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September 26, 2011

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffery A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-11326

Subject: MHI's Response to US-APWR DCD RAI No. 817-5990 Revision 3 (SRP 03.03.02)

Reference: 1) "Request for Additional Information No. 817-5990 Revision 3, SRP Section: 03.03.02 – Tornado Loads," dated 8/25/2011

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 817-5990, Revision 3."

Enclosed is the response to the RAI contained within Reference 1. This transmittal completes the response to this RAI.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

Sincerely,



Yoshiki Ogata,
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

DO81
NRO

Enclosure:

1. Response to Request for Additional Information No. 817-5590, Revision 3

CC: J. A. Ciocco
C. K. Paulson

Contact Information

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Docket No. 52-021
MHI Ref: UAP-HF-11326

Enclosure 1

UAP-HF-11326
Docket No. 52-021

Response to Request for Additional Information No. 817-5990,
Revision 3

September, 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/26/2011

**US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021**

RAI NO.: NO. 817-5990 REVISION 3
SRP SECTION: 03.03.02 – Tornado Loads
APPLICATION SECTION: 3.3.2
DATE OF RAI ISSUE: 8/25/2011

**QUESTIONS FOR STRUCTURAL ENGINEERING BRANCH 1 (AP1000/EPR PROJECTS)
(SEB1)**

QUESTION NO. 03.03.02-5:

1. RAI Text

The US-APWR applicant is requested to provide the rationale used to determine that ASCE/SEI 7-05, Section 6.5.1, Method 2, Condition 2 is satisfied for the PCCV and the R/B, and that ASCE/SEI 7-05, Section 6.4.1.1, Method 1, Condition 6 is satisfied for the PS/Bs at any site where a nuclear power plant may be located. The applicant is also requested to identify the responsibilities of the COL applicant for the actions that the COL applicant needs to take to verify that ASCE/SEI 7-05, Section 6.5.1, Method 2, Condition 2 is satisfied for the PCCV and the R/B, and that ASCE/SEI 7-05, Section 6.4.1.1, Method 1, Condition 6 is satisfied for the PS/Bs based on site-specific conditions for these structures.

2. Concern

US-APWR DCD Sec. 3.3.2, Revision 3 includes the following text.

Specific descriptions of wind load design method and importance factor for US-APWR standard structures are as follows.

- The US-APWR PCCV has a relatively low profile (overall height-to-diameter ratio of approximately 1.5), and the PCCV is surrounded by the rectangular-shaped R/B such that approximately only the upper half of the PCCV is exposed to wind loading. The PCCV does not have response characteristics which make it subject to across wind loading, vortex shedding, or other unusual wind effects which might require investigation using method 3 (wind tunnel procedure) of ASCE/SEI 7-05. Further, the site location of the PCCV is such that channeling or buffeting effects do not warrant special consideration. Therefore, the PCCV is also analyzed using method 2 of ASCE/SEI 7-05.
- The R/B (seismic category I), the A/B (seismic category II), and the T/B (seismic category II) are analyzed using method 2 and an importance factor of 1.15.

- The US-APWR east and west PS/Bs (seismic category I) and the AC/B (nonseismic) are low-rise, simple rigid diaphragm buildings which conform to the requirements of ASCE/SEI 7-05 Subsections 6.4.1.1 and 6.4.1.2. Therefore, these buildings have been analyzed using method 1 of ASCE/SEI 7-05 (Reference 3.3-1).

According to ASCE/SEI 7-05, Section 6.5.1, Method 2 can only be used if the building or other structure meets the following condition.

2. The building or other structure does not have response characteristics making it subject to across wind loading, vortex shedding, instability due to galloping or flutter; or does not have a site location for which channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.

Similarly, according to ASCE/SEI 7-05, Section 6.4.1.1, Method 1 can only be used if the building meets the following condition.

6. The building or other structure does not have response characteristics making it subject to across wind loading, vortex shedding, instability due to galloping or flutter; or does not have a site location for which channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.

Accordingly, in order for the ASCE SEI 7-05 methods to be applicable as committed, the COL applicant is requested to verify that the PCCV, R/B, and PS/Bs do not have site locations for which channeling effects or buffeting in the wake of upwind obstructions warrant special considerations. This COL action item should be included in Table 1.8-2 of the DCD.

ANSWER:

Please note that the DCD text being quoted in the RAI is from DCD Section 3.3.1, "Wind Loadings", not Section 3.3.2, "Tornado Loadings". DCD Subsection 3.3.1.1 states that the exposure category is category C, and that this envelopes sites that are in exposure category D. As described in ASCE/SEI 7-05 Subsections 6.5.6.2 and 6.5.6.3, exposure categories C and D exclude urban areas with tall buildings and topographic areas with mountain gorges or hills that can cause channeling effects or wakes. Therefore, any such site features that would contradict the standard plant design basis exposure category C and D conditions could be addressed by the COL Applicant as a departure. However, as suggested by the NRC staff, COL Applicants will be specifically requested to verify that site locations do not have features that promote channeling effects or buffeting in the wake of upwind obstructions that warrant special considerations. DCD Subsection 3.3.1.2 will be expanded as indicated in "Impact on DCD" below to add the verification requirement. COL Action Item 3.3(4), and Table 1.8-2 of the DCD will also be revised accordingly as indicated in "Impact on DCD" below.

Impact on DCD

See the Attachment 1 mark-up of DCD Tier 2, Subsection 3.3, changes to be incorporated.

The last paragraph in DCD Subsection 3.3.1.2 and COL Action Item 3.3(4) will be revised to read as follows.

"The COL Applicant is to provide the wind load design method and importance factor for site-specific seismic category I and seismic category II buildings and

structures. The COL Applicant shall also verify that the site location does not have features promoting channeling effects or buffeting in the wake of upwind obstructions that invalidate the standard plant wind load design methods described above.”

See the Attachment 2 mark-up of DCD Tier 2, Subsection 1.8, changes to be incorporated.

COL Action Item 3.3(4) in Table 1.8-2 will be revised to read as follows.

“The COL Applicant is to provide the wind load design method and importance factor for site-specific seismic category I and seismic category II buildings and structures. The COL Applicant shall also verify that the site location does not have features promoting channeling effects or buffeting in the wake of upwind obstructions that invalidate the standard plant wind load design methods described above.”

Impact on R-COLA

The revised COL Action Item 3.3(4) above will be addressed in the R-COLA with mark-ups in a future revision to the R-COLA.

Impact on S-COLA

The revised COL Action Item 3.3(4) above will be addressed in the S-COLA with mark-ups in a future revision to the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on a Technical/Topical Report.

This completes MHI's responses to the NRC's question.

- ii. a negative value of GC_{pi} applied to all internal surfaces

Non-building structures and components and cladding are designed using effective wind velocity force and pressure formulae from ASCE/SEI 7-05 (Reference 3.3-1), consistent with those described above.

All US-APWR and site-specific structures and components subject to wind loads are designed using the same basic wind speed defined in Subsection 3.3.1.1. For certain non-seismic, non-safety related structures and components, an importance factor may be used that is less than that for seismic category I and II structures. Those structures and components that are designed with a lower importance factor are investigated to assure that their failure would impact neither the function nor integrity of adjacent safety-related SSCs, nor result in the generation of missiles having more severe effects than those discussed in Subsection 3.5.1.4. Where required by the results of the investigation, structural reinforcement and/or missile barriers are implemented so as not to jeopardize safety-related SSCs due to failure effects from wind loads.

Specific descriptions of wind load design method and importance factor for US-APWR standard structures are as follows.

- The US-APWR PCCV has a relatively low profile (overall height-to-diameter ratio of approximately 1.5), and the PCCV is surrounded by the rectangular-shaped R/B such that approximately only the upper half of the PCCV is exposed to wind loading. The PCCV does not have response characteristics which make it subject to across wind loading, vortex shedding, or other unusual wind effects which might require investigation using method 3 (wind tunnel procedure) of ASCE/SEI 7-05. Further, the site location of the PCCV is such that channeling or buffeting effects do not warrant special consideration. Therefore, the PCCV is also analyzed using method 2 of ASCE/SEI 7-05 (Reference 3.3-1).
- The R/B (seismic category I), the A/B (seismic category II), and the T/B (seismic category II) are analyzed using method 2 and an importance factor of 1.15.
- The US-APWR east and west PS/Bs (seismic category I) and the AC/B (non-seismic) are low-rise, simple rigid diaphragm buildings which conform to the requirements of ASCE/SEI 7-05 Subsections 6.4.1.1 and 6.4.1.2. Therefore, these buildings have been analyzed using method 1 of ASCE/SEI 7-05 (Reference 3.3-1).

The COL Applicant is to provide the wind load design method and importance factor for site-specific seismic category I and seismic category II buildings and structures. The COL Applicant shall also verify that the site location does not have features promoting channeling effects or buffeting in the wake of upwind obstructions that invalidate the standard plant wind load design methods described above.

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3.3.2 Tornado Loadings

The US-APWR standard and site-specific plant is designed to protect SSCs listed in the Appendix to US NRC RG 1.117, Revision 1, dated April 1978 (Reference 3.3-3).

3. DESIGN OF STRUCTURES, SYSTEMS, COMPONENTS, AND EQUIPMENT

US-APWR Design

ATTACHMENT 1
to RAI 817-5990

- COL 3.3(3) *It is the responsibility of the COL Applicant to assure that site-specific structures and components not designed for tornado loads will not impact either the function or integrity of adjacent safety-related SSCs, or generate missiles having more severe effects than those discussed in Subsection 3.5.1.4.*
- COL 3.3(4) *The COL Applicant is to provide the wind load design method and importance factor for site-specific category I and category II buildings and structures. The COL Applicant shall also verify that the site location does not have features promoting channeling effects or buffeting in the wake of upwind obstructions that invalidate the standard plant wind load design methods described above.*
- COL 3.3(5) *The COL Applicant is to note the vented and unvented requirements of this subsection to the site-specific category I buildings and structures.*

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3.3.4 References

- 3.3-1 Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers/Structural Engineering Institute, ASCE/SEI 7-05, Reston, Virginia, 2006.
- 3.3-2 Wind Loads, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, NUREG-0800, United States Nuclear Regulatory Commission SRP 3.3.1, Rev. 3, March 2007.
- 3.3-3 Tornado Design Classification, United States Nuclear Regulatory Commission Regulatory Guide 1.117, Rev. 1, April 1978.
- 3.3-4 Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants, United States Nuclear Regulatory Commission Regulatory Guide 1.76, Rev. 1, March 2007.
- 3.3-5 Tornado Loads, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, NUREG-0800, United States Nuclear Regulatory Commission SRP 3.3.2, Rev. 3, March 2007.
- 3.3-6 Williamson, R.A. and Alvy, R.R., Impact Effect of Fragments Striking Structural Elements, Holmes and Narver, Inc. Publishers, November 1973.
- 3.3-7 Tornado and Extreme Wind Design Criteria for Nuclear Power Plants, Bechtel Topical Report BC-TOP-3-A, Bechtel Power Corporation, San Francisco, California, Rev. 3, August 1974.

Table 1.8-2 Compilation of All Combined License Applicant Items for Chapters 1-19 (Sheet 3 of 35)

COL ITEM NO.	COL ITEM
COL 3.3(4)	<i>The COL Applicant is to provide the wind load design method and importance factor for site-specific category I and category II buildings and structures. The COL Applicant shall also verify that the site location does not have features promoting channeling effects or buffeting in the wake of upwind obstructions that invalidate the standard plant wind load design methods described above.</i>
COL 3.3(5)	<i>The COL Applicant is to note the vented and unvented requirements of this subsection to the site-specific category I buildings and structures.</i>
COL 3.4(1)	<i>The COL Applicant is to address the site-specific design of plant grading and drainage.</i>
COL 3.4(2)	<i>The COL Applicant is to demonstrate the DBFL bounds their specific site, or is to identify and address applicable site conditions where static flood level exceed the DBFL and/or generate dynamic flooding forces.</i>
COL 3.4(3)	<i>Site-specific flooding hazards from engineered features, such as from cooling water system piping, is to be addressed by the COL Applicant.</i>
COL 3.4(4)	<i>The COL Applicant is to address any additional measures below grade to protect against exterior flooding and the intrusion of ground water into seismic category I buildings and structures.</i>
COL 3.4(5)	<i>The COL Applicant is to identify and design, if necessary, any site-specific flood protection measures such as levees, seawalls, floodwalls, site bulkheads, revetments, or breakwaters per the guidelines of RG 1.102 (Reference 3.4-3), or dewatering system if the plant is not built above the DBFL.</i>
COL 3.4(6)	<i>The COL Applicant is to identify any site-specific physical models used to predict prototype performance of hydraulic structures and systems.</i>
COL 3.4(7)	<i>The COL Applicant is responsible for the protection from internal flooding for those site-specific SSCs that provide nuclear safety-related functions or whose postulated failure due to internal flooding could adversely affect the ability of the plant to achieve and maintain a safe shutdown condition.</i>
COL 3.5(1)	<i>The COL Applicant is to have plant procedures in place prior to fuel load that specify unsecured equipment, including portable pressurized gas cylinders, located inside or outside containment and required for maintenance or undergoing maintenance is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile.</i>
COL 3.5(2)	<i>The COL Applicant is to commit to actions to maintain P1 within this acceptable limit as outlined in RG 1.115, "Protection Against LowTrajectory Turbine Missiles" (Reference 3.5-6) and SRP Section 3.5.1.3, "Turbine Missiles" (Reference 3.5-7).</i>
COL 3.5(3)	<i>As described in DCD, Section 2.2, the COL Applicant is to establish the presence of potential hazards, except aircraft, which is reviewed in Subsection 3.5.1.6, and the effects of potential accidents in the vicinity of the site.</i>

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