlled under the criteria of the Westinghouse quality assurance program. Appendix B includes loads due to sub compartment pressure analysis and analysis of hydrodynamic loads determined as part of the design of the Passive Core Cooling System.

The pressure loading on the screen is included in the loads combinations required to be analyzed by the design specification. Evaluation of the screen assembly design is included in the documentation provided by the manufacturer.

c) Mass Value and Flow Rate Justification:

The determination of the AP1000 debris inventory in containment and the development of supporting containment cleanliness programs, have been the subject of intensive interaction between Westinghouse and the NRC. The screen pressure drop and the flow rate through the screen have been developed in support of responding to GSI-191 issues. This information is summarized below and documented in APP-GW-GLN-147, Screen Design Report and APP-GW-GLR-79, Verification of Water Sources for Long Term Recirculation Following a LOCA.

i) As a part of Generic Letter 2004-02 "Supplemental Responses and Close-Out' responses," operating PWRs have performed walkdowns in order to determine the amount of latent debris that may exist in their containment. This information has been evaluated for its applicability to estimate the mass of latent debris within the AP1000 containment. Several factors were considered, including the containment sizes and the type of insulation used inside each.

ii) The test flow rate was adjusted by the ratio of the screen areas. The test screen was compared to the AP1000 IRWST screen, as it has a larger debris loading (per unit of frontal area) than the CR screens.

The amount of debris loading was similarly scaled by the ratio of the screen frontal areas. The debris loading is based on the amount of fibrous, particulate, and chemical debris. The IRWST Screens were used in this scaling because they have a larger debris

loading (per unit of frontal area) than the CR screens. The screen used in the test flume consists of two full-sized modules or screen cartridges. The use of the frontal area to scale the debris loadings to be tested provides a conservatively large amount of debris to be deposited on the test screen pockets compared to the AP1000 design.

For CR screen scaling purposes, both CR screens are considered, because both will always operate due to the cross connection between them. For IRWST screen scaling purposes, both IRWST screens are considered, because the limiting core cooling case is a DVI break in a PXS room resulting in the IRWST line spilling into the room. This case results in a reduced containment flood-up level and in the earliest initiation of recirculation operation. This leads to the lowest driving head and highest decay heat load.

The nominal "full flow" values for the flume recirculation flow rate is different for the recirculation screens and the IRWST screens. For the containment IRWST screen tests, the flow rate should be higher during the injection phase when particles and fibers can be transported to these screens, and lower during recirculation when chemicals as well as particles and fibers can be transported. A conservative flow rate is used for the IRWST screen during recirculation conditions. The tests show that the head loss across the screen is insignificant during both of these operating conditions (injection and recirculation phases).

The flow used in the recirculation screen tests was above the minimum flow at which the flume flow meter provides the stated accuracy. Using a higher flow rate for the tests is conservative, as it more effectively transports debris to the screens and produces a higher pressure drop across the recirculation screens.

Westinghouse calc notes with full information on debris estimates, flow areas, and flow rates for all screen tests can be provided for review.

Additional Westinghouse Response: (Revision 1)

1. The 'Sparger Loading' is the maximum value due to actuation of the sparger. The actual shape of the pressure will be sinusoidal shape. The forces in the walls of the IRWST are bounded by a case with a uniform pressure of 5 psi applied to the walls. The actuation of the sparger will occur during discharge of ADS 1, 2, 3 valves. Tests conducted at the ENEA's VAPORE facility showed the maximum pressure exerted on the IRWST walls during a sparger actuation of 400lbm/s steam. The pure steam blowdown caused the highest pressures exerted on the IRWST floor directly below the sparger arm during sparger actuation. Additionally, the tests simulated a sparger steam flow of 400lbm/s. This flow more than bounds the actual calculated maximum steam flow of 145 lbm/s for the AP1000 (APP-ME02-Z0C-001 Rev. 0). The nominal hydrodynamic load exerted during the above mentioned sparger test was 5 psig. Given the steam flow was more than 2.7 times the actual design flow this bounds the structural design requirement for DP mentioned above.

2. The sparger load is in addition to the hydrodynamic loads experienced during IRWST injection, and the differential pressure associated with debris loading. However, it is very unlikely that sparger actuation will occur coincident with IRWST injection as the sparger actuation comes from the ADS 1, 2, 3 discharge. IRWST injection cannot occur until the pressure in the RCS drops below the hydrostatic pressure exerted on the IRWST water due to the level in the tank. This only occurs after ADS 4 has been actuated. Therefore the 0.25 psi debris differential pressure load is not coincident with 5 psi loading for the screens. These two loads are not lincluded in the same load combination.

3. The sequences for the postulated accidents are such that the seismic event producing the sloshing and the actuation of the sparger are not coincident. Therefore, the sloshing loads need to be included as a load on the screen. The sloshing loads are combined in load combinations with seismic loads. The sloshing load is not combined in a load combination with the sparger loadings. The load combination with the sloshing load is being included in the system specification document for the passive core cooling system (PXS).

Design Control Document (DCD) Revision: ~~None~~

Revise Table 3.2-3 as shown below: (Note: the IRWST Screen C is added as part of the changes to address resolution of GSI-191 issues)

TABLE 3.2-3 (SHEET 15 OF 65)

AP1000 CLASSIFICATION OF MECHANICAL AND FLUID SYSTEMS, COMPONENTS, AND EQUIPMENT

Tag Number	Description	AP1000 Class	Seismic Category	Principal Construction Code	Comments
Passive Core Cooling System (Continued)					
PXS-MY-Y01A	IRWST Screen A	C	I	Manufacturer Std.	Structural Frame and attachment use ASME III, Subsection NF criteria. Screen Modules use Manufacturer Std.
PXS-MY-Y01B	IRWST Screen B	C	I	Manufacturer Std.	Structural Frame and attachment use ASME III, Subsection NF criteria. Screen Modules use

					Manufacturer Std.
PXS-MY-Y01C	IRWST Screen C	C	I	Manufacturer Std.	Structural Frame and attachment use ASME III, Subsection NF criteria. Screen Modules use Manufacturer Std.
PXS-MY-Y02A	Containment Recirculation Screen A	C	I	Manufacturer Std.	Structural Frame and attachment use ASME III, Subsection NF criteria. Screen Modules use Manufacturer Std.
PXS-MY-Y02B	Containment Recirculation Screen B	C	I	Manufacturer Std.	Structural Frame and attachment use ASME III, Subsection NF criteria. Screen Modules use Manufacturer Std.

Revise the first paragraph of Subsection 6.3.2.2.7 as follows

The passive core cooling systems has two different sets of screens that are used following a LOCA; IRWST screens and containment recirculation screens. These screens prevent debris from entering the reactor and blocking core cooling passages during a LOCA. The screens are AP1000 Equipment Class C and are designed to meet seismic Category I requirements. The structural frames, attachment to the building structure, and the attachment of the screen modules use the criteria of ASME Code, Section III Subsection NF. The screen modules are fabricated of sheet metal and are designed and fabricated to a manufacturer's standard. These screens are designed to comply with applicable licensing regulations including:

PRA Revision: None

Technical Report (TR) Revision: None