MITSUBISHI HEAVY INDUSTRIES, LTD.
16-5, KONAN 2-CHOME, MINATO-KU
TOKYO, JAPAN

March 25, 2013

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-13068

Subject: MHI's Response to US-APWR DCD RAI No. 997-7033 (SRP 06.03)

Reference: [1] "Request for Additional Information No. 997-7033, SRP Section: 06.03 – Emergency Core Cooling System –Application Section: 06.03 and 06.02.02." dated February 25, 2013.

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. 997-7033 (SRP 06.03)".

Enclosed is the response to Question 06.03-112 contained within Reference 1.

Please contact Mr. Joseph Tapia, General Manager of Licensing Department, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

Sincerely,

Hiroki Nishi for

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

Enclosure:

1. Response to Request for Additional Information No. 997-7033

CC: J. A. Ciocco
J. Tapia

Contact Information
Joseph Tapia, General Manager of Licensing Department
Mitsubishi Nuclear Energy Systems, Inc.
1001 19th Street North, Suite 710
Arlington, VA 22209
E-mail: joseph_tapia@mnes-us.com
Telephone: (703) 908 – 8055

D081
NRO

Enclosure 1

UAP-HF-13068
Docket No. 52-021

Response to Request for Additional Information No. 997-7033

March 2013

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/25/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI No.:	**997-7033**
SRP Section:	**06.03 – Emergency Core Cooling System**
Application Section:	**06.03 and 06.02.02**
DATE of RAI issue:	**02/25/2013**

QUESTION NO.: 06.03-112

RG 1.206 (June 2007) Regulatory Position, Part IV: Miscellaneous Topics, describes the following:

The creation of, and restrictions on, changing Tier 2* information resulted from the development of Tier 1 information for the advanced BWR design certification (Appendix A to 10 CFR Part 52) and the Asea Brown Boveri-Combustion Engineering System 80+ reactor design certification (Appendix B, "Design Certification Rule for the System 80+ Design," to 10 CFR Part 52). During this development process, these applicants requested that the agency minimize the amount of information in Tier 1 to allow additional flexibility for an applicant or licensee who references these appendices. Tier 2 also specified many codes, standards, and design processes that Tier 1 does not specify but that are acceptable for meeting ITAAC. As a result, certain significant information only exists in Tier 2, and the Commission does not want this significant information to be changed without prior NRC approval. The generic DCD identifies this Tier 2* information with italicized text and brackets.

NUREG-1792 "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Plant Design", describes the following:

The ACRS review for the AP1000 highlighted the significance of certain assumptions about debris in containment to the adequacy of long-term core cooling, and a concern that the values not be revised without substantial additional testing and analysis. As a means of emphasizing this, the applicant proposed to designate the key information as Tier 2*, to require prior NRC approval, in a letter dated February 23, 2011. This change is included in Revision 19. The NRC agrees that this is a prudent change and will modify the final rule language to reflect this addition, as a Tier 2* item without expiration at fuel load.

(Note, in an amendment, dated December 2011, to Appendix D to Part 52 "Design Certification Rule for the AP1000 Design" the Tier 2* change was put into effect.)

Given the information provided in Technical Report MUAP-08013 "US-APWR Sump Strainer Downstream Effects," Revision 4 and containment debris limits in DCD Section 6.2.2 (as

modified by GSI-191 Tracking Report dated August 2012), it appears that the US-APWR is similar to the AP1000 regarding assumptions about debris in containment to the adequacy of long term core cooling, specifically the debris limits for core inlet blockage evaluations. Therefore, the NRC staff request that the applicant evaluate the appropriateness of applying Tier 2* designation to items associated with long term core cooling and/or the appropriateness of establishing a technical specification. If information related to long term core cooling is designated as Tier 2*, then the staff request the applicant to identify this information in the DCD to ensure that the appropriate change process and limits are followed.

ANSWER:

MHI proposes a Tier 2* item for containment debris in lieu of establishing a Technical Specification (TS) requirement. This action is based on regulatory precedence and an evaluation of the requirements of 10 CFR 50.36 related to the required content of TS.

Current NRC and industry guidance on the content of TS are incorporated into standard technical specifications (STS) which are published as a NUREG-series publication. STS were developed based on the criteria in the Final Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated July 22, 1993 (58 FR 39132). This policy statement was subsequently codified by changes to 10 CFR 50.36. These improved STS were the result of extensive technical meetings and discussions among the NRC staff, industry owners groups, vendors, and other stakeholders regarding the appropriateness of including specific requirements in TS. The TS in US-APWR DCD Tier 2 Chapter 16 are the result of the experience gained in the development of the improved STS.

The rule change that followed the issuance of NRC's policy statement on TS improvements provided the basis for many nuclear power plant licensees to relocate a number of existing TS requirements which do not fall within or satisfy the criteria 10 CFR 50.36 to other licensee-controlled documents. The NRC staff concluded that these "relocated" provisions were not related to dominant contributors to plant risk. Some of the relocated requirements were associated with containment cleanliness/foreign material exclusion requirements. NRC-approved STS do not include specific containment debris limits.

MHI has evaluated the appropriateness of including containment debris limits in TS and concludes that debris limits do not meet any of the four criteria for establishing TS limiting conditions for operation as provided under 10 CFR 50.36(c)(2)(ii). This position is consistent with that taken by the Westinghouse AP1000 design center and NRC staff comments made during the December 15, 2010 ACRS subcommittee meeting regarding AP1000 design certification.

According to 10 CFR 50.36(c)(2)(ii), a TS limiting condition for operation must meet one or more of the following criteria:

> *Criterion 1.* Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.

Criterion 1 relates to installed instrumentation, which does not apply to containment debris.

> *Criterion 2.* A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

Criterion 2 applies to certain process variables, design features and operating restrictions that are initial conditions of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. Containment debris is neither a process variable nor a design feature. However, a containment debris limit could be considered an operating restriction, but it is not an explicit item identified in the design basis accident or transient analyses described in the DCD Chapter 15 safety analysis, which has been industry practice for consideration of inclusion into TS.

> *Criterion 3.* A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

Criterion 3 involves structures, systems and components, which does not apply to containment debris.

> *Criterion 4.* A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety.

Criterion 4 involves structures, systems and components, which does not apply to containment debris.

Therefore, no TS is proposed for containment debris limits.

MHI has determined that Latent Debris and Miscellaneous Debris should be designated as Tier 2*, although other types of debris are also included in the design basis assumptions for determining sump strainer performance. This is because the amounts of Latent Debris and Miscellaneous Debris are affected by plant operations throughout the life of the facility and are not deliberate, planned actions, while the other debris assumptions are based on the as-designed and as-evaluated values included in the US-APWR standard plant design information and not subject to change without deliberate action by the COL Applicant. Because the other debris design basis assumptions are part of standard plant design, and are not subject to changes due to changes in cleanliness of the containment over time, it is not likely that the limits would require changing during the life of the facility. As stated in DCD Tier 2, Section 6.2.2.3.2:

> "Programmatic controls will be established to ensure that potential sources of debris introduced into containment (e.g., insulation, coatings, foreign material, aluminum), and plant modifications, will not adversely impact the ECC/CS recirculation function. These programmatic controls will be established consistent with guidance provided in RG 1.82, Rev. 3 (Ref. 6.2-23), in order to ensure that potential quantities of post-accident debris are maintained within the bounds of the analyses and design bases that support Emergency Core Cooling (ECC) and Containment Spray (CS) recirculation functions and to ensure that the long term core cooling requirements of 10 CFR 50.46 are met."

Additionally, COL Item 6.2(5) requires that the COL holders prepare cleanliness, housekeeping and foreign materials exclusion program that will implement the debris limitations described above. Based on these programmatic controls, MHI concludes that the Latent Debris and Miscellaneous Debris limits should be designated as Tier 2* to ensure that sump strainer performance is not adversely affected over the life of the facility.

Section 3 of Technical Report MUAP-08001-P, US-APWR Sump Strainer Performance, provides containment debris limits that are similar to debris parameters provided for the AP1000 design. Therefore, DCD Tier 2, Section 6.2.2.3.2, 6.2.2.3.3 and Table 6.2.2-4, are revised to apply Tier 2* designation to these containment debris limits. In addition, DCD Tier 2, Chapter 1, Appendix 1A, Table 1A-1, is revised to include a summary, expiration, and location of this Tier 2* information. The containment debris limit is specified as Tier 2* without expiration at fuel load. Although these limits are subject to change, any such change will require prior NRC approval in accordance with the change process specified in the US-APWR design certification rule. COL item 6.2(5) is also revised to remove the specific debris limit values and instead refer to the limits in Table 6.2.2-4.

MHI has reviewed other GSI-191 design/debris inputs and assumptions for consideration as Tier 2* information. However, their relative importance does not rise to the high level for Tier 2* designation. This review included an evaluation of the performance requirements for the sump strainers described in, including testing performed in support of, Technical Report MUAP-08001-P, US-APWR Sump Strainer Performance.

Impact on DCD

DCD Tier 2, Chapter 1, Appendix 1A, Table 1A-1, Table 1.8-2, and DCD Tier 2 Sections 6.2.2.3.2 6.2.2.3.3, and 6.2.8 and Table 6.2.2-4 are revised as shown in the attached mark-ups.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Reports

There is no impact on the Technical / Topical Reports.

Table 1.8-2 Compilation of All Combined License Applicant Items for Chapters 1-19 (Sheet 15 of 37)

COL ITEM NO.	COL ITEM	
COL 6.1(7)	*The COL Applicant is responsible for identifying the implementation milestones for the coatings program.*	
COL 6.2(1)	*Deleted*	
COL 6.2(2)	*Deleted*	
COL 6.2(3)	*Deleted*	
COL 6.2(4)	*Deleted*	
COL 6.2(5)	*Preparation of a cleanliness, housekeeping and foreign materials exclusion program is the responsibility of the COL Applicant. This program will be established to limit ~~200lbs of~~ latent debris, and to limit the allocated ~~200ft^2 of~~ miscellaneous debris per sump to the limits specified in Table 6.2.2-4. ~~addresses other debris sources such as latent debris inside containment. This program minimizes foreign materials in the containment.~~*	DCD_06.02.02-35 DCD_06.03-112
COL 6.2(6)	*~~Deleted~~Preparation of administrative procedures is the responsibility of the COL Applicant. The procedures will ensure that RMI and fiber insulation debris within ZOIs will be consistent with the design basis debris specified in Table 6.2.2-4, and will ensure that the aluminum in containment exposed to water in containment in post-LOCA condition (i.e., spray and blowdown water) is limited to equal or less than 810 ft^2.*	MIC-03-01-00007 DCD_06.02.02-66
COL 6.2(7)	*Deleted.*	
COL 6.2(8)	*The COL Applicant is responsible for identifying the implementation milestone for the containment leakage rate testing program described under 10 CFR 50, Appendix J.*	
COL 6.2(9)	*Deleted*	
COL 6.2(10)	*Deleted*	
COL 6.3(1)	*Deleted*	
COL 6.3(2)	*Deleted*	
COL 6.3(3)	*Deleted*	
COL 6.3(4)	*Deleted*	
COL 6.3(5)	*Deleted*	
COL 6.3(6)	*Deleted*	
COL 6.4(1)	*The COL Applicant is responsible to provide details of specific toxic chemicals of mobile and stationary sources within the requirements of RG 1.78 (Ref 6.4-4) and evaluate the control room habitability based on the recommendation of RG 1.78 (Ref 6.4-4).*	
COL 6.4(2)	*The COL Applicant is responsible to discuss the automatic actions and manual actions for the MCR HVAC system in the event of postulated toxic gas release.*	
COL 6.4(3)	*Deleted*	
COL 6.4(4)	*Deleted*	

Table 1A-1 Index of Tier 2* Information (Sheet 1 of 1) MIC-03-01-0 0019

Description	Expiration	Location
Cladding oxide thickness inspection and documentation	Successful completion of inspection and documentation for first plant.	4.2.4.5.3
Containment latent debris and miscellaneous debris design basis limits	None	6.2.2.3.2, 6.2.2.3.3, Table 6.2.2-4

DCD_06.03-112

As discussed in Subsection 6.1.2, DBA-qualified epoxy coatings are applied in the containment in accordance with RG 1.54 (Ref. 6.2-41). DCD_06.02.02-55

~~The available and required NPSH at the inlet of the CS/RHR and SI pumps are provided in Table 6.2.2-1. Thus, adequate NPSH is provided to the CS/RHR and SI pumps, including margin.~~ MIC-03-06-00005

~~Table 6.2.2-1 presents values used in the calculations described above.~~

Programmatic controls will be established to ensure that potential sources of debris introduced into containment (e.g., insulation, coatings, foreign material, aluminum), and plant modifications, will not adversely impact the ECC/CS recirculation function. ~~Programmatic control~~These programmatic controls will be established consistent with guidance provided in RG 1.82, Rev. 3 (Ref. 6.2-23), in order to ensure that potential quantities of post-accident debris are maintained within the bounds of the analyses and design bases that support Emergency Core Cooling (ECC) and Containment Spray (CS) recirculation functions and to ensure that the long term core cooling requirements of 10 CFR 50.46 are met. ~~The following is a summary of the programmatic controls that will be implemented to ensure that activities are conducted in a manner that ensures ECC/CS strainer operation, and limits the quantity of latent (unintended dirt, dust, paint chips, and fibers) and miscellaneous (tape, tags, stickers) debris inside containment:~~Table 6.2.2-2 presents a comparison of the RWSP sump strainer design to the guidance of RG 1.82. Also, refer to Subsection 6.2.2.3.12 and 6.2.2.3.13, "Downstream Effects – In-Vessel/Ex-Vessel." DCD_06.02.02-63 MIC-03-06-00006 MIC-03-06-00006 MIC-03-06-00006

The following is a summary of the programmatic controls that will be implemented to ensure that activities are conducted in a manner that ensures ECC/CS strainer operation, and limits the quantity of latent (unintended dirt, dust, paint chips, and fibers) and miscellaneous (tape, tags, stickers) debris inside containment:

- Preparation of a cleanliness, housekeeping and foreign materials exclusion program. This program addresses latent and miscellaneous debris inside containment (Ref. 6.2-40). An acceptance criterion below the conservative assumption of *[200 lbs]*~~200 lb~~ for latent debris (unintended dirt, dust, paint chips, and fibers which principally consist of fiber and particulate debris) inside containment will be established consistent with MUAP-08001-P Sump Strainer Performance Evaluation (Ref.6.2-34).~~inside containment will be established consistent with MUAP-08001-P, Sump Strainer Performance Evaluation (Ref.6.2-34).~~ The program will also ensure that the quantity of miscellaneous debris in containment will be limited such that the allocated *[200 ft^2]*~~200 ft^2~~ strainer surface area per sump ~~uncertainty~~margin per MUAP-08001-P, will be met to ensure ECC/CS strainer operation. A cleanliness, housekeeping and foreign materials exclusion program will be established by the COL Applicant. MIC-03-06-00006 DCD_06.03-112 DCD_06.03-112

- Procedures will be implemented to ensure administrative controls ~~and regulatory/quality requirements for plant modifications and temporary changes that include consideration of materials introduced into the containment that could contribute to sump strainer blockage.~~are established for regulatory and quality requirements, for plant modifications and temporary changes, which include consideration of MIC-03-06-00006

~~The containment design heat removal evaluations documented in Subsection 6.2.1.1 includes the effects of the CSS operation (including single failure considerations). Table 6.2.1-5 provides ESF system parameters relating to event sequence such as ECCS and CSS actuation timing. Table 6.2.1-5 also provides both full capacity and partial capacity (used for containment design evaluation) system operation parameters. These evaluations conclude that the acceptance criteria are met. Therefore, the CSS design is acceptable. Subsection 6.2.1.1 includes information about the energy content of the containment atmosphere and the recirculation water during the transients that are evaluated.~~ MIC-03-06-00006

~~Information on the integrated energy content of the containment atmosphere and RWSP water as functions of time following the postulated design basis LOCA and the integrated energy absorbed by the structural heat sinks and CS/RHR heat exchangers is provided in the following Tables and Figures :~~

- ~~Table 6.2.1-12, Distribution of Energy at Selected Locations within Containment for Worst Case Postulated DEPSG Break~~
- ~~Table 6.2.1-14, Distribution of Energy at Selected Locations within Containment for Worst Case Postulated DEHLG Break~~
- ~~Figure 6.2.1-84, Containment Energy Distribution Transient for DEPSG Break (C_D=1.0)~~
- ~~Figure 6.2.1-85, Containment Energy Distribution Transient for DEHLG Break (C_D=1.0)~~

Information in this subsection that is italicized and enclosed in square brackets with an asterisk following the closing bracket is a special category of information designated by the NRC as Tier 2. Any change to this information requires prior NRC approval.* DCD_06.03-112

6.2.2.3.3 Debris Generation DCD_06.02.02-55

The SE of NEI 04-07 guidance report (GR) (Ref. 6.2-24) and the NRC letters to NEI (Ref. 6.2-46 and 6.2-47) are used to determine the zone of influence (ZOI) for generating debris. The diameter of the ZOI for RMI debris generation is 2 inside diameters of the worst-case break line and 4 inside diameters for coating debris. For the sump performance evaluation, the design basis debris quantities are based on the following:

- For RMI insulation, all insulation on a cross-over leg (CO/L) is considered to generate debris.
- No design fiber insulation debris is generated within the ZOI. As an operational margin for future plant modification, fiber insulation debris is assumed and included in the strainer design.
- For coating debris, the generated debris volume is based on the surface area for the ZOI from the main coolant pipe break and a conservative coating thickness. As an operational margin for the plant, an additional amount of coating debris is

assumed and included in the strainer design. DCD_06.02.02-55

For latent debris, *[200 lbs]*~~200 lbs~~ of fiber and particulate is applied, as recommended in the guidance (Ref. 6.2-24). Specific material types for miscellaneous debris, such as tapes, tags or stickers, reaching the strainer are not specified. Instead, a *[200 ft^2]*~~200 ft^2~~ penalty of sacrificial strainer surface area per sump is considered as a margin for future detailed design and installation. These debris sources are controlled by the foreign material exclusion program that will be established by the plant owner. DCD_06.03-112 DCD_06.03-112

The design basis debris for sump strainer performance is summarized in Table 6.2.2-4. More detailed information is provided in the Sump Strainer Performance Evaluation document (Ref. 6.2-34).

Information in this subsection that is italicized and enclosed in square brackets with an asterisk following the closing bracket is a special category of information designated by the NRC as Tier 2. Any change to this information requires prior NRC approval.* DCD_06.03-112

6.2.2.3.4 Debris Characteristics

The US-APWR assumes that all fiber debris within the ZOI is "fines". The specification of debris characteristics used for the sump performance evaluation is determined based on the SE of NEI 04-07. (Ref.6.2-24). The SE classified fibrous debris into four groups as follows:

1. fines that remain suspended,
2. small piece debris that are transported along the floor,
3. large piece debris with the insulation exposed to potential erosion, and
4. large debris with the insulation undamaged but still protected by a covering and thereby preventing erosion.

Fine fiber debris is considered suspended and transportable to the strainer. The Post-LOCA 30-day erosion of small fiber debris into fines does not require consideration, because all fiber debris is already assumed to be fine.

RMI insulation debris is assumed to consist of 75 percent small fines and 25 percent large pieces, in accordance with the SE of NEI 04-07. (Ref 6.2-24). The RMI debris is considered as "non-suspended" in the sump pool due to its specific gravity. For RMI debris characterization, the effect of erosion during the 30 days of Post-LOCA operation is not required.

Coating debris within the ZOI is assumed to consist of 100 percent fines, in accordance with the SE of NEI 04-07. (Ref. 6.2-24). The effect of erosion is not considered for coating debris because coating debris is defined as fines.

The latent debris characteristics are based on the SE of NEI GR (Ref 6.2-24). Latent fiber comprises 15 percent (by mass) of the total latent debris loading ~~(i.e., 200 lbs)~~. The latent fiber is comparable to fiberglass "NUKON" insulation and is considered to be fines, as DCD_06.03-112

6.2.7 Fracture Prevention of Containment Pressure Vessel

Ferritic containment pressure boundary materials include the ferritic portions of the containment vessel and all penetration assemblies or appurtenances attached to the containment vessel; all piping, pumps and valves attached to the containment vessel, or to penetration assemblies out to and including the pressure boundary materials of any valve required to isolate the system and provide a pressure boundary for the containment function.

Ferritic containment pressure boundary materials meet the fracture toughness criteria and requirements for testing identified in Article NE-2000 of Section III, Division 1 (Ref. 6.2-32) or Article CC-2000 of Section III, Division 2 of the ASME Code (Ref. 6.2-33).

6.2.8 Combined License Information

Any utility that references the US-APWR design for construction and Licensed operation is responsible for the following COL items:

COL 6.2(1) *Deleted*

COL 6.2(2) *Deleted*

COL 6.2(3) *Deleted*

COL 6.2(4) *Deleted*

COL 6.2(5) *Preparation of a cleanliness, housekeeping and foreign materials exclusion program is the responsibility of the COL Applicant. This program ~~addresses other debris sources such as latent debris inside containment. This program minimizes foreign materials in the containment.~~ will be established to limit ~~200lbs of~~ latent debris, and to limit the allocated ~~200ft^2 of~~ miscellaneous debris per sump to the limits specified in Table 6.2.2-4.* MIC-03-06-00007 DCD_06.03-112 MIC-03-06-00067 DCD_06.03-112

COL 6.2(6) *Preparation of administrative procedures is the responsibility of the COL Applicant. The procedures will ensure that RMI and fiber insulation debris within ZOIs will be consistent with the design basis debris specified in the Table 6.2.2-4, and will ensure that the aluminum in containment exposed to water in containment in post-LOCA condition (i.e., spray and blowdown water) is limited to equal or less than 810ft^2.* MIC-03-06-00008 DCD_06.02.02-66

COL 6.2(7) *Deleted*

COL 6.2(8) *The COL Applicant is responsible for identifying the implementation milestone for the containment leakage rate testing program described under 10 CFR 50, Appendix J.*

COL 6.2(9) *Deleted*

COL 6.2(10) *Deleted*

DCD_06.02.02-55

Table 6.2.2-4 Design Basis Debris

Type		Amount
RMI (Transco)		106 (ft^3)
Fibrous Insulation (Nukon)		0.0 (ft^3) (1)
Coating (Epoxy)		3.0 (ft^3) (2)
Latent Debris *[(200 lbm)]*~~(200 lbm)~~	Fiber (15%)	30 (lbm)
	Particle (85%)	170 (lbm)
Miscellaneous Debris		*[200 ft^2 strainer surface area per sump]**
Chemical debris	Aluminum Hydroxide	300 (lbm)
	Sodium Aluminum Silicate	330 (lbm)

DCD_06.03-112

MIC-03-06-00071

Note: The following debris is included as operational margin, in addition to the amounts above:
(1) 1.875 (ft^3) of fiber debris
(2) 200 (lbs) of coating debris

Information in this table that is italicized and enclosed in square brackets with an asterisk following the closing bracket is a special category of information designated by the NRC as Tier 2. Any change to this information requires prior NRC approval.*

DCD_06.03-112