

Request for Additional Information No. 132 (1013), Revision 0

11/18/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020

SRP Section: 14.03.02 - Structural and Systems Engineering - Inspections, Tests, Analyses, and Acceptance Criteria

Application Section: EPR FSAR Tier 2 Section 14.3.2 and Tier 1 Section 2.1

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)

14.03.02-11

General

10 CFR 52.47(be)(1) requires the DC application contain the proposed inspections, tests, and analysis that, if performed and the acceptance criteria is met, will provide assurance that the plant will be built and operate in accordance with the Design Certification, the Atomic Energy Act and NRC regulations. The top level requirements for Building Structures are found in the General Design Criteria (GDC) of 10 CFR Par 50 Appendix A which include GDC 1, "Quality Standards and Records", GDC 2, Design Bases for the Protection Against Natural Phenomena", GDC 4, "Environmental and Dynamic Effects Design Basis", GDC 16, "Containment Design", and GDC 50, "Containment Design Basis". The RAIs which follow pertain to EPR FSAR Tier 1 Section 2.1 and the associated ITAAC tables as they relate to Building Structures.

Specific RAIs

1. EPR FSAR Tier 1 Section 2.1.1 Nuclear Island (NI) provides design descriptions of NI structures including RB (RSB and RCB), SBs, FB, MSV and MFV. The staff review of the section determined that the design descriptions provided in the section are too brief and lack key information with acceptable level of details. The applicant is requested to revise and augment the Section 2.1.1 design descriptions with additional information including the following design characteristics, as applicable, for each of the NI structures:

- a. The dynamic, static and thermal loading conditions associated with the various loads and load combinations, which form the structural design basis. The loads described in the design descriptions should be (as applicable) those associated with:

Natural phenomena - wind, floods, tornados (including tornado missiles), earthquakes, rain and snow.

Internal events - floods, pipe breaks including LOCA and missiles.

Normal plant operation - live loads, dead loads, temperature effects and building vibration loads.

- b. The functional arrangement of each NI structure that is referenced to appropriate figures with sufficient information (e.g., designation of column lines/wall lines and floor elevations) for identification of walls and floor slabs needed for configuration validation inspections and other ITAAC inspections.
- c. The critical dimensions used for seismic analyses with references to structural element dimensions and acceptable tolerances
- d. Key system analysis parameters such as the structural holdup volume and delay release of radioactivity to the environment that is consistent with the LOCA dose analysis assumptions.
- e. Description of key design basis, such as, fire barriers for separation of independent safe shut down trains.
- f. Design basis for NI structures against external and internal floods including discussion of wall thicknesses below flood level designed to withstand hydrostatic loads, water stops provided in all expansion and construction joints below flood and groundwater levels, water seals in external walls at pipe penetrations below flood and groundwater levels, roofs designed to prevent pooling of large amounts of water in excess of the structural capacity of the roof for design loads and waterproofing of below flood and groundwater level external surfaces for external flood design.
- g. Protective features used to mitigate or eliminate the consequences of internal flooding.
- h. Description of applicable basis for protection against pressurization effects associated with postulated rupture of pipes.

2. EPR FSAR Tier 1 Figures 2.1.1-1 through 2.1.1-13 and similar figures provided in Sections 2.1.2 through 2.1.5 are considered by the staff as nothing more than a pictorial depictions of EPR structures with names of structures annotated therein, thus, would not be useful for the purposes of EPR structural ITAAC implementation. The applicant is requested to revise the sections and provide complete and more detailed structural drawings needed for ITTAC inspections including structural design, analysis and configuration validation work.
3. For each NI structure described in Section 2.1.1 and structures discussed in Section 2.1.2 through 2.1.5, as appropriate, provide tables listing critical dimensions and locations of key structural walls, slabs and other elements needed for implementing configuration validation ITAAC. The column heading of a table depicting critical dimensions of structures should include: Label, Wall or Section Description, Column Line or Region, Floor Elevation or Elevation Range (EL: mm), Concrete Thickness (mm), and Tolerance (mm).
4. With respect to item 2.1 of EPR FSAR Tier 1 Table 2.1.1-7 – Nuclear Island ITAAC (5 sheets), the wording under “Commitment Wording” column states that “ The as-installed basic configuration of the NI structures is as described in Section 2.1.1, and as shown on Figures 2.1.1-1, 2.1.1-3, 2.1.1-4, and 2.1.1.5.” The staff reviewed the noted section and figures and determined that the design description as provided is incomplete and lacks necessary detail information, and the figures shown are nothing more than pictorial depictions of the NI structures and do not contain required information for adequate execution of ITAAC related inspections. Further more, the information provided under the “Acceptance Criteria” column generally pertains to verification of relative positions/locations among NI structures, and is judged not really relevant for ITTAC inspections including structural design, analysis and configuration validation work. The applicant is requested to revise Tables 2.1.1-7 to provide more substantive ITAAC related information, and to reflect the staff comments and concerns raised in items (1), (2) and (3) above, such that the revised table would clearly describe the applicant’s commitments, intended ITAAC actions and their applicable acceptance criteria for implementing the ITAAC for the NI structures pursuant to 10 CFR 52.47(b)(1). In summary, the staff determined that the table as presented is incomplete and inadequate to serve as the needed basis for implementation of an acceptable ITAAC for EPR NI structures. The applicant should provide its NI structures ITAAC plans, commitments, methods of implementation and as-built structural inspection/validation plans that are consistent, in scope, clarity and level of detail, with those provided in other recent design certification applications that were found acceptable by the staff. For other EPR structures discussed in EPR FSAR Tier 1 Sections 2.1.2 through 2.1.5, the staff expects that similar scope, clarity and level of detail as discussed above should be provided in their respective ITAAC design descriptions and tables.

5. In Tier 1, FSAR Section 2.1.1, Nuclear Island, under description it states that dimensions on figures are for information only. As the spatial separation of buildings, building dimensions, floor and wall thicknesses are developed in Tier 2 documents and have a direct impact on the ability of structures to perform their safety-related function, the critical dimensions need to be provided as a key inspection attribute for each Nuclear Island structure (also refer to item (3) above).
6. In Tier 1, FSAR Section 2.1.1, under 1.0 "Description" it does not include flood loads as a design requirement for Nuclear Island structures. This is a requirement under GDC 2. The design features to protect against flood and water ingress for safety-related structures needs to be added as an ITAAC requirement to Table 2.1.1-7.
7. In Tier 1, FSAR Section 2.1.1 it states that the primary functions of the RCB are to protect the safety-related systems, structures and components (SSCs) located within it, to prevent the release of radiation during plant operations, to prevent the release of radiation during plant operations and to prevent the release of radiation and contamination in the event of accident conditions. To meet the requirements of GDC 16 and GDC 50, this last phrase in this sentence needs to be revised to state that one of the primary functions of the RCB is to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity and to accommodate without exceeding the design leakage rate and with sufficient margin the calculated pressure and temperature conditions resulting from any loss of coolant accident. The ITAAC provided in Table 2.1.1-7, item 4.3 does not address the building leak rate and pressure test which is the major test verification for this structure. This requirement needs to be added to the ITAAC table.(also refer to item (4) above).
8. In Tier 1, FSAR Section 2.1.1, it states that a slight negative pressure is maintained in the RBA to facilitate the secondary function of the RSB, which is to provide a barrier to the release of contamination. If a slightly negative pressure is a Tier 1 safety-related requirement for the RSB, a corresponding ITAAC needs to be provided in Table 2.1.1-7 (also refer to item (4) above).
9. In Tier 1, FSAR Section 2.1.1, on page 2.1-2, it states that downward expansion of the lower head is limited by concrete support structures which preserve sufficient space for the outflow of melt and the later formation of a molten pool in the reactor cavity. The Tier 1 design features of the RCB internal structure as it relates to containment of a core melt needs to be added as an ITAAC requirement in Table 2.1.1-7. The same level of details and scope as defined in item (4) above should apply to ITAAC for internal structures.
10. In FSAR Section 2.1.1, under 4.0 Mechanical Design Features, paragraph 4.4, Seismic 1E Classifications, paragraph 4.4 references Table 2.1.1-1, Separation for Internal Hazards Including Fire, Flooding and High Energy Line Break. The table does not provide the internal hazard for which a wall, slab or door must be designed, nor is there a thicknesses requirement provided for the walls or slabs. Table 2.1.1-1 should be revised to provide this information as it is necessary to perform a complete inspection and to reconcile the as-built features with design

basis for the structure and the protection features it is supposed to provide. As GDC 2 and 4 are requirements in the design of safety-related SSCs, the ITAAC should be clear in identifying what protection is required for these hazards and how it is provided.

11. In Tier 1, FSAR Table 2.1.1-7, Nuclear Island ITAAC, the method for documenting that the acceptance criteria has been met needs to be provided for each of the ITAAC commitments in this table. This same requirement needs to be provided in the other ITAAC tables contained in FSAR Section 2.1.
12. In Tier 1, Table 2.1.1-7, item 3.4 under Commitment Wording it states that core melt cannot relocate to upper containment due to the existence of concrete barriers as shown on Figure 2.1.1-13. There is no reference to the required slab thicknesses, or to any other attribute that is necessary for these slabs to perform their safety-related function. The requirements for these slabs should be provided in FSAR Section 2.1.1 and the inspection and acceptance criteria of Table 2.1.1-7 should be revised to reflect these requirements.
13. In Tier 1, Table 2.1.1-7, item 4.2 under Commitment Wording it states that the NI structures are constructed to withstand design basis loads as specified in Section 2.1.1. The section referenced does not contain all design basis loads, such as earthquake and flood which are required under GDC 2. FSAR Section 2.1.1 should be revised to contain all design basis loads required for NI structures. Also for item 4.2 under Inspection Test or Analysis, it states that a verification inspection of the NI structures design analysis versus construction records will be performed. This wording needs to be revised to reflect the requirements of SRP 14.3.2 which states that an analysis will be performed to reconcile the as-built conditions with the structural design basis loads and approved design documents. Under Acceptance Criteria, the wording needs to be revised to comply with the SRP which requires the results of the analysis need to be documented in a structural analysis report (see also items (1) and (4) above).
14. In Tier 1, Table 2.1.1-7, item 2.1 under the Inspection, Analysis, or Test, for (b) it states that an analysis will be performed. The type and stated purpose of the analysis needs to be provided (see also item (4) above).
15. In Tier 1, Table 2.1.1-7, item 3.1 under Commitment Wording, as items (b) and (c) are to verify the decoupling of structures to assure they can meet their safety-related function, it is necessary that gap dimensions between these structures be provided as an inspection attribute. The gaps should be provided in Table 2.1.1-7 or referenced in a separate table (see also item (4) above).
16. In Tier 1, Table 2.1.1-7, item 4.4 it states that the basic configuration of the NI structures separates the four SBs so that the impact of internal hazards is contained in the SB of hazard origination. In order to contain the internal hazard, it is necessary to not only determine that a wall exists, but also that it is of sufficient thickness to protect adjoining rooms and equipment. A table of wall thicknesses should be developed which identifies for internal hazards, the nature of the hazard, the room location and required wall or slab thicknesses to contain the hazard (see also item (3) above).

17. In Tier 1, FSAR Section Table 2.1.1-7, item 4.7, under Commitment Wording, it states that the RBA is separated from the SBs and FB by barriers, doors, dampers and penetrations that have a minimum three hour fire rating. Under the column Inspections, Analysis or Test, Item (a), it states that an analysis will be performed. It does not state the type of analysis or the purpose of the analysis. This information needs to be provided. Under the column titled Acceptance Criteria, for item (b), it states that the as-built configuration for barriers, doors, dampers and penetrations that separate the RBA from the SBs and FB agree with construction drawings. This should be revised to state that the as-built configuration agrees with the design basis, construction drawings, approved changes to the design documents including procurement specifications that provided the fire rating requirements for penetrations, doors and dampers (see also item (4) above).
18. In Tier 1, Table 2.1.1-7, item 4.9 under Inspection, Analysis or Test it states an analysis will be performed but does not describe the analysis purpose or what type of analysis will be performed to indicate that essential SSCs are protected from the dynamic effects of pipe breaks. This information needs to be added to the table. Table 2.1.1-4 provides RCB rooms with pipe whip restraints, but does not identify what is being protected. This needs to be identified and added as an ITAAC to item 4.9 (see also item (4) above).
19. In Tier 1, Table 2.1.1-7, item 4.13 under commitment wording it states that rooms within the SBs and the FB below elevations 0' 0" are provided with sufficient interconnections to keep the maximum released water volume stored within the affected division. It is not clear what the source or volume of the water is and which rooms must be interconnected to keep the maximum released water within the affected division. The boundaries of the affected divisions are also not provided. This information needs to be supplied and a revision provided to the Inspection, Analysis or Test, and Acceptance Criteria (see also item (4) above)..
20. In Tier 1, Table 2.1.2-2, item 4.3 for the EPGB and Table 2.1.5-2, item 4.3 for the ESWB, under Inspection, Analysis, or Test, it states that a verification of the structures' seismic design analysis versus construction records will be performed. In Tier 1, Section 2.1.2 for the EPGB and Tier 1, Section 2.1.5 for the ESWB, it states that each structure is to be designed for external loads including loads due to SSE earthquake, tornado, missiles, and flood. The wording in Table 2.1.2-2 needs to be revised to reflect the requirements of SRP 14.3.2 which states that an analysis is to be performed to reconcile the as-built conditions with the structural design basis loads and approved design documents. Under Acceptance Criteria, the wording needs to be revised to comply with the SRP which requires the results of the analysis need to be documented in a structural analysis report (see also item (4) above)..
21. In Tier 1, FSAR Section 2.1.2, Emergency Power Generating Buildings, under 1.0 "Description" it states that dimensions on figures are for information only. As the building size, floor and wall thicknesses are developed in Tier 2 documents and have a direct impact on the ability of structures to perform their safety-related function, the critical design dimensions need to be provided as key

inspection attributes for determining structural acceptance of the EPGB (see also items 2 and 4 above).

22. In Tier 1, FSAR Section 2.1.2, under 4.0 “Mechanical Design Features, Seismic 1E Classification, it states that the EPGBs are separated to address internal hazards including fire and flood as described in Table 2.1.2-1. However this table does not specify the hazards for which the wall provides protection from and does not indicate that any slabs are required for protection although there are fan rooms above the main floor of each building. A table should be provided which identifies for each room the hazard along with the associated barrier and required thickness that is necessary to provide protection to adjoining rooms (see also items (3) and (4)).
23. In FSAR Table 2.1.2-2, item 4.1, it states that the elevation is at 0’ 0” which for the FSAR is supposed to be one foot above the Probable Maximum Flood (PMF) elevation. Under the column titled Inspection Analysis or Test, it states that an inspection of the EPGB site grade level will be performed. This needs to be reworded to confirm that the grade elevation for the structure is one foot above the PMF (see also items (3) and (4)).
24. In Tier 1, FSAR Section 2.1.3 covering the Nuclear Auxiliary Building, the only ITAAC requirement for this structure is verification of a physical location and a requirement for a seismic separation. However in Tier 2 Section 3.8.4 it states that the NAB is designed so as not to fail on the adjacent Fuel Building or SB4. There is no commitment wording that reflects this requirement and needs to be added to Section 2.1.3. In addition, as required by SRP 14.3.2, the ITAAC table needs to be revised to reconcile the as-built conditions with the structural design basis loads and approved design documents. Under Acceptance Criteria the results of the analysis need to be documented in a structural analysis report. In addition, it is not sufficient to merely verify there is a seismic separation between the NAB and adjacent structures. The required separation must be specified and verified to be correct (see also item (4) above)..
25. In Tier 1, FSAR Section 2.1.4 covering the Radioactive Waste Building, the only ITAAC requirements for this structure are to verify its physical location and to verify a seismic separation between the RWB and the surrounding buildings. However, this building needs to meet the requirements of RG 1.143 and as such must be designed for ½ SSE load as well as a reduced tornado load and a tornado missile as specified in Table 2 of the Regulatory Guide. The requirements for this building need to be added to Section 2.1.4. In addition, as required by SRP 14.3.2, the ITAAC table needs to be revised to reconcile the as-built conditions with the structural design basis loads and approved design documents. Under Acceptance Criteria, the results of the analysis need to be documented in a structural analysis report. In addition, it is not sufficient to merely verify there is a seismic separation between the NAB and adjacent structures. The required separation must be specified and verified to be correct (see also items 2 and 4 above).
26. In Tier 1, FSAR Section 2.1.5 covering the Essential Service Water Building, under 1.0 “Description” it states that the dimensions on figures are for information only. In fact the only dimension provided is the height to a roof level

from grade level. As the building size, floor and wall thicknesses are developed in Tier 2 documents and have a direct impact on the ability of the structure to perform its safety-related function, the critical design dimensions need to be provided as a key inspection attribute for determining structural acceptance of the ESWB (see also items 1, 2 and 3 above).

27. In Tier 1, FSAR Section 2.1.5, under 3.0 “Key Design Features” it states that two of the ESWBs located adjacent to the turbine building have five missile protection shields provided for the safety-related fans and pumps. It further states that these ESWBs are positioned favorably outside the low-trajectory hazard zone for turbine missiles. The design loads for the missile shields are not clear from the text and need to be provided. In ITAAC Table 2.1.5.2, item 3.2 which covers the missile shields, under Inspection, Analysis or Test it states that an inspection of the ESWBs will be performed. However, it does not provide two of the attributes (thickness and size) which the inspection must verify. These need to be added to the ITAAC table or referenced in a separate table (see also items 1 and 3 above).
28. In Tier 1, FSAR Section 2.1.5, under 4.0 “Mechanical Design Features, Seismic 1E Classifications,” it states that the ESWBs are separated to address internal hazards including fire and flood as described in Table 2.1.5-1. However this table does not provide the internal hazard for which a wall, slab or door must be designed, nor is there a thicknesses requirement provided for the walls or slabs. This table should be revised such that for each room, the hazard is identified as well as the barrier thickness that is required to provide hazards protection (see also items 1 and 3 above).
29. In Tier 1, FSAR Table 2.1.5-2, item 4.1 it states that the ESWB site grade level is at elevation 0’ 0” but does not specify the safety significance of this design feature. What needs to be verified is the depth of burial of the structure as this has an impact on the design loads for the building such as passive soil pressure loads on the building walls and the seismic loads which will have been developed from a soil-structure interaction analysis assuming a partly imbedded structure. The Commitment Wording, Inspection Analysis or Test, and Acceptance Criteria need to be revised to reflect these requirements (see also item 1 above).
30. With respect to Table 2.1.1-7 of Tier 1 FSAR, no discussion of the vent stack ITAAC is provided. The applicant is requested to provide information pertaining to ITAAC for the vent stack (see also items 1 and 3 above).