REQUEST FOR ADDITIONAL INFORMATION 218-1907 REVISION 0

2/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 03.03.02 - Tornado Loads
Application Section: 03.03.02 - Tornado Loadings

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

03.03.02-1

RAI 3.3.2-01

1. RAI Text

Meteorological and topographic conditions, which vary significantly within the continental United States, influence the frequency of occurrence and intensity of tornadoes. The NRC staff has determined that the design-basis tornado wind speeds for new reactors correspond to the exceedance frequency of 10^{-7} per year as stated in Regulatory Guide 1.76, Rev. 1. However, the applicant used a different exceedance frequency in the DCD. Because these exceedance frequency values are not the same, the applicant is requested to provide the technical basis for using a different exceedance frequency.

2. Concern

The US-APWR applicant states that:

> "The parameters listed above are based on US NRC RG 1.76, Rev. 1, dated March 2007 (Reference 3.3-4). The parameters are those of a region 1 tornado as defined therein, and envelope the tornadoes of all other regions in the contiguous US. The annual probability of exceedance of the design basis tornado described above is 10^{7} as discussed in RG 1.76 and the corresponding recurrence interval is approximately one million years."

Comparison of the text in Regulatory Guide 1.76, Rev. 1 and the text presented by the US-APWR applicant on the subject of tornado exceedance frequency indicates inconsistencies.

In order for the NRC staff to verify that the US-APWR applicant has a complete and thorough understanding of the design basis for tornado characteristics and tornado missiles for nuclear power plants, the applicant is requested to provide an explanation for the differences in exceedance frequency values.

3. Applicant References

DCD Tier 2, Revision 1, Section 3.3.2.1

4. Context

Structural integrity of Seismic Category I structures, which assures that SSCs important to safety are protected, and not compromised according to GDC-2 in the Appendix A to Part 50 of 10 CFR.

5. Priority/Impact

Medium – information is essential to completing a technical review and resolving a safety issue. The review can continue, but cannot be completed without the requested additional information.

6. Dependencies

Internal – There are interfaces with SRP Chapter 3.0, Section 3.5.1.4.
External – There are no external dependencies.

03.03.02-2

RAI 3.3.2-02

1. RAI Text

The design-basis tornado missile spectrum and maximum horizontal speeds that are acceptable to the NRC staff are defined in Table 2 of Regulatory Guide 1.76, Rev. 1. The three types of missiles included in the spectrum are (1) a schedule 40 pipe, (2) an automobile, and (3) a solid steel sphere. According to the US-APWR applicant:

> "Overall effects of missile impact are designed for flexural, shear, and buckling effects on structural members using the equivalent static load obtained from the evaluation of structural response. The impact is assumed to be plastic, and is determined as outlined in "Impact Effect of Fragments Striking Structural Elements" (Reference 3.3-6)."

Provide a description of the fragment spectrum considered in Reference 3.3-6 and identify the missiles included in the fragment spectrum, if any, which are capable of producing tornado missile impact effects that are more severe than those produced by the missiles listed in the missile spectrum defined in Regulatory Guide 1.76, Rev. 1.

2. Concern

Compliance with GDC 2 requires that nuclear power plant SSCs are designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their intended safety functions. The design-basis tornado-generated missile spectrum in Table 2 of Regulatory Guide 1.76, Rev. 1 is generally acceptable to the NRC staff for the design of nuclear power plants. However, other possible types of missiles that could adversely affect SSCs by reducing their capability to perform their intended safety functions should be analyzed by the applicant to ensure compliance with GDC 2 requirements.

In order for the NRC staff to verify compliance with requirements in GDC-2 in 10 CFR 50, Appendix A, the applicant is requested to provide information about all potential tornado-generated missiles and fragments identified by the applicant that could produce tornado-generated missile impact effects more severe than those produced by the missiles included in the missile spectrum defined in Regulatory Guide 1.76, Rev. 1.

3. Applicant References

DCD Tier 2, Revision 1, Section 3.3.2.2.3.

4. Context

Structural integrity of Seismic Category I structures, which assures that SSCs important to safety are protected, and not compromised according to GDC-2 in the Appendix A to Part 50 of 10 CFR.

5. Priority/Impact

Medium – information is essential to completing a technical review and resolving a safety issue. The review can continue, but cannot be completed without the requested additional information.

6. Dependencies

Internal – There are interfaces with SRP Chapter 3.0, Sections 3.5.1.4 and 3.5.3.
External – There are no external dependencies.

03.03.02-3

RAI 3.3.2-03

1. RAI Text

The two equations used by the applicant to determine the combined tornado effects are consistent with the two equations for combined tornado effects in SRP Section 3.3.2. However, the applicant is requested to provide additional information about the technical approach being used to ensure that the combination of tornado effects for a structure is established in a conservative manner.

2. Concern

Wind speed variation and atmospheric pressure change associated with the passage of a tornado are modeled as a single Rankine combined vortex as described in Regulatory Guide 1.76, Rev 1. These two phenomena produce tornado wind effects and atmospheric pressure change effects that can adversely affect the ability of SSCs to perform their intended safety functions. In addition, tornado-generated missiles can produce tornado missile impact effects that can affect SSCs. Determining the combination of these effects that controls the design of the SSCs in a conservative

manner requires an analysis that takes many different tornado-related variables and structural parameters into consideration.

In order for the NRC staff to verify compliance with requirements in GDC-2 in 10 CFR 50, Appendix A, the applicant is requested to provide a complete description of the approach taken by the applicant to ensure that the combination of tornado effects for each Seismic Category I structure is established in a conservative manner.

3. Applicant References

DCD Tier 2, Revision 1, Section 3.3.1.2.

4. Context

Structural integrity of Seismic Category I structures, which assures that SSCs important to safety are protected, and not compromised according to GDC-2 in the Appendix A to Part 50 of 10 CFR.

5. Priority/Impact

Medium – information is essential to completing a technical review and resolving a safety issue. The review can continue, but cannot be completed without the requested additional information.

6. Dependencies

Internal – There are interfaces with SRP Chapter 3.0, Sections 3.5.1.4 and 3.5.3.
External – There are no external dependencies.

03.03.02-4

RAI 3.3.2-04

1. RAI Text

The US-APWR applicant indicates that wind loading for the Power Source Buildings (PS/Bs) is determined using ASCE/SEI 7-05, Method 1 and tornado wind loading for enclosed and partially enclosed buildings is determined using ASCE/SEI 7-05, Method 2. Based on these statements, it is not clear as to whether the PS/Bs are analyzed using Method 1 or Method 2.

Provide information about the method used by the applicant to determine wind loading effects for the PS/Bs including an assessment of whether the PS/Bs are classified as enclosed or partially enclosed buildings and whether or not the PS/Bs have openings capable of venting atmospheric pressure changes caused by passage of a tornado.

2. Concern

The applicability of using ASCE/SEI 7-05, Method 1 or Method 2 to determine wind loading effects on a particular structure depends on conditions described in ASCE/SEI 7-05 Sections 6.4.1.1 and 6.5.1, respectively.

In order for the NRC staff to ensure that the safety of the PS/Bs is not compromised due to wind loading effects, the applicant is requested to provide information that explains which method will be used to determine the design wind loads for these structures. Additional information about the description of either Method 1 or Method 2, as appropriate, is requested to demonstrate compliance with GDC-2 in 10 CFR 50, Appendix A.

3. Applicant References

DCD Tier 2, Revision 1, Sections 3.3.1.2 and 3.3.2.2.1.

4. Context

Structural integrity of Seismic Category I structures, which assures that SSCs important to safety are protected, and not compromised according to GDC-2 in the Appendix A to Part 50 of 10 CFR.

5. Priority/Impact

Medium – information is essential to completing a technical review and resolving a safety issue. The review can continue, but cannot be completed without the requested additional information.

6. Dependencies

Internal – There are interfaces with SRP Chapter 3.0, Section 3.3.1.
External – There are no external dependencies.