Request for Additional Information No. 88 (1239, 1044), Revision 0

10/9/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 05.02.03 - Reactor Coolant Pressure Boundary Materials
SRP Section: 05.03.02 - Pressure-Temperature Limits, Upper-Shelf Energy, and Pressurized Thermal Shock
Application Section: FSAER Ch. 5

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

05.02.03-1

The RCPB materials specified in Table 5.2-2 for the CRDM pressure housing lists martenstic stainless steel materials SA-182 Grade F6NM and SA-479 (UNS S41500). While SA-182 Grade F6NM is listed in ASME Code, Section II, Part D, Subpart I, Table 2A, for use in Class 1 systems in accordance with ASME Code Section III, NB-2121, "Permitted Material Specifications," the staff notes that SA-479 UNS S41500 is not listed in Table 2A and therefore does not meet ASME Code, Section III, NB-2121 requirements and thus does not meet the requirements of 10 CFR50.55a. The staff requests that the applicant delete SA-479 UNS S41500 and if necessary provide an alternative material that meets ASME Code requirements. Alternatively, the applicant may choose to submit a code case to the ASME Code to include SA-479 UNS S41500 in Table 2A.

05.02.03-2

The RCPB materials specified in Table 5.2-2 for the CRDM lists SA-312 Grade 347 as one of the materials used for the pressure housing. The staff notes that Grade 347 material is not listed in Section II material specification SA-312 although the staff notes that Grade TP347 is listed. In addition, under pressurizer components, the applicant has listed SA-213 Type 316L material. Material Type 316L does not appear in SA-213 although material Grade TP 316L is listed. The staff requests that the applicant modify Table 5.2-2 to list the appropriate material grades consistent with the applicable material specifications.

05.02.03-3

Table 5.2-2 lists several material specifications and grades for the RCPB piping, steam generator, pressurizer, reactor coolant pump and CRDM components. The applicant did not however identify the individual components that will be fabricated from each material specification. In order for the staff to complete its review of the RCPB materials, the staff requests that the applicant modify Table 5.2-2 to list the components fabricated with each material specification. For example, the specifications listed for the steam generators should identify which specification is used for the shell, heads, tubesheet, nozzles, etc. The Table 5.2-2 entry for the pressurizer safety relief valves should list all valve components that perform a pressure boundary function (valve bonnet, bolting etc.). In

addition, the staff requests that the applicant identify weld filler materials used to weld the various material types and combinations.

05.02.03-4

The amount of specified preheat for the welding of ferritic steels should be in accordance with ASME Code, Section III, Appendix D, Article D-1000. Appendix D is supplemented by positions described in RG 1.50 for the control of preheat temperatures for low alloy steels. Although the applicant stated, in FSAR Section 5.2.3.3.2, that it will conform to the requirements of RG 1.50, it is unclear if the applicant intends to follow the minimum preheat requirements in Appendix D for all ferritic materials in the RCPB. The staff requests that the applicant modify FSAR Section 5.2.3.3.2 to state that the minimum preheat requirements for all carbon steel and low alloy steel components in the RCPB will meet ASME Code, Section III, Appendix D.

05.02.03-5

FSAR Section 5.2.3.4.6 indicates that the ferrite content of the RCP casing is limited to 20 percent to reduce the susceptibility of thermal aging. The staff position regarding the susceptibility of cast austenitic stainless steels (CASS) to thermal aging embrittlement is documented in a letter from Christopher I. Grimes of the NRC to Douglas J. Walters of the Nuclear Energy Institute, dated May 19, 2000 (Agency wide Documents Access and Management System (ADAMS) Accession No. ML003717179). To be consistent with staff's position referenced above, ferrite should be calculated using Hull's equivalent factors as indicated in NUREG/CR-4513, "Estimation of Fracture Toughness of Cast Stainless Steels During Thermal Aging in LWR Systems," Revision 1, issued May 1994. The basis for using Hull's equivalent factors is that for ferrite content above 12 percent, other methods to calculate ferrite, such as ASTM A800, may produce nonconservative ferrite levels lower than those calculated using Hull's equivalent factors. Therefore, the staff requests that the applicant modify FSAR Section 5.2.3.4.6 to state that for all CASS material used in the RCPB, the percent ferrite is calculated using Hull's equivalent factors as indicated in NUREG/CR-4513, Rev. 1 (May 1994). In addition, the staff requests that the applicant modify FSAR Section 5.2.3 to state that all CASS components in the RCPB will be limited to a ferrite content not to exceed 20 percent.

05.02.03-6

In FSAR Section 5.2.3.4.1, the applicant states that stabilized grades of austenitic stainless steels have a stabilizing heat treatment above 800°F. The applicant further states that due to this stabilizing heat treatment, stabilized austenitic stainless steels are not expected to experience sensitization. Given that stabilizing heat treatments are supplementary requirements to the materials specifications for the stabilized grades listed in Table 5.2-2 and the specifications only stipulate that this heat treatment be carried out at a temperature lower than that used for the initial solution annealing heat treatment, the staff requests the following.

1. Modify FSAR Section 5.2.3.4.1 to include the stabilizing heat treatment temperature and a basis for its selection including a discussion on verification testing that AREVA has performed to determine that its stabilizing heat treatment is adequate for material in the RCS environment to prevent stress corrosion cracking.

2. Modify FSAR Section 5.2.3.4.1 to include corrosion testing requirements for stabilized grades of stainless steels and a basis for the adequacy of the testing requirements selected.

05.02.03-7

FSAR Section 5.2.3.3.2 states that electroslag welding performed on RCPB components conforms to the requirements of RG 1.34. The staff requests that the applicant identify the components that will be fabricated using the electroslag weld process.

05.02.03-8

FSAR Section 3.3.4.2 and Table 5.2-2 indicate that MCL and SL piping will be fabricated from SA-336 F304LN or SA-182 F304LN forged austenitic stainless steel material. These specifications do not contain limitations on grain size. Given that grain size can affect the material properties of a material and the ability to perform ultrasonic examination, the staff request that the applicant modify FSAR Section 5.2.3 to include the maximum grain size for forged stainless steel components within the entire RCPB and a basis for the grain size specified.

05.02.03-9

FSAR Section 5.2.3.4.1 indicates that unstabilized austenitic stainless steels contain less than 0.03 wt percent carbon but Table 5.2-2 does not limit carbon to less than 0.03 percent for all unstabilized carbon steels. For example, under RCPB piping in Table 5.2-2, the applicant has specified ASME SA-312 Grade TP304L but does not list Table 5.2-2 Note 3 which limits carbon to less than 0.03 percent. SA-312 Grade TP304L specifies a maximum carbon content of 0.035 percent. The staff requests that the applicant modify Table 5.2-2 to be consistent with FSAR Section 5.2.3.4.1.

05.02.03-10

FSAR Sections 5.3 and 3.6.3 indicate that dissimilar metal welds (DMWs) joining low alloy steel nozzles and stainless steel safe ends will use the GTAW process with a narrow groove weld joint design and no weld buttering of low alloy steel nozzles. The staff requests the following information in order for the staff to complete its review.

1. Discuss development and testing programs that AREVA has performed on narrow groove welding of nozzle to safe ends without first applying a buttering layer.

2. Discuss the PWHT procedures used in welding procedure qualification testing and those proposed to be used during fabrication. In addition, discuss any nontraditional PWHT regimes and discuss their adequacy.

3. Discuss typical HAZ impact test values (Charpy and mills lateral expansion) obtained during welding procedure qualification and discuss controls on welding to ensure that production welds will have similar fracture toughness to the fracture toughness testing results from welding procedure qualifications.

4. Discuss welding process controls employed to reduce weld metal dilution in order to retain the maximum percentage of Chromium possible in order to decrease the susceptibility of components to stress corrosion cracking for the life of the plant.

05.02.03-11

FSAR Section 5.3 indicates that Alloy 690 CRDM adapters are welded to the RPV head using Alloy 52/52M/152. The partial penetration j-groove joint design can be difficult to weld given the highly restrained nature of the joint design and the limited accessibility for the welder. The staff notes that recently fabricated RPV replacement heads have required extensive welding repairs during fabrication. In addition, large numbers of welding flaws have been identified during baseline UT examination of CRDM nozzles. Given the susceptibility of Alloys 52, 52M and 152 to ductility dip cracking and other types of welding flaws in partial penetration j-groove welds, the staff requests that the applicant discuss its welding process controls to minimize welding flaws in CRDM adapter to RPV head welds and any other partial penetration welds that involve dissimilar materials within the RCPB. In addition, discuss welding process controls employed to reduce weld metal dilution in order to retain the maximum percentage of Chromium possible in order to decrease the susceptibility of components to stress corrosion cracking for the life of the plant.

05.02.03-12

Table 5.2-2 indicates that Alloy 52/52M, Alloy 152 and Type 347 weld filler materials will be used in the fabrication of CRDM pressure housings. In reviewing the information provided in FSAR Sections 3.9.4, 4.5.1 and 5.2.3, the staff cannot identify where the CRDM pressure housing welds are located or what material/weld filler metal combinations are used. In order for the staff to continue its review, the staff requests that the applicant provide a description of the CRDM pressure housing welds including a detailed sketch that shows the locations of welds in the pressure housing and identifies the materials that are welded. In addition, provide a discussion of the weld joint designs, welding processes and heat treatment requirements that are used in the fabrication process.

05.02.03-13

Cold work and residual stress imparted on components fabricated from austenitic stainless steels and nickel based alloys has contributed to stress corrosion

cracking in several currently operating PWRs and BWRs. The staff requests that the applicant describe special fabrication process requirements employed to limit the effects of cold work and residual stress, caused by grinding/repair or other fabrication processes on surfaces that come into contact with RCS fluids in order to minimize the susceptibility of components to stress corrosion cracking for the design life of the plant.

05.02.03-14

In FSAR Tier 1, Table 2.2.1-5 “RCS Inspections, Tests, Analyses, and Acceptance Criteria,” the applicant has listed ITAAC for fabrication, welding and welding inspection for RCS components. The staff noted some inconsistencies in the applicant’s ITAAC. For example, Table 2.2.1-5 line item 3.1 has a design commitment that states that components designated as ASME Section III in Table 2.2.1-1 are designed to ASME Code Section III requirements. The ITA for this line item states that inspections will be conducted of ASME design, NDE, and hydrostatic test reports. The ITAACs related to design should be separate from those related to fabrication, weld inspection and hydrostatic testing to provide clarity. Table 2.2.1-5, line item 3.4 is divided into two sections but is not consistent with the similar requirements for components in line item 3.1. The staff request that the applicant modify Table 2.2.1-5 to provide clear consistent ITAAC associated with the design, fabrication (including verification that welding was performed in accordance with ASME Code, Section III), weld inspection (NDE) and hydrostatic testing for ASME Code Section III piping and components. In addition, the type of report that is required under the acceptance criteria should be listed in Table 2.2.1-5 (i.e.; ASME N-5 data report or other type of report). The staff notes that this format should be applied to all Tier 1 ITAAC for ASME Code Section III, Class 1, 2, or 3 systems.

05.03.02-6

In Table 1.8-2, "U.S. EPR Combined License Information Items," the applicant did not provide an action for the COL applicant to provide its plant-specific pressurized thermal shock (RT_{PTS}) values for vessel beltline materials. Please add another item under Item No. 5.3-2 (Table 1.8-2) stating “A COL applicant that references the U.S. EPR design certification will provide plant-specific RT_{PTS} values in accordance with 10 CFR 50.61 for vessel beltline materials.”