Request for Additional Information No. 30, Revision 0

7/29/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 15.06.05 - Loss of Coolant Accidents Resulting From Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary
Application Section: FSAR Ch 15
SRSB Branch

QUESTIONS

15.06.05-1

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

Please provide the following information for the EPR Design:

a. Loop friction and geometry pressure losses from the core exit to the steam generators through the cold legs to the inlet nozzle of the reactor vessel. Also, provide the locked rotor RCP k-factor. Please provide the mass flow rates,
flow areas, k-factors, hydraulic diameters and coolant temperatures for the pressure losses provided (upper plenum, hot legs, SGs, suction legs, RCPs, discharge legs, and all exit/inlet nozzles). Please also provide the loss from each of the intact cold legs through the annulus to a single broken cold leg.

b. mixing volume void fraction at two hrs in fig. 2-19 for the limiting large break LOCA.

c. LHSI head flow curve

d. elevation of the top of the core, bottom elevation of the suction leg piping, bottom elevation of the discharge legs, and bottom elevation of the downcomer

15.06.05-2

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

Do the large break LOCA precipitation times and, hence, timing to switch to the simultaneous injection includes consideration for breaks located on the top of the discharge leg piping? If not, please provide an analysis of breaks in this location.

15.06.05-3

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

What is the sump temperature vs. time following recirculation and how does this impact precipitation? Is the boric acid concentration in the vessel below the precipitation limit based on the minimum sump temperature at the time the switch to simultaneous injection is performed? Please explain.

15.06.05-4

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

Can debris from the sump block portions of the core inlet and, if so, what is the impact on precipitation timing in the regions where the core boric acid cannot diffuse downward into the lower plenum? Please identify the maximum core inlet blockage that can occur and show local concentrations in the core are below the precipitation limit. With the core inlet blocked, and boric acid and other precipitates in the core, show that the switch to simultaneous injection can flush the core and reduce the concentration to acceptable levels.

15.06.05-5

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

Vapor exiting the two-phase surface in the core during the long term contains boric acid. What happens to the boric acid in the vapor as it passes through the steam generators to reach the break? Please discuss the plate-out effects on the RCS internals and the impact on long term cooling.

15.06.05-6

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," data November 2007.

Please justify and explain how the void fractions were determined in Table 2-3.

15.06.05-7

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

Does the mixing volume consider the maximum content of sump debris that can accumulate in the core? What is the maximum amount (volume) of debris that can accumulate in the core and lower plenum regions during recirculation?

15.06.05-8

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

Please describe the tests used to validate the two-phase level swell and boric acid precipitation models.

15.06.05-9

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

Justify the mixing of boric acid from the core into the lower plenum region throughout the entire event (given that colder water will stratify in the lower plenum during injection). Was the mixing volume in Table 2-3 used for all times in the boric acid buildup calculations presented in Fig 2-19? Explain the basis for using other mixing volumes, if that is the case.

15.06.05-10

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," date November 2007.

Page 2-7 describes four sources of boric acid in the EPR design. Since following a large break LOCA very little liquid will remain in the vessel, combining the low concentration core boric acid with the other sources does not appear appropriate. Please discuss the effect of excluding the initial RCS concentration from the boric acid calculations. Also computing a mixed mean boric acid concentration to determine precipitation time does not take into account that some of the higher concentration sources could inject at much higher flow rates. As such, please show the concentration vs. time in Fig. 2-19 assuming that the EBS injects alone followed by only the IRWST as sources.

15.06.05-11

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

Discuss the means by which the boric acid from the high concentration EBS tanks can be injected into the RCS? Could this be the sole source of injection once the accumulators empty? Please explain.

15.06.05-12

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

What is the basis for choosing the 200 second time for void fraction to compute the boric acid concentration vs. time? Also, what is the basis for choosing 2.5 sq. ft. break? Please explain.

15.06.05-13

The staff submits the following Request for Information (RAI) based on the review of ANP-10288P entitled "U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report," dated November 2007.

The switch to simultaneous injection is identified to be two hours post-LOCA. Is this switch time to be identified in the EOPs? Since the precipitation limit is reached about 10 minutes later, please demonstrate that the switch can be performed in less than 10 minutes.

Also, at two hours post-LOCA, what is the entrainment rate in the hot legs due to steaming from the core at the lowest achievable RCS pressure following the limiting LBLOCA? Please justify and demonstrate that the hot leg injection is not entrained into the hot legs and steam generators at 7200 seconds. Please also justify the maximum elevation of the two-phase level in the hot leg at this time so that the appropriate vapor velocity (used in the entrainment calculation) in the upper portion of the hot leg can be determined.

15.06.05-14

Please provide the values of the sampled parameters and the range of each parameter used for the 59 cases for the equilibrium cycle and the 59 cases for the initial cycle analyses. Include the PCT result for each case. Provide the information in an Excel spreadsheet format if possible.

15.06.05-15

Please confirm that FSAR Figures 5.6-27 through 15.6-36 are from the same simulation as FSAR Figures 15.6-37 through 15.6-50.

15.06.05-16

Plotted information has only been provided for the equilibrium cycle case. Please provide a set of plots similar to FSAR Figures15.6-27 through 15.6-50 for the limiting PCT initial cycle case.

15.06.05-17

FSAR Figure 15.6-49 shows the broken loop pump is calculated to overspeed to twice its normal value. Please provide the methodology used to determine that such an overspeed can be physically accommodated.

15.06.05-18

Please provide a description of the approach taken to assess the particulates bypass fraction through the sump screens, as well as possible accumulation of debris in the core region taking into account the specific types, amounts, and characteristics of insulation materials, and other latent debris initially present in the U.S. EPR containment. Discuss the results obtained along with any supporting evidence used.

15.06.05-19

Please provide assessment of any possible degradation of long-term core cooling capabilities resulting from debris particulates penetration, transport, and accumulation in the primary reactor coolant system.

15.06.05-20

The limiting size for the SBLOCA has changed from 4 inches in ANP-10263 to 6.5 inches in the FSAR. Please explain what model assumptions resulted in this change of the limiting break size.

15.06.05-21

According to FSAR Figure 15.6-83, the highest PCTs for non-LOOP cases are the 3½ in. break as well as the 5½ in. - 6½ in. breaks. The SG nodding study presented in ANP-10291P showed that PCT for 4 in. break increased 121 K when more axial nodes were used. If this same result applied to non-LOOP cases, a different size break might then be the limiting case. Please justify not using detailed SG axial nodalization as given in ANP-10291P for the nodalization used in the FSAR analyses.

15.06.05-22

Please provide the methodology to determine that the single failure of an EDG is worse than the failure of the MSRCV in the broken loop SG.

15.06.05-23

According to ANP-10291P, the accumulators in the SBLOCA simulation are isolated when non-condensable gases are detected at their nozzles. Please justify the conservatism of this assumption, particularly with respect to long term cooling.

15.06.05-24

The SBLOCA calculations assume no leakage paths between the hot legs and the vessel downcomer. Please justify this assumption and discuss its impact on the analysis and related safety conclusions.

15.06.05-25

Please provide the methodology for determining the various break locations (e.g., bottom, side, and top) in the RCP discharge leg.