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November 24, 2009

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-09534

Subject: MHI's Responses to US-APWR DCD RAI No. 466-3715 Rev 0

Reference: [1] "Request for Additional Information No. 466-3715 Revision 0, SRP Section: 06.02.02 – Containment Heat Removal System - Design Certification and New License Applicants, Application Section: 6.2 and 6.3," dated October 6, 2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document as listed in Enclosure.

Enclosed are the responses to 3 questions that are 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. 466-3715 Revision 0

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

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NRO

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Docket No. 52-021
MHI Ref: UAP-HF-09534

Enclosure 1

UAP-HF-09534
Docket No. 52-021

Second Response to Request for Additional Information
No. 466-3715 Revision 0

November 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/24/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.:	**NO. 466-3715 REVISION 0**
SRP SECTION:	**06.02.02 – Containment Heat Removal System**
APPLICATION SECTION:	**6.2 & 6.3**
DATE OF RAI ISSUE:	**10/06/2009**

QUESTION NO.: 06.02.02-53

Provide additional information that demonstrates MHI's analysis approach to strainer debris accumulation is conservative as compared to the approved methodology (NEI 04-07 and associated SE). This is a follow-up to RAI 354 (2585) Question 06.02.02-23 – basis for uniform debris assumption - and was discussed in a conference call on 9/3/2009.

ANSWER:

Based on the conference call, the staff clarified they would like more justification why the 70 / 30 split of debris collecting on two operating sumps is conservative. In that discussion; the staff articulated a concern that although it was conservative to assume 100% transport; this may not necessary define the most conservative quantity of "fines" when using a 70 / 30 allocation of debris to two operating sumps.

Based on the above, it appears the root concern is whether or not the US APWR methodology approach defines more fiber fines reaching the sumps than is expected in the post LOCA event. Note the following logic applied to address this issue.

1. Since 100% of fibrous debris is assumed to transport to the US-APWR RWSP; this is clearly more conservative than the assumption of 60% suspends & transports (i.e., small fines) and 40% (i.e., larges) will not suspend and transport.
2. Since 100% of debris transports to the RWSP; the location of debris when recirculation starts is not a factor regardless if it is uniformly distributed, or not. Whether or not the debris is "uniformly distributed" might affect what types (i.e., latent, fines, smalls, and larges) of debris would reach the strainer array first and / or might affect to what extent different forms of debris are mixed or segregated before reaching the sumps. In other words, neither the type of debris or the quantity of debris is affected by where it starts with the assumption that 100% of all debris suspends and transports; only the debris sequencing and extent to which any debris form is mixed with another debris form on its way to the strainer sumps is affected. This concern is addressed in the US-APWR testing approach; wherein debris forms are sequenced from that which would transport most easily to that which would transport less easily. Again, this is a very conservative approach to qualification.
3. Under the assumption the "percent" of fiber fines "expected" to reach the screen is the key factor left to determine the head loss performance based on the postulated Design Basis accident, a comparison of the quantity of fines using the NEI 04-07 and associated SE

approach versus the US-APWR approach, and subsequent test planned should resolve this issue. If more fines are tested using the US-APWR approach versus the NEI 04-07 and associated SE approach, the overall approach should be accepted as "conservative" and bounding to the expected post LOCA conditions. See the quantification of "fines" in the following sections.

Associated NRC's question No. 8 provided for Comanche Peak applicable to the US-APWR (Refer RAI 422-2823) requested to clarify the basis for the quantity of fines to be tested. To resolve this question, the percent of fiber fines to be implemented for US-APWR testing shall be based on the following:

1. Of the 100% of fibrous debris generated, the default value from NEI 04-07 and associated SE states 60% of the debris that is generated is "smalls / fines" and is "assumed" to suspend and transport; and the other 40% of fibrous debris (i.e., larges) does not transport.
2. Further assume that a portion of the 40% of fibers that did not transport erodes into fines that do transport. Since the debris that does not transport is likely to be in stagnate areas; we will use the 10% erosion factor supported by industry's 30 day erosion testing for debris that is in a flow stream. This equals 10% x 40 or 4% of the total fibrous debris generated.
3. Of the 60% that is "assumed" to suspend and transport; assume 25% is fines and 75% is smalls; which equates to 15% of the debris generated is "fines". This is based on the SE; Appendix II that states it is acceptable to assume 15%-25% of the "smalls / fines" is fines.
4. Of the 60% that was supposed to transport but may not based on prior large flume debris testing; assume 45% (60% smalls/fines - 15% fines) erodes at a rate of 40% (4 times the erosion factor supported by the industry's testing of fibers in a flow stream); which yields another 18% of fines for testing; e.g., 40% x 45% = 18%.
5. Adding up all fines from 2, 3 & 4 above yields a total percentage of fines to be tested of 4% + 15% + 18%= 37% of total fiber debris generated.

In summary, of the 100% of debris generated; US APWR will test 37% as "fines", 63% as "smalls", and 0% as 'larges' (even though it was initially assumed that the NEI 04-07 and associated SE 'split' of 60/40 resulted in 40% larges). This is because the US-APWR has decided to test on the basis that 100% of the fibrous debris generated will suspend and transport. This is a very conservative approach.

Percent of fiber fines as defined by NEI 04-07and associated SE methodology as typically applied by the industry is considered as follows:

1. Of the 100% of fibrous debris generated, the default value from NEI 04-07 and associated SE states 60% of the debris that is generated is "smalls / fines" that is "assumed" to suspend and transport; and the other 40% of fibrous debris (i.e., 'larges') does not transport.
2. Further assume the 40% of fibers that did not transport erodes into fines that do transport. Since the debris that does not transport is likely to be in stagnate areas; we will use the 10% erosion factor supported by industry's 30 day erosion testing for debris that is in a flow stream. (MHI understood the SE 'default' assumption for erosion is 90% of the non-transportable fibrous debris, however, most of the industry has replaced this default value with the industry's 30 day test. The NRC has challenged this test; and therefore, it is likely another test will be performed by industry in the future to confirm the 10% as a bounding value.) This value is therefore calculated as 10% x 40 or 4% of the debris generated.
3. Of the 60% that is "assumed" to suspend and transport; assume 25% is fines and 75% is smalls; which equates to 15% of the debris generated is "fines". This is based on the SE; Appendix II that states it is acceptable to assume 15%-25% of the "smalls / fines" is fines.
4. Adding up all fines from 2 and 3 above yields a total percentage of fines to be tested of 4% + 15% = 19% of fiber debris generated.

Comparison of the quantity of fines debris reaching "one" of two arrays:

In the following table, we compare the NEI 04-07 and associated SE approach to the US-APWR approach:

Item	Descriptions	Fiber Class	NEI 04-07	US-APWR
1	Percent of Debris Generated		100.0%	100.0%
2	Percent that suspends and transports	Smalls/Fines	60.0%	60.0%
3	Percent that suspends and transports	Large	0.0%	40.0%
4	Percent that does not transport	Large	40.0%	0.0%
5	Max % of Fines Contained in "Smalls/Fines"	Fines	25.0%	25.0%
6	% of "Fines" Transporting as a % of Debris Generated	Fines	15.00%	15.00%
7	% of "Smalls" Transporting as a % of Debris Generated	Smalls	45.0%	45.0%
8	% of "Larges" Transporting as a % of Debris Generated	Smalls	0.0%	40.0%
9	% of "Larges" NOT Transporting as a % of Debris Generated	Larges	40.0%	0.0%
10	Total % of Debris Generated	All Classes	100.0%	100.0%
11	% of Erosion to Apply to "Larges"	Fines	10.0%	10.0%
12	% of Erosion to Apply to "Smalls"	Fines	0.0%	40.0%
13	% of Fines as a % of Debris Generated	Fines	4.0%	22.0%
14	Plus % of Fines Generated	Fines	15.0%	15.0%
15	Total % of Fines Generated or Eroded	Fines	19.0%	37.0%
16	Allocation of Debris to I of 2 Sumps		50.00%	70.0%
17	Percent of "Fines" Debris Reaching One Sump		9.5%	25.9%

Conclusions from the table above:

The US APWR is significantly more conservative than the normal NEI 04-07 and associated SE approach for the following reasons:

1. More fibrous debris is assumed to transport.
2. The US-APWR assumes "larges" that would not transport are "Smalls" that will transport
3. The percent of fines created (as a percent of debris generated) is 37% versus 19% for NEI 04-07 and associated SE.
4. The percent of fines reaching "one of two sumps" (as a percent of debris generated) is 25.9% versus 9.5% for NEI 04-07 and associated SE.
5. If the US-APWR were to assume 100% of all debris is collected on one sump, the percent of fines reaching "one of two sumps" (as a percent of debris generated) is 19% versus the 25.9% calculated using the US-APWR approach.
6. The USAPWR debris head loss testing will sequence debris in the most conservative protocol possible; meaning from most transportable to least transportable.

In summary, the assumption of uniform distribution and the allocation of debris as 70% / 30% to two sumps combined with the US-APWR approach of 100% transport and a bounding quantity of fiber fines applied is very conservative and bounding to the NEI 04-07 and associated SE methodology and especially to the expected post LOCA condition.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There will be no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/24/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.:	**NO. 466-3715 REVISION 0**
SRP SECTION:	**06.02.02 – Containment Heat Removal System**
APPLICATION SECTION:	**6.2 & 6.3**
DATE OF RAI ISSUE:	**10/06/2009**

QUESTION NO.: 06.02.02-54

Air ingestion due to deaeration of the fluid as it passes through the debris bed may occur at containment sump strainers. Air ingestion due to deaeration is a plant specific or load specific issue. If strainer submergence is less than the head loss some deaeration may occur. Therefore, request MHI to evaluate the potential for US APWR to experience deaeration. If deaeration is predicted to occur, assess the impact on required NPSH. This is a follow-up to RAI 354 (2585) Question 06.02.02-28 and was discussed in a conference call on 9/3/2009.

ANSWER:

As it stated, air ingestion due to deaeration of the fluid as it passes through the debris bed may occur at containment sump strainers when strainer submergence is less than the head loss. The solubility of gas is proportional to the pressure in accordance with Henry's law. The air may be eluted during passing the debris bed due to the difference of saturated solubility. But the potential to impact on debris head loss is considered to be negligible because of the following reasons:

- Dissolved air in the RWSP water with normal condition is considered not to be saturated. In general, air does not dissolve much into the water. Diffusion is not rapid phenomena, so it is difficult for the RWSP water to be saturated.

- Even if the RWSP water is saturated with air, the amount of dissolved air is small (In general, air does not dissolve much into the water). Therefore, the amount of eluted air due to the head loss can be considered to be negligible.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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APPLICATION SECTION:	**6.2 & 6.3**
DATE OF RAI ISSUE:	**10/06/2009**

QUESTION NO.: 06.02.02-55

Many design requirements for the containment sump strainer performance evaluation such as break selection, debris generation, ZOI, debris sizing, debris transport etc, are detailed in technical report MUAP 08001. Much of this information should be part of the FSAR description required by 10CFR52.47 (a)(2) to permit sufficient understanding of the strainer performance design basis. Explain the basis for not including this type of information in the DCD FSAR or why MUAP 08001 is not treated as incorporated by reference (IBR) in DCD Chapter 1.

ANSWER:

As pointed, much of information associated with sump strainer performance is included in the technical report MUAP-08001, because the report was originally issued after the initial submission of the DCD rev.0. After that, the report has been updated as per the progress of activities required to resolve GS-191 issue, and still be subject to revise the further activities, including plant specific testing plan and results. The associated subsections in the DCD has been revised to refer the technical report, but not duplicated in the DCD FSAR to avoid redundant descriptions between them. This was the intention to just refer the technical report in the DCD.

MHI agrees that principle and important information associated with sump strainer performance is also to be provided in associated subsections in the DCD to provide sufficient understanding of the sump strainer performance design basis. Such information will be carefully selected and incorporated into the further tracking report of the DCD and eventually into the next revision of the DCD.

Impact on DCD

The information associated with sump strainer performance design basis will be carefully selected as per ongoing resolution activities and eventually incorporated into the next revision of the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There will be no impact on the PRA.