Response to

Request for Additional Information No. 118 (1519, 1476), Revision 0

11/05/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.04.01 - Internal Flood Protection for Onsite Equipment Failures
SRP Section: 03.09.03 - ASME Code Class 1, 2, and 3 Components
Application Section: FSAR Ch. 3

QUESTIONS for Balance of Plant Branch 2 (ESBWR/ABWR) (SBPB)
QUESTIONS for Engineering Mechanics Branch 2 (ESBWR/ABWR Projects) (EMB2)

Question 03.04.01-4:

GDC 2 requires in part that "structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as … floods … without loss of capability to perform their safety functions." The staff reviewed the safety-related SSCs that must be protected against flooding in accordance with SRP Section 3.4.1, Subsection I.1 and the location of the safety-related SSCs relative to the internal flood level in accordance with SRP Section 3.4.1, Subsection I.2. The FSAR has not provided the above information for the staff to review in accordance with SRP Section 3.4.1 Subsections I.1 and I.2. FSAR Tier 2, Section 3.2, "Classifications of Structures, Components, and Systems," Table 3.2.2-1, "Classification Summary," are not referenced by FSAR Tier 2 Section 3.4 as the SSCs that must be protected against flooding. FSAR Tier 2 Section 3.4.3.1 indicates its flood analysis includes an identification of safety-related equipment. However, the results of this identification are not shown in the FSAR Section 3.4.1, "Internal Flood Protection." Further, the location of the safety-related SSCs relative to the internal flood level is not shown in the FSAR.

Based on the above review, the applicant is requested to provide in the FSAR the following information:

a. The safety-related SSCs that must be protected against flooding, (A proper cross reference of existing FSAR tables, sections is acceptable.)

b. The location level of the safety-related SSCs relative to the internal flood level.

Response to Question 03.04.01-4:

a) Safety-related SSC that must be protected against flooding are listed in U.S. EPR FSAR Tier 2, Table 3.2.2-1. U.S. EPR FSAR Tier 2, Section 3.4 will be revised to reference U.S. EPR FSAR Tier 2, Table 3.2.2-1.

b) Seismic Category I structures that feature physical separation between divisions, including Safeguard Buildings, Fuel Building, Emergency Power Generating Buildings, and Essential Service Water Pump Buildings are designed to protect against flooding by containing flood water within the affected division. A division can be lost to flooding, including safety-related SSC within that division, but all associated safety-related functions will continue to be adequately performed by a redundant division.

   In Seismic Category I structures that do not have strict physical separation between divisions, such as inside the Reactor Building and inside the Reactor Shield Building annulus, the elevation of safety-related SSC relative to internal flood level is cited in U.S. EPR FSAR Tier 2, Section 3.4.3.3. Containment flood level is given as -4 feet, 7 inches and the elevation of safe shutdown systems and components, including the safety injection/residual heat removal system (SIS/RHRS), containment isolation valves, and reactor protection system inside containment are located above elevation -4 feet, 3 inches. Reactor Shield Building annulus flood level is below elevation +0 feet, 0 inches while cable penetration plug boxes for electrical and instrumentation and control equipment are located above elevation +16 feet, 10-3/4 inches.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.4 will be revised as described in the response and indicated on the enclosed markup.

Question 03.04.01-5:

FSAR Tier 2 Section 3.4.1 states that the principal protective measures for Seismic Category I building is physical separation of the redundant safe shutdown systems and components. The plant arrangement provides divisional separation walls to physically separate the redundant trains of safe shutdown systems and components. Division walls below elevation 0 feet provide separation and serves as flood barriers. These division walls are watertight, have no doors, and have a minimum number of penetrations. Above elevation 0 feet, a combination of watertight doors and opening for water flow to the lower building levels prevent water ingress into adjacent divisions. Watertight doors have position indicators for control of the closed position. Based on above, the staff has determined that the watertight door is an important design feature for the flood protection. SRP Section 3.4.1 Subsection III.2 provide guidance for the staff to evaluate the adequacy of flood protection features including watertight doors. The staff was not able to find the information in the FSAR about the door seals, aging degradation, and the maintenance procedure requirements for the door seal.

The applicant is requested to provide the above information about door seals to ensure water tight doors serve their intended flood protection function.

Response to Question 03.04.01-5:

Water resistant door design details are to be specified later in the design process. Water resistant door designs will be engineered to meet functional requirements such as leak-rate limits, door-closure indication, door-seal aging-degradation characteristics, and maintainability. Maintenance requirements are based on manufacturer recommendations, and maintenance procedures are written by COL applicants in accordance with their respective regulatory approved maintenance programs.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 03.04.01-6:

SRP Section 3.4.1 states that the requirements of GDC 4 are met if SSCs important to safety are designed to accommodate the effects of discharged fluid resulting from high and moderate energy line breaks that are postulated in SRP Sections 3.6.1 and 3.6.2. In addition, the requirements of GDC 2 relate to the SSCs important to safety being designed to withstand the effects of natural phenomena such as earthquakes, flood without loss of capability to perform their safety functions. Meeting the requirements of GDC 2 includes evaluating the effects of flooding from full circumferential failures of non-seismic, moderate-energy piping.

The FSAR Section 3.4.3.3 states that an analysis was performed by the applicant, and it determined the maximum flood level in the containment is elevation -1.3 meters (-4 feet, 3 inches). The bounding pipe break that defines this volume of water is the fire water pipe break. The breaks being considered in FSAR Section 3.4.3.3 are LOCA, main steam line break, main feedwater line break, and fire water distribution pipe break. Based on the above, the staff could not determine whether the applicant has considered all the pipe breaks postulated in SRP Section 3.6.1 and 3.6.2 and all postulated breaks from non-seismic, moderate-energy pipes. There is insufficient information in the FSAR for the staff to review the flood analysis. Specifically, the applicant is requested:

a. to provide a list of potential flood sources in the containment and reactor building annulus including all the postulated high and moderate energy line breaks according to SRP Sections 3.6.1 and 3.6.2 and non-seismic moderate-energy line breaks,

b. to explain how the bounding pipe breaks for the flood analysis in the containment and in reactor building annulus were determined,

c. to provide details of the analysis outlined in FSAR Tier 2 Section 3.4.3.1, Internal Flooding Events for the containment and reactor building annulus, including flood water flow rates and volumes, building floor elevation, free areas, free volumes, and assumptions used for obtaining these volumes and flood levels.

Response to Question 03.04.01-6:

a) The flooding analyses, for both the Reactor Building annulus and containment, considered all of the water-carrying systems inside each building including high and moderate energy lines.

b) As stated in U.S. EPR FSAR Tier 2, Section 3.4.3.3, U.S. EPR containment flooding analysis identified the bounding piping failure as a full break in the fire water distribution system. The Reactor Shield Building annulus flooding analysis eliminated all high energy lines that are enclosed in guard pipes. The bounding case for the annulus was determined to be a full break in the fire water distribution system.

c) Containment and Reactor Shield Building annulus flooding analyses supporting U.S. EPR FSAR Tier 2, Section 3.4.3.3 are available for inspection at AREVA offices.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 03.04.01-7:

10 CFR 52.47(b)(1), which requires that a design certification (DC) application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations. The FSAR Tier 2, Section 3.4.1 describes a flood-protection design to meet GDC 2 and GDC 4. SRP Section 3.4.1 Acceptance Criteria 3 asks the applicant to provide an ITAAC to verify the plant is built in accordance with the design certification. The staff reviewed the FSAR and could not find such an ITAAC.

The staff requests the applicant to provide additional ITAAC for verifying all important design features described in the FSAR Tier 2 Section 3.4 for flood protection are properly implemented. Important design features include that all the safety-related SSCs are located above the flood levels in all buildings containing safety-related equipment. In addition, other design features such as adequacy of the physical separation, all safety-related equipment areas being protected from cross-divisional flooding, watertight doors with indicators in the control room are verified in the ITAAC. As-built flood walk-downs as part of the ITAAC would assure these design features are fully implemented. In all buildings containing safety-related equipment, ITAAC should verify barrier integrity below the flood level and should verify the flood protection design features above the flood level (e.g., watertight doors and position indicators) are properly implemented.

Response to Question 03.04.01-7:

A response to this question will be provided by February 26, 2009.

Question 03.09.03-16:

In FSAR Section 3.9.3, AREVA states that a COL applicant that references the U.S. EPR design certification will prepare the design specifications and design reports for ASME Class 1, 2, and 3 components, piping, supports and core supports structures that comply with and are certified to the requirements of Section III of the ASME Code. In order for the staff to reach a reasonable assurance finding based on the requirements of 10 CFR 52.47, however, certain information is required during the NRC review of the design certification application. The staff requests that AREVA commit to provide the design specifications of risk-significant mechanical components, as a minimum, for NRC audit. This is to ensure that the components are ready to be procured, and that the DCD design methodologies and criteria are adequately reflected in the associated component design specifications. As for the design reports, the staff requests that AREVA discuss in the DCD its plan and schedule of making the as-designed design reports of EPR major mechanical components available for NRC audit, e.g., through an ITAAC, to ensure that a vehicle of verifying the completion of the EPR component design is established.

Response to Question 03.09.03-16:

See the response to RAI 107, Question 03.09.03-4.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

U.S. EPR Final Safety Analysis Report Markups

3.4 Water Level (Flood) Design

03.04.01-4

In accordance with GDC 2 and RG 1.29, the Seismic Category I structures, systems, and components (~~SSCs~~SSC) identified in ~~Section 3.2~~Table 3.2.2-1 can withstand the effects of flooding due to natural phenomena or onsite equipment failures, without losing the capability to perform their safety-related functions. A description of these structures is provided in Section 3.8. The U.S. EPR design meets the requirements of GDC 4 because safety-related ~~SSCs~~SSC accommodate the effects of discharged fluid resulting from the high- and moderate-energy line breaks postulated in Sections 3.6.1 and 3.6.2 The criteria in RG 1.59 and ANSI/ANS-2.8-1992 "Determining Design Basis Flooding at Power Reactor Sites" (Reference 1) are used to establish the probable maximum flood (PMF), probable maximum precipitation (PMP), seiche, and other hydrologic considerations. The flood protection measures for Seismic Category I ~~SSCs~~SSC are designed in accordance with RG 1.102. Section 2.4 provides further information on hydrologic engineering. Section 2.5 provides information on safe shutdown earthquake ground motion. Section 3.8 provides information on the design of Seismic Category I structures. The risk assessment for external and internal flooding is provided in the U.S. EPR probabilistic risk assessment addressed in Chapter 19.

3.4.1 Internal Flood Protection

The U.S. EPR includes measures for protecting safety-related ~~SSCs~~SSC against the effects of internal flooding from postulated flooding sources. These measures also protect safety-related ~~SSCs~~SSC from flooding from non safety-related ~~SSCs~~SSC that are not required to be protected from either internal or external flooding. Because of these measures, a failure of components due to an internal flooding event will not prevent safe shutdown of the plant or mitigation of the flooding event. The nuclear island general arrangement drawings in Section 3.8 are a useful reference for the following description of protective measures for internal flooding.

The principal protective measure for Seismic Category I buildings is physical separation of the redundant safe shutdown systems and components. The plant arrangement provides divisional separation walls to physically separate the redundant trains of safe shutdown systems and components. A combination of fluid diversion flow paths and passive features contain the water within the affected division.

Division walls below elevation +0 feet, 0 inches (hereinafter +0 feet) provide separation and serve as flood barriers to prevent flood waters spreading to adjacent divisions. These division walls are watertight, have no doors, and a minimal number of penetrations. Water is directed within one division to the building elevations below +0 feet, where it is stored. Above elevation +0 feet, a combination of watertight doors and openings for water flow to the lower building levels prevent water ingress into adjacent divisions. Watertight doors have position indicators for control of the closed