

ArevaEPRDCPEm Resource

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Sent: Friday, July 01, 2011 7:58 AM
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Subject: Draft - U.S. EPR Design Certification Application RAI No. 498 (5842), FSAR Ch. 6
Attachments: Draft RAI_498_CIB1_5842.doc

Attached please find draft RAI No. 498 regarding your application for standard design certification of the U.S. EPR. If you have any question or need clarifications regarding this RAI, please let me know as soon as possible, I will have our technical Staff available to discuss them with you.

Please also review the RAI to ensure that we have not inadvertently included proprietary information. If there are any proprietary information, please let me know within the next ten days. If I do not hear from you within the next ten days, I will assume there are none and will make the draft RAI publicly available.

Thanks,
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Request for Additional Information No. 498(5842), Revision 0

7/1/2011

U. S. EPR Standard Design Certification
AREVA NP Inc.

Docket No. 52-020

SRP Section: 06.02.02 - Containment Heat Removal Systems

Application Section: 6.2.2

QUESTIONS for Component Integrity, Performance, and Testing Branch 1 (AP1000/EPR Projects)
(CIB1)

06.02.02-110

ANP-10293P, Revision 3, Sections G.2.4 and G.2.6, describe the total debris generated during a large break LOCA and the downstream post-LOCA fluid constituents which are assumed to pass through the strainers and ingested into the ECCS. Since components in the ECCS will be design and qualified to operate in the post-LOCA fluid environment, NRC requests the following additional information to further describe the downstream post-LOCA fluid constituents:

- a. Table G.2.2, "Total Debris Generated during the LB LOCA," lists the debris sizes as particulate, small fines, and large pieces. To better define the debris sizes, describe the range of sizes for particulate, small fines, and large pieces.
- b. Table G.2.2 states that 1476 ft³ of RMI small fines are generated during a LB LOCA. Since no RMI is included in the post-LOCA fluid constituents in Table G.2.3, provide justification for the assumption that no RMI will enter the ECCS. [Note: ANP-10293P, Section E.4.1 states, "RMI debris pieces of 2 mil thickness and various sizes from RMI 0.25"x0.25" up to 4"x4" were shown to sink and settle on the bottom of the retaining basket." It also states that "Removing RMI from subsequent tests also prevents the possibility of RMI debris trapping fibrous debris in the retaining basket, thus resulting in less conservative test conditions." NRC agrees that this test is conservative for bypass of fibers but it is not conservative for downstream component evaluation.]
- c. Table G.2.2 states that 100 ft³ of miscellaneous large pieces of debris are generated during a LB LOCA. Since no miscellaneous debris is included in the post-LOCA fluid constituents in Table G.2.3, describe the miscellaneous debris and provide justification that no miscellaneous debris or pieces of miscellaneous debris will enter the ECCS.
- d. The post-LOCA fluid constituents listed in Table G.2.3 will be used by the vendor for design and qualification of downstream ECCS components to ensure operation during the mission time. The table lists debris amount and concentration but does not list material properties such as density, abrasiveness, size, etc. that may be needed by the vendor for component design and qualification. Describe the post-LOCA fluid constituent properties that may be needed by the vendor for component design and qualification.

06.02.02-111

ANP-10293P, Revision 3, Section G.2.5 for ECCS Flow Rate and Flow Velocity states, “the SIS design allows fluid velocity in excess of debris material terminal settling velocities to exist, and debris settling will not occur.” Provide justification that debris settling will not occur by providing additional information such as flow velocities through ECCS, the settling velocity, system realignments that may reduce flow rates, etc.

06.02.02-112

ANP-10293P, Revision 3, Section G.3.1 for Wear Rate Evaluation states, “Erosive wear is caused by particles that impinge on a component surface and remove material from the surface because of momentum effects. The wear rate of a material depends on the debris type, debris concentration, material hardness, flow velocity, and valve position. The component vendor(s) will provide data to support acceptable wear rates based on the provided equipment specifications.” Appendix G does not provide details that may be needed by the vendor such as debris material properties, debris abrasiveness, flow velocities for each component, valve position, etc. Provide details of the information needed by the vendor to perform component wear evaluations.

06.02.02-113

ANP-10293P, Revision 3, Section G.3.2 for LHSI and MHSI Pump Evaluation describes the methodology for the design and qualification of LHSI and MHSI pumps. To more fully describe the design and qualification process for the pumps in a post-LOCA fluid environment, NRC requests that AREVA address the following item:

The NRC approved qualification standard for pumps is QME-1-2007. This standard is applicable for service conditions when debris is present in the operating fluid. Therefore, NRC staff requests that, “the LHSI and MHSI pumps be qualified per QME-1-2007 as endorsed by RG 1.100 revision 3 to operate with the post LOCA fluids for at least 30 days. As part of the qualification process, the pump vendor, at a minimum, will evaluate the pump criteria listed in Appendix G, Section G.3.2. Any additional potential pump malfunctions shall be identified by the vendor per QME-1-2007, Section QP-7200.”

06.02.02-114

ANP-10293P, Revision 3, Section G.3.2 for LHSI and MHSI Pump Evaluation describes five actions for the pump vendor during the design and qualification process. However, the design, qualification, and acceptance criteria are not fully described. To more fully describe the design, qualification, and acceptance criteria for the pumps in the post-LOCA fluid environment, NRC requests that AREVA address the following items.

- a. State that the vendor is to provide a list of the opening sizes and internal running clearances for the LHSI and MHSI pumps. This statement does not describe the acceptance criteria. To better describe the evaluation methodology and acceptance criteria, the vendor should provide tests and/or analyses to confirm that pump opening sizes and internal running clearances provide acceptable

- operation in post-LOCA fluids during the 30-day mission time. Opening sizes and internal running clearances are to be recorded in the qualification documentation.
- b. State that hydraulic performance test results confirming that the LHSI and MHSI pumps can provide the required safety injection flow rates for at least 30 days of ECCS post-LOCA operation. Discuss if pump design parameters such as NPSHA (available) accounts for suction head losses due to strainer clogging.
 - c. State that the vendor is to provide, “a list of materials of the wetted pump surfaces (such as wear rings, pump internals, bearing, and casing) and the hardness of each material (for example, Brinell hardness number).” To better describe the evaluation methodology and acceptance criteria, the vendor should provide tests and/or analyses to confirm that the pump wetted surface material (such as wear rings, pump internals, bearing, and casing) wear rates provide acceptable operation in post-LOCA fluids during the 30 day mission time. A list of materials of the wetted pump surfaces, the hardness of each material, and verification of acceptable wear rates are to be recorded in the qualification documentation.
 - d. Describe design and testing for the pump mechanical seals. The NRC approved qualification standard for pump mechanical seals is QME-1-2007. This standard is applicable for service conditions when debris is present in the operating fluid. Therefore, NRC staff requests that, “the LHSI and MHSI pump mechanical seals be qualified per QME-1-2007 as endorsed by RG 1.100 revision 3 to operate with the post LOCA fluids for at least 30 days.
 - e. State that, “The pump vendor should also provide an analysis to confirm that the cyclone separator, if applicable, is not susceptible to clogging or impairment by fiber or other particulates and that there is no adverse impact on pump performance or reliability. If the cyclone separators will be impaired in 30 days of operation with post- LOCA fluids, test results and/or analysis should be provided to show that the absence of cyclone separators yields acceptable seal performance.” NRC staff suggests revising “cyclone separator” to state “cyclone separator or any filtering device”.

06.02.02-115

ANP-10293P, Revision 3, Section G.3.3 for LHSI Heat Exchanger Evaluation states, “The LHSI heat exchangers are evaluated for susceptibility to tube plugging. The vendor will verify that plugging by post-LOCA debris constituents will not occur or adversely affect the performance of the heat exchanger.” However, this section does not address the heat exchanger heat transfer performance for post-LOCA fluid conditions. The applicant is requested to discuss how it intends to verify acceptable performance of the LHSI heat exchangers in post-LOCA fluids during the 30-day mission time.

06.02.02-116

ANP-10293P, Revision 3, Section G.3.4 for Evaluation of Valves states, “The ECCS valves, pipes, and orifices are evaluated for susceptibility to blockage. An analysis will be performed to verify adequate performance during operation with post-LOCA fluid.” NRC staff requests the applicant to address the following comments:

- a. The title should be expanded to include Orifices, Pipes, and Instrument Tubing.
- b. The NRC approved qualification standard for valves is QME-1-2007. This standard is applicable for service conditions when debris is present in the operating fluid. Therefore, NRC staff requests that, the valves be qualified per QME-1-2007 as endorsed by RG 1.100 revision 3 to operate with the post-LOCA fluids for at least 30 days.

06.02.02-117

ANP-10293P, Revision 3, Section G.3.5 for Confirmatory Items states, "The design, procurement, installation, and layout of components consider the reliability of the SIS, RHRS, and ECCS. Based on the ex-vessel downstream effects evaluation, the following ECCS components need verification to confirm post-LOCA operation (with debris constituents listed in Table G.2-3) for a minimum of 30 days." NRC staff has the following comments regarding confirmatory items:

- a. For Item 1, LHSI and MHSI pumps, these items should be revised as needed to be consistent with any revisions due to RAIs. Also, pump design and qualification in a post-LOCA environment should be addressed by a specific component ITAAC.
- b. For Item 2, LHSI heat exchanger should state that the vendor will verify that post-LOCA debris constituent will not affect heat exchanger performance. Also, LHSI heat exchanger test/analysis should be addressed by a specific component ITAAC.
- c. For Item 3, Valves and Orifices should be revised as needed to be consistent with any revisions due to RAIs. Also, valve design and qualification in a post-LOCA environment should be addressed by a specific component ITAAC.

06.02.02-118

FSAR Tier 2, Section 6.3, "Emergency Core Cooling System," Tables 6.3-2 and 6.3-3 for the LHSI and MHSI pump design and operating parameters do not list the Service Fluid. To clarify the operating fluids for these pumps, these tables should be revised to list the normal operating fluids and the "Post-LOCA Downstream Fluid (for 30-day mission time)." Also, FSAR Tier 2, Table 6.3-5 for the LHSI heat exchanger design and operating parameters lists the tube side fluid as primary coolant. To clarify the tube side fluid for the LHSI heat exchanger, the table should be revised to include Post-LOCA Downstream Fluids (for 30-day mission time). In order to provide a link between the ECCS design criteria in FSAR Tier 2, Section 6.3 and the design criteria in ANP-10293P, Appendix G, the applicable portions of FSAR Tier 2, Section 6.3 should reference ANP-10293P, Appendix G for additional component design and evaluation parameters for downstream ex-vessel components exposed to post-LOCA fluids.

06.02.02-119

FSAR Tier 2, Section 6.3.3.3, "NPSH Evaluation," states, "The SIS pump NPSH evaluation for LB LOCA events is performed using the maximum pump flow head-

capacity curves, maximum system resistances, debris laden sump screen resistance, and a reduced IRWST level to account for liquid hold up in the containment. The limiting evaluation of NPSH does not credit containment overpressure." However, Tables 6.3-2 and 6.3-3, "LHSI and MHSI Pump Design and Operating Parameters," do not list NPSH available for the LHSI and MHSI pumps, and Table 6.3-4, "IRWST Design Parameters," does not list the head loss due to screen blockage for SIS pump screen filters. The NRC staff requests that the applicant describe these design parameters in FSAR Tier 2, Section 6.3.