REQUEST FOR ADDITIONAL INFORMATION 454-3000 REVISION 0

9/9/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
Application Section: 19.1.5

QUESTIONS for Structural Engineering Branch 1 (AP1000/EPR Projects) (SEB1)

19-398

(Question 19-293 follow-up)
DCD FSAR Section 19.1.5.1, Table 19-1-51, lists the HCLPFs for US-APWR Structures, Systems and Components (SSCs). Most of the HCLPFs are generic values derived from the EPRI Utility Requirements Document (URD), Reference 19.1-35. The staff expectation at the DC stage is that the design of structures within the scope of DC is essentially complete. Consequently, it is also expected that all the critical structural sections are identified, and the structural HCLPF values are specific to USAPWR. Also, the in-structure response spectra at all reference locations are established. Table A.3-4 of the URD lists median capacity values based on local spectral acceleration with associated composite uncertainty, βc. The URD also lists median PGA capacities that are based on assumed structural response for different soil types. The applicant has used the PGA values directly from the URD without consideration of the specific amplification of the structures included in the US-APWR Design Certification. The in-structure response spectra for the PCCV, R/B, CIS and PS/B show higher amplification for some equipment locations than the generic amplification in the URD.

To verify that the generic HCLPFs are representative for the US-APWR PRA based SMA, the staff requests that the applicant compare the US-APWR in-structure spectra to the generic URD spectral acceleration capacities for bounding cases and confirm that the HCLPFs are at least 1.67 times the CSDRS.

The response to RAI 19-293 provided a portion of report MUAP-07030(R1) that contained the seismic fragility calculation for the containment structure. The staff has observed several areas where the calculation is not correct and other areas where assumptions are not justified. The staff requests the applicant to provide correction or further explanation/justification of the following items:

a) Spectral Shape Factor: The SME should be 1.67 times the CSDRS. NUREG/CR-0098 median spectral amplification is not applicable, thus the spectral shape factor is unity. The calculation requires correction.
b) Modeling factor: The uncertainty, βu, for frequency uncertainty is not zero as the CSDRS has a slope at the fundamental frequency of the structure. The calculation requires correction.
c) Modal Combination: Modal phasing varies with different earthquake time histories, thus βr is not zero. Ref. EPRI TR-103959 Pg. 3-19. The calculation requires correction.

d) Earthquake component combination: βr for ECC is not zero. For a vertical cylinder, two horizontal components in phase results in a vector acceleration of 1.414 times the single direction acceleration. For two directions in phase, consider this about a 1% probability and compute a value for βr for use in the fragility. Ref. EPRI TR-103959, pages 3-26 and 3-27.

e) Soil-structure interaction: 1.0 is stated in the calculation but 1.2 is used in Table 24.3-1 of the MUAP-07030(R1) PRA report. Clarify the value assumed and the calculation of fragility and the basis for the value. Also, if the SSI factor is greater than 1.0, assure that the rock case will not govern the fragility.

f) Inelastic energy absorption: A factor of 1.8 is assumed based on experience. A calculation should be done in accordance with EPRI TR-103959 assuming a story drift limit of 0.0075 as stated in Table 3-5 of EPRI TR-103959. The calculated value should be the basis for the inelastic energy absorption factor.

g) Capacity factor: The compressive stress induced by pre-stressing is included in the tangential shear capacity equation. At the basemat to cylinder interface where the maximum shear and overturning moment occur, the hoop compression is not fully developed due to the radial restraint of the basemat. Clarify and justify the basis for the prestressing compression stresses in the concrete used in the capacity calculation.

19-399

RAI 19-296 (follow-up question)
DCD FSAR Section 19.1.5.1, Table 19-1-51 lists a HCLPF for the fuel assembly (reactor internals and core assembly) as 0.5g. No basis for this HCLPF value was provided by the applicant. However, staff review finds that if the median PGA value and composite βc in Table A.3-4 of the EPRI Utility Requirements Document (URD), Reference 19.1-35, are used, the HCLPF would be less than 0.5g PGA.

Due to the safety significance of the fuel assemblies, the staff requests the applicant justify the HCLPF values using an acceptable approach e.g., test, analyses or bounding analyses that can be evaluated by the staff and conclude that the HCLPF value of the fuel assembly and the combined reactor support arrangement is at least 0.5g.

19-400

RAI 178-1930 (Question 19-297)
DCD Section 3.10.2.1, “Seismic Qualification of Instrumentation and Electrical Equipment” describes meeting the minimum requirements of IEEE 344 (Reference 3.10-6) for seismic qualification by testing or type testing. The staff believes that if fragilities are developed for function during and after the earthquake using EPRI-TR-103959, “Methodology for Developing Seismic Fragilities,” a HCLPF of 1.67 times the SSE will generally not be achieved, if only the minimum test level required by IEEE 344 is utilized. ASCE/SEI 43-05, “Seismic Design Criteria for Structures, Systems and Components,” recommends that a load factor of 1.4 be applied to the required response spectrum for components qualified by test. This is to guarantee that the HCLPF will be at least as high as the SSE.

The staff requests that the applicant describe how a HCLPF of 1.67 times the SSE will be achieved by qualification testing to the requirements of IEEE 344.

19-401

RAI 19-299 (follow-up question)
DCD Subsection 19.3.3 lists the resolution of COL Action Items relating to Chapter 19. COL Action Item 19.3 (5) states that when the design activity progresses, and specific design data become available, SSC fragilities are updated during the COLA phase to reflect design data. As discussed under Regulatory Bases above, the COLA needs to conduct a seismic PRA. Since the design of generic classes of commodities such as piping, valves, HVAC ducting, cable raceways, etc. will be conducted under a program of Design Acceptance Criteria, and the applicable Codes and Standards, their HCLPF values are to be verified under as-built condition. SSCs within the scope of certified design are expected to retain their seismic margin under as-built conditions Therefore, it is necessary to include an ITAAC to conduct a plant walk down and verify that the as-built SSC HPLPF values are at least equal to the 1.67 times the certified seismic design peak ground acceleration value prior to fuel load.

The staff requests that the applicant identify proposed ITAAC to provide reasonable assurance that, it the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC's regulations.