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TOKYO, JAPAN

April 14, 2010

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

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-10103

Subject: MHI's Response to US-APWR DCD RAI No.547-4426 Revision 2

References: 1) "Request for Additional Information No.547-4426 Revision 2, SRP Section: 02.03.01 – Regional Climatology, Application Section: DCD Tier 1 Table 2.1-1 and Tier 2 Table 2.0-1 dated March 15, 2010.

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.547-4426 Revision 2".

Enclosed are the responses to 3 RAIs contained within Reference 1.

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

Sincerely,

Y. Ogata

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

Enclosure:

1. Response to Request for Additional Information No. 547-4426, Revision 2

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

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Enclosure 1

UAP-HF-10103
Docket Number 52-021

Response to Request for Additional Information
No. 547-4426, Revision 2

April, 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/14/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 547-4426 REVISION 2**
SRP SECTION:	**02.03.01 – Regional Climatology**
APPLICATION SECTION:	**DCD Tier 1 Table 2.1-1 and Tier 2 Table 2.0-1**
DATE OF RAI ISSUE:	**03/15/2010**

QUESTION NO. RAI 02.03.01-17:

DCD Revision 2 changed one of the site parameter descriptions in Tier 1, Table 2.1-1 and Tier 2, Table 2.0-1 from:

> "Roof Snow Load (100-year snowpack maximum snow weight including contributing portion of 48-hour probable maximum winter precipitation [PMWP])"

to

> "*Extreme winter precipitation roof load* (100-year snowpack maximum snow weight including contributing portion of *either extreme frozen winter precipitation event or extreme liquid winter precipitation event*)"

and added footnote #12 which describes the basis for the extreme winter precipitation roof load.

Footnote #12 is a more accurate description of the *extreme winter precipitation roof load* site parameter than that provided within the parenthesis of the parameter description provided in Tier 1 Table 2.1-1 and Tier 2 Table 2.0-1 (i.e., footnote #12 states the extreme winter precipitation roof load is based on the sum of the normal ground level winter precipitation plus the highest weight at ground level resulting from either the extreme frozen winter precipitation event or the extreme liquid winter precipitation event). Consequently, please consider deleting the information within the parenthesis of the *extreme winter precipitation roof load* site parameter descriptions provided in Tier 1 Table 2.1-1 and Tier 2 Table 2.0-1.

ANSWER:

MHI agrees the information contained in footnote #12 to Tier 1 Table 2.1-1 and Tier 2 Table 2.0-1 adequately describes extreme winter precipitation roof load. The parenthetical information for extreme winter precipitation roof load contained in Tier 1 Table 2.1-1 and Tier 2 Table 2.0-1 will be deleted.

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Table 2.0-1, changes to be incorporated.

- Replace the parameter description for the 3rd Row of Table 2.0-1, Sheet 1 with the following:

  "Extreme winter precipitation roof load(12)"

See Attachment 2 for the mark-up of DCD Tier 1, Table 2.1-1, changes to be incorporated.

- Replace the parameter description for the 3rd Row of Table 2.1-1, Sheet 1 with the following:

  "Extreme winter precipitation roof load(12)"

Impact on COLA

- The parenthetical information in the parameter description for extreme winter precipitation roof load in R-COLA Table 2.0-1R (Sheet 1 of 12) is to be deleted.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/14/2010

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

RAI NO.:	**NO. 547-4426 REVISION 2**
SRP SECTION:	**02.03.01 – Regional Climatology**
APPLICATION SECTION:	**DCD Tier 1 Table 2.1-1 and Tier 2 Table 2.0-1**
DATE OF RAI ISSUE:	**03/15/2010**

QUESTION NO. RAI 02.03.01-18:

Footnote #13 to DCD Tier 1, Table 2.1-1, and footnote #13 to DCD Tier 2, Table 2.0-1 both state that the 48-hour probable maximum winter precipitation (PMWP) is based on interpolation of 24-hour PMP and 72-hour PMP data *for the month of March*. Providing this information in the footnotes of these two tables could be interpreted by COL applicants that they should also define their 48-hr PMWP site characteristic values using data for the month of March, whereas the month of March may not be bounding for all sites. Consequently, please consider deleting footnote #13 from both tables and moving the information contained in the footnote to DCD Tier 2, Section 2.3.1.

ANSWER:

The DCD will be clarified to state that the 48- hour probable maximum winter precipitation (PMWP) is based on interpolation of 24-hour PMP and 72-hour PMP data for the month of March for the information contained in the tables. The footnote #13 will be deleted from both tables.

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Section 2.3, changes to be incorporated.

- Insert the following as the second sentence in Subsection 2.3.1: "The 48-hour PMWP in Table 2.0-1 is selected as a key site parameter, determined from HMR-53 (Reference 2.3-11) by interpolating the 24-hour PMP and 72-hour PMP data for the month of March."

- Add the following reference to Section 2.3.7:

"2.3-11 Hydrometeorological Report No. 53, Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, Figures 27 and 37"

See Attachment 1 for the mark-up of DCD Tier 2, Table 2.0-1, changes to be incorporated.

- Replace the parameter description for the 3rd Row of Table 2.0-1, Sheet 1 with the following:

  "48-hr probable maximum winter precipitation (PMWP)"

- Replace Note 13 of Table 2.0-1, Sheet 8 with the following:

  "13. Deleted."

See Attachment 2 for the mark-up of DCD Tier 1, Table 2.1-1, changes to be incorporated.

- Replace the parameter description for the 4th Row of Table 2.1-1, Sheet 1 with the following:

  "48-hr probable maximum winter precipitation (PMWP)"

- Replace Note 13 of Table 2.1-1, Sheet 8 with the following:

  "13. Deleted."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/14/2010

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

RAI NO.:	**NO. 547-4426 REVISION 2**
SRP SECTION:	**02.03.01 – Regional Climatology**
APPLICATION SECTION:	**DCD Tier 1 Table 2.1-1 and Tier 2 Table 2.0-1**
DATE OF RAI ISSUE:	**03/15/2010**

QUESTION NO. 02.03.01-19:

A new set of Tier 1 ambient design air temperature site parameters (5% exceedance maximum and minimum) were added to Tier 1 Table 2.1-1 in DCD Revision 2.

a. The Tier 1 site parameters should be a subset of Tier 2 site parameters that are certified by rule. However, this new set of 5% exceedance ambient design air temperature site parameters was not added to Tier 2 Table 2.0-1. Please revise DCD Tier 2 Table 2.0-1 to include this new set of 5% exceedance ambient design air temperature site parameters.

b. Please revise the DCD to clarify the definition of the maximum and minimum 5% exceedance ambient design temperature site parameters. For example, do these site parameters represent annual, seasonal, or monthly exceedances? Do the coincident wet bulb values represent mean or maximum values?

c. Please revise DCD Section 2.3.1 to provide a technical basis for how the 5% exceedance ambient design temperature site parameter values were chosen, including justifying that the values are representative of a reasonable number of potential COL sites.

ANSWER:

a. In response to RAI 23, Question 02.03.01-6 dated 7/18/2008, DCD Chapter 2 Table 2.01 was to be revised by adding the 5% and 1% minimum and maximum exceedance values to the ambient design air temperature (Tier 1 Table 2.1-1 was revised to include the 5% and 1% minimum and maximum exceedance values to the ambient design air temperature based on this RAI). However, this RAI question was amended on 8/12/2008 negating the need for the 5% minimum and maximum exceedance values (considered extraneous information) and Tier 2 Table 2.0-1 was revised accordingly.

   MHI agrees that the Tier 1 site parameters should be a subset of the Tier 2 site parameters that are certified by rule. Therefore, MHI will again revise Tier 1 Table 2.1-1 ambient design air temperature site parameters to be consistent with Tier 2 site parameters by removal of the 5% minimum and maximum exceedance values.

b. As discussed in (a) above, the minimum and maximum 5% exceedance ambient design temperature site parameters will be removed from Tier 1 Table 2.1-1 eliminating the need for clarification.

c. As discussed in (a) above, the minimum and maximum 5% exceedance ambient design temperature site parameters will be removed from Tier 1 Table 2.1-1 eliminating the need for a technical basis. However, justification that the values (zero and one percent minimum and maximum exceedance) are representative of a reasonable number of potential COL sites is provided in the following statement in Tier 2, Section 2.3.1: "Annual exceedance values of zero and one percent are based on the EPRI Advanced Light Water Reactor Utilities Requirements Document (Reference 2.3-8) and conservative estimates of historical high and low values for potential US-APWR sites. These values are considered to bound approximately 75% to 80% of the continental US (excluding Alaska)."

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 1, Table 2.1-1, changes to be incorporated.

- Delete the following row below "Extreme wind speed (other than in tornado)" of Table 2.1-1, Sheet 1:

Ambient design air temperature (5% annual exceedance maximum)	Secondary HVAC	95°F dry bulb, 77°F coincident wet bulb, 79°F non-coincident wet bulb
	Normal Plant Heat Sink	92°F dry bulb, 75°F coincident wet bulb, 76°F non-coincident wet bulb

- Delete the following row below "Ambient design air temperature (0% annual exceedance maximum)" of Table 2.1-1, Sheet 1:

Ambient design air temperature (5% annual exceedance minimum)	-5°F dry bulb

Impact on COLA

There is no COLA impact.

Impact on PRA

There is no impact on the PRA.

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

ATTACHMENT 1
to RAI 547-4426

Table 2.0-1 Key Site Parameters (Sheet 1 of 8)

Meteorology	
Parameter Description	**Parameter Value**
Normal winter precipitation roof load [11]	50 lb/ft^2
Extreme winter precipitation roof load[12] ~~(100-year snowpack maximum snow weight including contributing portion of either extreme frozen winter precipitation event or extreme liquid winter precipitation event)~~	75 lb/ft^2
48-hr probable maximum winter precipitation~~[13]~~ (PMWP)	36 in.
Tornado maximum wind speed	230 mph
	184 mph maximum rotational
	46 mph maximum translational
Radius of maximum rotational speed	150 ft
Tornado maximum pressure drop	1.2 psi
Rate of Pressure drop	0.5 psi/s
Tornado-generated missile spectrum and associated velocities	15 ft long schedule 40 steel pipe moving horizontally at 135 ft/s[1]
	4,000 lb automobile moving horizontally at 135 ft/s[1]
	1 in diameter steel sphere moving horizontally at 26 ft/s[1]
Extreme wind speed (other than in tornado)	155 mph for 3-second gusts at 33 ft above ground level based on 100-year return period, with importance factor of 1.15 for seismic category I/II structures
Ambient design air temperature (1% annual exceedance maximum)	100°F dry bulb, 77°F coincident wet bulb, 81°F non-coincident wet bulb
Ambient design air temperature (0% annual exceedance maximum)	115°F dry bulb, 80°F coincident wet bulb, 86°F non-coincident wet bulb, historical limit excluding peaks <2 hr
Ambient design air temperature (1% annual exceedance minimum)	-10°F dry bulb
Ambient design air temperature (0% annual exceedance minimum)	-40°F dry bulb, historical limit excluding peaks <2 hr
Atmospheric dispersion factors (χ/Q values) for onsite locations:	
Exclusion area boundary (EAB) 0-2 hrs	5.0×10^{-4} s/m^3
EAB annual average	1.6×10^{-5} s/m^3

ATTACHMENT 1
to RAI 547-4426

Table 2.0-1 Key Site Parameters (Sheet 8 of 8)

Total settlement of R/B complex foundation[14]	6.0 in.
Differential settlement across R/B complex foundation[14]	2.0 in.
Maximum differential settlement between buildings[14]	0.5 in.
Maximum tilt of R/B complex foundation generated during operational life of the plant[14]	1/2000

NOTES:

1. The specified missiles are assumed to have a vertical speed component equal to 2/3 of the horizontal speed.
2. These dispersion factors are chosen as the maximum values at all intake points.
3. These dispersion factors are chosen as the maximum values at all inleak points.
4. These dispersion factors are used for a loss-of-coolant accident (LOCA) and a rod ejection accident.
5. These dispersion factors are used for a LOCA, a rod ejection accident, a failure of small lines carrying primary coolant outside containment and a fuel-handling accident inside the containment.
6. These dispersion factors are used for a steam generator tube rupture, a steam system piping failure, a reactor coolant pump rotor seizure and a rod ejection accident.
7. These dispersion factors are used for a fuel handling accident occurring in the fuel storage and handling area.
8. These dispersion factors are used for a steam system piping failure.
9. These dispersion factors are used for a LOCA.
10. These dispersion factors are used for a rod ejection accident, a failure of small lines carrying primary coolant outside containment and a fuel-handling accident inside the containment.
11. Normal winter precipitation roof load is determined by converting ground snow load p_g in accordance with ASCE 7-05. The ground snow load p_g is based on the highest ground-level weight of:
    - the 100-year return period snowpack,
    - the historical maximum snowpack,
    - the 100-year return period snowfall event, or
    - the historical maximum snowfall event in the site region.
12. The extreme winter precipitation roof load is based on the sum of the normal ground level winter precipitation plus the highest weight at ground level resulting from either the extreme frozen winter precipitation event or the extreme liquid winter precipitation event. The extreme frozen winter precipitation event is assumed to accumulate on the roof on top of the antecedent normal winter precipitation event. The extreme liquid winter precipitation event may not accumulate on the roof, depending on the geometry of the roof and the type of drainage provided. The extreme winter precipitation roof load is included as live load in extreme loading combinations using the applicable load factor indicated in DCD Section 3.8.
13. Deleted. ~~The 48-hour PMWP is based on interpolation of 24-hour PMP and 72-hour PMP data for the month of March in HMR-53 (Reference: Hydrometeorological Report No. 53, Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, Figures 27 and 37)~~
14. Acceptable parameters for settlement without further evaluation.

ATTACHMENT 1
to RAI 547-4426

2.3 Meteorology

The US-APWR is designed for meteorological information as specified in Table 2.0-1. The COL Applicant, whether the plant is to be sited inside or outside the continental US, is to provide site-specific pre-operational and operational programs for meteorological measurements, and is to verify the site-specific regional climatology and local meteorology are bounded by the site parameters for the standard US-APWR design or demonstrate by some other means that the proposed facility and associated site-specific characteristics are acceptable at the proposed site.

2.3.1 Regional Climatology

Site-specific information is provided for regional climatology, including general climate conditions and frequency of severe weather phenomena as discussed in SRP 2.3.1 (Reference 2.3-6). The 48-hour PMWP in Table 2.0-1 is selected as a key site parameter, determined by interpolating the 24-hour PMP and 72-hour PMP data for the month of March in HMR-53 (Reference 2.3-11). Refer to Subsection 3.3.2.1 for a complete summary of design basis tornado parameters, including maximum wind speed, maximum rotational speed, maximum translational speed, radius of maximum rotational wind from center of tornado, atmospheric drop, and rate of pressure change. The extreme wind speed as stated in Table 2.0-1 corresponds to the criteria described in Subsection 3.3.1.1. Ultimate heat sink (UHS) meteorological conditions are dependent on the site-specific climatology and selection of UHS type, as discussed in Subsection 9.2.5. Annual exceedance values of zero and one percent are based on the EPRI Advanced Light Water Reactor Utility Requirements Document (Reference 2.3-8) and conservative estimates of historical high and low values for potential US-APWR sites. These values are considered to bound approximately 75% to 80% of the continental US (excluding Alaska).

2.3.2 Local Meteorology

Site-specific information on local meteorology is based on long-term data from nearby reasonably representative locations and shorter-term onsite data as discussed in SRP 2.3.2 (Reference 2.3-7).

2.3.3 Onsite Meteorological Measurements Program

The site-specific pre-operational and operational programs for meteorological measurements are to be provided, which may include offsite satellite facilities. RG 1.23 (Reference 2.3-1) contains guidance on acceptable onsite meteorological programs, and any deviations from RG 1.23 guidance are to be identified and justified on a site-specific basis.

Additional sources of meteorological data is to be obtained from National Weather Service stations and other meteorological programs such as other nuclear facilities, university and private meteorological programs. These sources may be used in the description of airflow trajectories from the site to a distance of 50 miles, particularly measurements made, locations and elevations of measurements, exposure of instruments, descriptions of instruments used, and instrument performance specifications.

ATTACHMENT 1
to RAI 547-4426

References

2.3-1 Meteorological Monitoring Programs for Nuclear Power Plants. Regulatory Guide 1.23, Rev.1, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

2.3-2 Short-Term Atmospheric Dispersion Estimates for Accident Releases, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 2.3.4, Rev.3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

2.3-3 Contents of Applications: Technical Information in the Final Safety Analysis Report, Title 10, Code of Federal Regulations, Part 52.79, U.S. Nuclear Regulatory Commission, Washington, DC.

2.3-4 Criterion 19 - Control Room, General Design Criteria for Nuclear Power Plants, Energy. Title 10, Code of Federal Regulations Part 50, Appendix A, U.S. Nuclear Regulatory Commission, Washington, DC.

2.3-5 Long-Term Atmospheric Dispersion Estimates for Accident Releases, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 2.3.5, Rev.3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

2.3-6 Regional Meteorology. NUREG-0800, SRP 2.3.1, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

2.3-7 Local Meteorology. NUREG-0800, SRP 2.3.2, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

2.3-8 Advanced Light Water Reactor Utility Requirements Document. Rev. 8, Electric Power Research Institute, Palo Alto, CA, March 1999.

2.3-9 Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants, Regulatory Guide 1.194, Rev.0, US Nuclear Regulatory Commission, Washington, DC, June, 2003.

2.3-10 Atmospheric Relative Concentrations in Building Wakes, NUREG/CR-6331, PNNL-10521, Rev. 1. U.S. Nuclear Regulatory Commission, Washington, DC. May 1997.

2.3-11 Hydrometeorological Report No. 53, Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, Figures 27 and 37.

Table 2.1-1 Key Site Parameters (Sheet 1 of 7)

Meteorology	
Parameter Description	**Parameter Value**
Normal winter precipitation roof load [11]	
Extreme winter precipitation roof load[12] ~~(100-year snowpack maximum snow weight including contributing portion of either extreme frozen winter precipitation event or extreme liquid winter precipitation event)~~	75 lb/ft²
48-hr probable maximum winter precipitation~~[13]~~ (PMWP)	36 in.
Tornado maximum wind speed	230 mph
	184 mph maximum rotational
	46 mph maximum translational
Radius of maximum rotational speed	150 ft
Tornado maximum pressure drop	1.2 psi
Rate of Pressure drop	0.5 psi/s
Tornado-generated missile spectrum and associated velocities	15 ft long schedule 40 steel pipe moving horizontally at 135 ft/s[1]
	4,000 lb automobile moving horizontally at 135 ft/s[1]
	1 in diameter steel sphere moving horizontally at 26 ft/s[1]
Extreme wind speed (other than in tornado)	155 mph for 3-second gusts at 33 ft above ground level based on 100-year return period, with importance factor of 1.15 for seismic category I/II structures
Ambient design air temperature (1% annual exceedance maximum)	100°F dry bulb, 77°F coincident wet bulb, 81°F non-coincident wet bulb
Ambient design air temperature (0% annual exceedance maximum)	115°F dry bulb, 80°F coincident wet bulb, 86°F non-coincident wet bulb, historical limit excluding peaks <2 hr
Ambient design air temperature (1% annual exceedance minimum)	-10°F dry bulb
Ambient design air temperature (0% annual exceedance minimum)	-40°F dry bulb, historical limit excluding peaks <2 hr

NOTES:

1. The specified missiles are assumed to have a vertical speed component equal to 2/3 of the horizontal speed.
2. These dispersion factors are chosen as the maximum values at all intake points.
3. These dispersion factors are chosen as the maximum values at all inleak points.
4. These dispersion factors are used for a loss-of-coolant accident (LOCA) and a rod ejection accident.
5. These dispersion factors are used for a LOCA, a rod ejection accident, a failure of small lines carrying primary coolant outside containment and a fuel-handling accident inside the containment.
6. These dispersion factors are used for a steam generator tube rupture, a steam system piping failure, a reactor coolant pump rotor seizure and a rod ejection accident.
7. These dispersion factors are used for a fuel handling accident occurring in the fuel storage and handling area.
8. These dispersion factors are used for a steam system piping failure.
9. These dispersion factors are used for a LOCA.
10. These dispersion factors are used for a rod ejection accident, a failure of small lines carrying primary coolant outside containment and a fuel-handling accident inside the containment.
11. Normal winter precipitation roof load is determined by converting ground snow load p_g in accordance with ASCE 7-05. The ground snow load p_g is based on the highest ground-level weight of:
    - the 100-year return period snowpack,
    - the historical maximum snowpack,
    - the 100-year return period snowfall event, or
    - the historical maximum snowfall event in the site region.
12. The extreme winter precipitation roof load is based on the sum of the normal ground level winter precipitation plus the highest weight at ground level resulting from either the extreme frozen winter precipitation event or the extreme liquid winter precipitation event. The extreme frozen winter precipitation event is assumed to accumulate on the roof on top of the antecedent normal winter precipitation event. The extreme liquid winter precipitation event may not accumulate on the roof, depending on the geometry of the roof and the type of drainage provided. The extreme winter precipitation roof load is included as live load in extreme loading combinations using the applicable load factor indicated in DCD Section 3.8.
13. Deleted. ~~The 48-hour PMWP is based on interpolation of 24-hour PMP and 72-hour PMP data for the month of March~~
14. Acceptable parameters for settlement without further evaluation.