ArevaEPRDCPEm Resource

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Sent: Friday, October 29, 2010 5:54 PM
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Subject: Draft - U.S. EPR Design Certification Application RAI No. 457(5169,5195,5202), FSAR Ch. 6
Attachments: Draft RAI_457_CIB1_5169_SPCV_5195_5202.doc

Attached please find draft RAI No. 457 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. 457(5169, 5195, 5202), Revision 0

10/29/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 06.02.02 - Containment Heat Removal Systems
SRP Section: 06.02.01.02 - Subcompartment Analysis
Application Section: 6.2.2

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

06.02.02-80

The evaluation of the ex-vessel downstream ECCS flow path components includes the plugging and wear models used for the piping, valve disks and seats, pump wear rings, pump bearings and seals, pump rotors and shafts, and heat exchanger tubes and shells. This includes the effects of individual equipment strainers, cyclone separators, branch lines, pump recirculation lines, and other components that may become plugged. This also includes the limiting assumptions to address possible variations in operational lineup and use of various systems (e.g., use of either HPSI or MHSI versus using only LPSI for hot leg injection or use of only one train versus multiple trains of ECCS flow). Therefore, the staff raised a question regarding plugging and wear of the ex-vessel downstream ECCS components and their ability to function for the necessary mission time.

In a December 8, 2008 response to RAI 111, Question 06.02.02-10, the applicant stated that both the HPSI and MHSI pumps are designed with increased clearances, appropriate hardening of parts for wear, and a filtration system for the mechanical seals. The applicant also stated that an analysis of the ECCS pumps showed negligible impact on the pump performance for debris-laden recirculation water conditions, and that the analysis was validated against existing qualification tests under equivalent pumping conditions. However, the specific ex-vessel downstream components have not yet been selected or designed for specific EPR plants, and the staff will base its findings regarding their ability to adequately perform their safety functions for the required mission time on a review of the applicable evaluation methods and acceptance criteria. Since no quantitative methods or acceptance criteria were provided, the staff requested additional information in a follow-up question.

In a February 16, 2010 response to RAI 297, Question 06.02.02-41, the applicant repeated its intent to evaluate the ex-vessel downstream components using samples of the test fluid downstream of the ECCS strainers during strainer testing. The applicant further stated its intent to provide the plant-specific component vendors with the debris bypass test data and its decay time characteristics and duration for which the equipment must operate. The applicant also stated that the vendor would then be required to evaluate the test debris composition for potential component wear and corrosion effects.

The staff requires additional information to make a safety finding on this issue. Furthermore, the staff notes that tests which maximize the head loss across the strainer may not maximize the debris that passes downstream. The applicant has to date provided no specific methodology and acceptance criteria that the staff can review to determine if they appropriately address uncertainties.

Provide the methodology and acceptance criteria for evaluating the ex-vessel downstream components. Further, given the plant-specific ex-vessel downstream components are not yet designed or selected, provide a COL action item in Chapter 6 to require proper implementation of the component evaluations and an ITAAC to verify the implementation activity prior to plant operation. This should include assessing system or component flow resistance or flow balance changes as a result of wear, assessing system piping vibration response changes due to wear, the capability to isolate components under debris laden conditions, and the capability of credited operator actions.

06.02.02-81

Containment accident pressure (CAP) is the pressure in containment during a postulated accident. RG 1.82 (and RG 1.1) state that pump performance should be independent of the calculated increases in containment pressure caused by postulated LOCAs and also states that sufficient available NPSH should be provided to system pumps assuming no increase in containment pressure from that present prior to the postulated LOCA. SRP 6.2.2 states that if "containment accident pressure is credited in determining available NPSH, an evaluation of the contribution to plant risk from inadequate containment pressure should be made." The U.S. EPR design uses containment accident pressure in evaluating the net positive suction head (NPSH) for pumps that perform emergency core cooling and containment heat removal functions. (See also RAI 416, Question 06.03-15). Perform a risk assessment and provide the results, along with a summary description of the methods used and assumptions made, to the staff for review. The risk assessment should address all plant accident conditions where CAP is credited for reliable operation of the ECCS and containment heat removal system pumps and discuss the bases (e.g., results of thermal-hydraulic analyses) for determining whether CAP credit is needed. All accident initiating events (internal and external) and modes of operation modeled in the U.S. EPR design-specific PRA must be addressed in assessing the risk associated with CAP credit. Qualitative arguments can be used to demonstrate that the risk associated with certain initiating events or accident sequences is insignificant or smaller than the risk associated with analyzed cases, as applicable. In particular, the risk analysis and its documentation should address the following items, as applicable:

a. Method, assumptions, and results for each LOCA initiating event category.

b. Method, assumptions, and results for non-LOCA accident initiating event categories which include feed-and-bleed operation, stuck-open safety valves, or any other means of providing heat to the in-containment refueling water storage tank.

c. Investigate any potential adverse interaction among the operator actions credited in the PRA for accident mitigation and the need to prevent human actions that could lead to inadvertent opening of the containment isolation valves or to containment depressurization.

d. Investigate the risk impact of operating emergency core cooling and containment heat removal systems with impaired containment integrity (e.g., undetected pre-existing containment opening) or operation of containment heat removal systems at too high a rate.

In addition, describe the monitoring program that demonstrates that the actual performance of plant equipment is consistent with the performance assumed in the engineering and probabilistic analyses used to justify CAP in determining NPSH available.

06.02.01.02-5

Documentation of the Subcompartment Analysis.

To satisfy GDC 4 it must be shown that containment internal compartments protect against discharging fluids that result from equipment failures or postulated accidents. FSAR Section 6.2.1.2 presents subcompartment analysis for the U.S. EPR. The analysis was reviewed by the staff. The staff raised questions as to whether the guidance given in SRP 6.2.1.2 and 6.2.1.3 was followed. During audits of U.S. EPR January 26, 2010 and April 30, 2010 AREVA informed the staff that the subcompartment analyses were being redone to conform with the SRP guidance and that FSAR would be revised accordingly. The current FSAR Rev. 2 Section 6.2.1.2 still reflects the original analyses.

Some information regarding the revised analysis appears in Responses to RAI 266, Questions 06.02.01.02-2, 06.02.01.02-3, and 06.02.01.02-4. The information in these responses does not provide a full description of the revised analysis. The FSAR should be updated to reflect the new evaluations. The staff requests that the applicant provide in the FSAR all information needed for the design certification including references to supporting documents. Relative to the subcompartment analysis, the staff is required by the SRP to review the selection process that led to the subcompartments be analyzed, nodding scheme, initial thermodynamic conditions, vent flow path, distribution of mass and energy release, calculated differential pressures, design pressure, the margin above the calculated values, ITAAC and COL action items. The information needed for the staff's review relative to the revised subcompartment analyses is missing from the FSAR.

Regulatory Guide 1.206 provides additional guidance on the information to be included in The FSAR. Section 6.2.1.2 of the FSAR is to provide a transient differential pressure analysis for each subcompartment or group of subcompartments that have high-energy piping. As a minimum, provide the following information:

a. A description of subcompartment grouping or screening for inclusion in the analysis, description of the screening process,

b. Describe the multi-node GOTHIC model used for analysis of subcompartments in the equipment area of the containment, and the multi-node GOTHIC model used for analysis of subcompartments in the service area of the containment,

c. Discuss the selected nodalization; demonstrate that the nodalization maximizes differential pressures,

d. Discuss the nodalization sensitivity runs, provide sample results,

e. Provide the initial thermodynamic conditions within each subcompartment, discuss selection of the initial conditions,

f. Provide the models used for energy discharge rates in the saturated region and in the subcooled region,

g. Provide for all vent flow paths specification of flow condition up to the time of peak pressure, describe the methods used to determine vent loss coefficients,

h. Present important results of the analysis, preferably in the form specified in R.G. 1.206.

i. Propose ITAACs and COL Action Items, as needed,

j. Discuss whether all SRP guidance were followed, if there are differences between the analytical techniques employed and the SRP guidance, identify the differences and justify the techniques used.

06.02.01.02-6

Follow-up to RAI 266, Question 06.02.01.02-2

Please provide the following additional information in reference to the supplement 8 response to RAI 266, Question 06.02.01.02-2:

a. The maximum break flow in Table 06.01.01.02-2-4 is lower than the mass flux in equivalent conditions (KBA34BR022) in Table 06.02.01.02-2-2. The maximum break flow is also lower than estimated by the staff with the Moody model. Provide additional information to justify the used mass and energy discharge.

b. In Table 06.02.01.02-2-2 the temperatures of pipes JNK10BR009, JNK10BR013, JNK10BR058, JNK11 BR192, and JNK11BR195 are above saturation but the enthalpies correspond to saturated liquid. Was saturated liquid used in the evaluation of the discharge? The temperature of pipe KPL85BR004 is below saturation, but the enthalpy is the enthalpy of steam. Was steam assumed in the evaluation?

c. AREVA provided the staff with 4 GOTHIC input files. These are RM 23-3.gth, SDV 23-3.gth, RM 29-14.gth and SDV 29-14.gth. Describe these input files and relate them to Table 06.02.01.02-2-2.

d. Provide justification for the break opening times listed in table 06.02.01.02-2-2.

e. Some breaks of pressurizer lines are assumed to be all steam and to be a constant flow rate. These are from pipes JEF10BR004, JEF10BR006, and JEF10BR103. Level swell in the pressurizer would eventually cause these breaks to become two-phase. Provide comparisons of the resulting subcompartment pressure when two-phase flow occurs with the all steam cases in the RAI response.

f. From GOTHIC input file RM 23-3 it appears to the staff that instead of the break flow in Table 06.02.01.02-2-3, that a constant value of flow rate was used. Provide clarification as to which break flow rate was used to produce the pressure given for room UJA23003 in Table 06.02.01.02-3-1 and justify that conservative results are obtained. Are there other rooms for which a simplified blowdown was used other than that indicated by Table 06.02.01.02-2-2.

g. This is a follow-up of RAI response to RAI No. 266, Supplement 8 dated 9/10/2009 and the staff audit of the GOTHIC subcompartment calculational notebooks October 19 and 20, 2010. In Table 06.02.01.02-3-1, some of the names for Room and HELB pipe, for example, UJA07018-LCQ51BR001, UJA07026-KBA12BR001, UJA07027-KBA11BR001 etc. could not be found by the staff in the proprietary calculation notebooks (Document No. 32-9092307-001 and 32-9118154-001). Explain the inconsistency and correct all inconsistencies between RAI response and these two calculation notebooks. Note that this information is needed for the staff to perform confirmatory analyses against the GOTHIC models that were developed based on these two calculation notebooks.

06.02.01.02-7

Follow-up question to RAI 266, Question 06.02.01.02-3

The supplement 8 response to RAI 266, Question 06.02.01.02-3 indicates that higher than expected initial air temperatures were assumed in the equipment area and in the service area. Higher initial temperatures would result in a lower initial air mass. Justify that the initial temperatures are conservative relative to if cooler initial air temperatures were assumed.