MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

September 18, 2008

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-08195

Subject: **MHI's Responses to US-APWR DCD RAI No.53-956**

Reference: 1) "Request for Additional Information No. 53-953 Revision 0, SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation, Application Section: 19.1.5.3," dated August 21, 2008

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 53-953 Revision 0".

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

As indicated in the enclosed materials, this document contains information that MHI considers proprietary, and therefore should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential. A non-proprietary version of the document is also being submitted with the information identified as proprietary redacted and replaced by the designation "[ ]".

And one version includes certain information, designated pursuant to the Commission guidance as sensitive unclassified non-safeguards information, referred to as security-related information ("SRI"), that is to be withheld from public disclosure under 10 CFR § 2.390. The information that is SRI is identified by braces "{ }". On the other hand, another version omits the SRI and is suitable for public disclosure. In the public version of the DCD, the SRI is replaced by the designation "{Security-Related Information - Withheld Under 10 CFR § 2.390}".

This letter includes a copy of the proprietary and SRI included version (Enclosure 2), a copy of the non-proprietary and SRI excluded version (Enclosure 3), and the Affidavit of Yoshiki Ogata (Enclosure 1) which identifies the reasons MHI respectfully requests that all materials designated as "Proprietary" in Enclosure 2 be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

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.

D081
NRO

Sincerely,

Y. Ogata

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

Enclosures:

1. Affidavit of Yoshiki Ogata

2. Responses to Request for Additional Information No.53-956 Revision 0 (proprietary and SRI included version)

3. Responses to Request for Additional Information No.53-956 Revision 0 (non-proprietary and SRI excluded version)

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

<u>Contact Information</u>

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ENCLOSURE 1

Docket No. 52-021
MHI Ref: UAP-HF-08195

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshiki Ogata, state as follows:

1. I am General Manager, APWR Promoting Department, of Mitsubishi Heavy Industries, LTD ("MHI"), and have been delegated the function of reviewing MHI's US-APWR documentation to determine whether it contains information that should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential.

2. In accordance with my responsibilities, I have reviewed the enclosed document entitled "Responses to Request for Additional Information No.53-956 Revision 0" dated September 2008, and have determined that portions of the document contain proprietary information that should be withheld from public disclosure. Those pages containing proprietary information are identified with the label "Proprietary" on the top of the page and the proprietary information has been bracketed with an open and closed bracket as shown here "[ ]". The first page of the document indicates that all information identified as "Proprietary" should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

3. The information identified as proprietary in the enclosed document has in the past been, and will continue to be, held in confidence by MHI and its disclosure outside the company is limited to regulatory bodies, customers and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and is always subject to suitable measures to protect it from unauthorized use or disclosure.

4. The basis for holding the referenced information confidential is that it describes the unique design and methodology developed by MHI for performing the design of the US-APWR reactor.

5. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of information to the NRC staff.

6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information. Other than through the provisions in paragraph 3 above, MHI knows of no way the information could be lawfully acquired by organizations or individuals outside of MHI.

7. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without incurring the costs or risks associated with the design of the subject systems. Therefore, disclosure of the information contained in the referenced document would have the following negative impacts on the competitive position of MHI in the U.S. nuclear plant market:

   A. Loss of competitive advantage due to the costs associated with development of methodology related to the analysis.

B. Loss of competitive advantage of the US-APWR created by benefits of modeling information.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information and belief.

Executed on this 18th day of September 2008.

Y. Ogata

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

Enclosure 3

UAP-HF-08195
Docket Number 52-021

Responses to Request for Additional Information No.53-956
Revision 0

September, 2008
(Non-Proprietary and Security-Related Information Excluded)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/18/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: NO.53-956 REVISION 0

SRP SECTION: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation

APPLICATION SECTION: 19.1.5.3

DATE OF RAI ISSUE: 8/21/2008

QUESTION NO. : 19-101

DCD FSAR Chapter 19, Section 19.1.5.3 Internal Flooding Risk Evaluation and MUAP-07030(R0)- Proprietary Document, US-APWR Probabilistic Risk Assessment, Chapter 22, Section 22.2.2, Assumptions:

It is stated that "Flooding of ESWS can be isolated within 15 minutes and flooding of fire protection system can be isolated within 30 minutes".

Please explain the consequences of these assumptions on the internal flooding analysis:
(1) What is the failure probability of the detection devices for flooding?
(2) Is the isolation of ESWS within 15 minutes a total success? In other words, no damage is assumed during the isolation of ESWS?
(3) Same question for the isolation of fire protection system.

ANSWER:

(1) Failure probability of the detection devices: The specific detection devices has not been decided at the design certification phase and the failure of such devices is not assumed to cause failure of the isolation. However, the flooding will be detectable using the leak detectors or ESWS flowmeters or announciation of spurious operation of fire suppression systems. For example, mean failure probability of a sensor (level) is 1.4E-06/hr (IEEE std-500 1984). The frequency of ESWS flood without isolation within 15 minutes is very small from consideration of the flood frequency and probability of the diversed detectors to fail. Also, although the failure of the isolation has not been considered, there is no significant risk impact as described below in (2).

(2) Isolation of ESWS: If the isolation of ESWS within 15 minutes has succeed, the amount of water discharged from an ESW pump for 15 minutes is considered to flood. Flood from the ESWS are assumed to propagate to the east side area (or the west side area) of the B1F in the R/B and cause the failure of both safety related trains in the side flood water has propagated.

If the isolation of the ESWS within 15minutes has failed, flooded water will propagate to the upper floor of east side of R/B and PS/B and equipments placed in the areas are assumed to fail. The impact of the flood is limited to the east side or the west side in the R/B even though isolation of the flooded ESW pump has failed. Accordingly, time to isolate ESWS has no significant impact on risk.

(3) Isolation of fire protection system: The flooding from the fire protection system has been assumed that the amount of all water in the fire suppression tank will be spilled out by the fire pumps. This assumption will be deleted in the revision of DCD.

More specific assessment will be possible when information of the specific detection devices has become available.

Impact on DCD

The next revision of DCD will involves this information.

Impact on COLA

There is no impact on COLA.

Impact on PRA

PRA report revision 1(MUAP-07030(R1)) involves this information.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/18/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: NO.53-956 REVISION 0

SRP SECTION: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation

APPLICATION SECTION: 19.1.5.3

DATE OF RAI ISSUE: 8/21/2008

QUESTION NO. : 19-102

DCD FSAR Chapter 19, Section 19.1.5.3 Internal Flooding Risk Evaluation and MUAP-07030(R0)- Proprietary Document, US-APWR Probabilistic Risk Assessment, Chapter 22, Section 22.2.2, Assumptions:

It is stated that detailed design of ESW intake structure and ESW piping tunnel are site specific and it is assumed that four trains of ESWS have physical separation and flooding in one train does not propagate to other trains.

What are the requirements of physical separations for the ESWS intake structure and piping tunnel? How does the COL applicant confirm their site specific ESWS structure and piping tunnel meet the separation requirements? Should a COL action item be issued?

ANSWER:

The ESWS intake structure and piping tunnel are designed in conjunction with the component cooling water system (CCWS). The safety related systems of the US-APWR consists of four trains. The key issue of the physical separations for the ESWS is the preservation of the safety function of CCWS/ESWS. COL applicant will also design the ESWS to preserve the safety function of CCWS. Therefore, the requirements of the physical separations for the ESWS will not the specific issues on the internal flooding risk.

COL applicant will confirm the impact on the function of the CCWS/ESWS due to the flood at the site specific ESWS intake structure and piping tunnel.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/18/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO.53-956 REVISION 0**

SRP SECTION: **19 – Probabilistic Risk Assessment and Severe Accident Evaluation**

APPLICATION SECTION: **19.1.5.3**

DATE OF RAI ISSUE: **8/21/2008**

QUESTION NO. : 19-103

DCD FSAR Chapter 19, Section 19.1.5.3 Internal Flooding Risk Evaluation and MUAP-07030(R0)- Proprietary Document, US-APWR Probabilistic Risk Assessment, Chapter 22, Section 22.2.2, Assumptions:

It is stated in the assumption that "The first floor of the electrical equipment room of T/B is designed to be water proof and the first floor of T/B is equipped with relief panels so that these measures prevent the occurrence of loss of offsite power due to flood in the T/B".

Please provide further discussion about the electrical room configuration and operation of the relief panels to prevent the occurrence of loss of offsite power in case of flooding event in T/B.

ANSWER:

Electrical rooms are located adjacent to west side of turbine building (T/B). The first floor is electrical room B and the second floor is the electrical room A as shown in Figure 1. The first floor of the electrical room B is the water tight area. Offsite power sources such as 13.8 kV non Class 1E buses and 6.9 kV non Class 1E buses are took in the electrical room B and the electrical room A separately as shown in Figure 2.

Will either one function of the electrical room A or the electrical room B be available, loss of offsite power will not occur.

The relief panels are installed on the south side first floor walls of the T/B. Flood water is drained outside through the operated relief panels even if the major flood occurs and accumulates water in the T/B.

If a major flood has occurred and water has been accumulated in the T/B, loss of offsite power will not occur because the electrical room A and/or electrical room B will be intact against the any flood propagation scenarios in the T/B.

Important assumptions are the followings:

- Water tight electrical room B (1F) prevents the flood propagation.
- The relief panels on the first floor drain out water before the water level reaches the following height,
    - ➢ The electrical room A (2F) and
    - ➢ The heights of HVAC ducts of the first floor (DCD subsection 10.4.5.3.4.1).

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

PRA report revision 1(MUAP-07030(R1)) involves the additional information.

{Security-Related Information - Withheld Under 10 CFR 2.390}

Layout

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/18/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: NO.53-956 REVISION 0

SRP SECTION: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation

APPLICATION SECTION: PRA

DATE OF RAI ISSUE: 8/21/2008

QUESTION NO. : 19-104

DCD FSAR Chapter 19, Section 19.1.5.3.2 Results from the Internal Flooding Risk Evaluation and MUAP-07030(R0)- Proprietary Document, US-APWR Probabilistic Risk Assessment, Chapter 22, Section 22.7.2, Sensitivity Analysis:

The statement says "US-APWR designs to prevent electrical equipment rooms from the flooding and fire such as separation of the electrical rooms on the first floor and the second floor of T/B....... If the measures against the flooding for electrical room of T/B have not been done, it is difficult to switchover to alternate gas turbine generators for power supply to class 1E buses when all emergency gas turbine generators failed. As a sensitive study, loss of offsite power due to the flooding in the T/B is assumed. If these measures have not done and a loss of offsite power with all four class 1E gas turbine generators failure occurred, the CDF and LRF of this scenario are 1.1 E-06/ry and 3.8E-08/ry, respectively. These measures are effective to reduce flooding risk."

Please provide a list of the electrical equipment on the first and second floor in the T/B which have significant impact on the loss of offsite power event. What are the values of CDF and LRF due to the use of separation of electrical equipment on the first and second floor of the T/B in the event of loss of offsite power? Are there any other sensitivity studies performed associated with the internal flood risk evaluation?

ANSWER:

(1) List of the key electrical equipment

The list of electrical equipment which has significant impact on the loss of offsite power event is shown in Table 1. (Figure 2 in the response to RAI 19-103 illustrates the electrical equipment in the electrical rooms of T/B.)

The identifier of the flood area on the first floor of the T/B (electrical room B) is FA6-101-03.
The identifier of the flood area on the second floor of the T/B (electrical room A) is FA6-101-14.

(2) CDF and LRF due to the use of separation of electrical equipment in the T/B
The results of CDF and LRF due to the use of separation of electrical equipment on the first and second floor of the T/B are 1.4E-06/RY and 2.8E-07/RY respectively. This is the results of reference case as described in the DCD Revision 1 subsection 19.1.5.3.2. In this reference case, it is assumed that flood will not cause loss of offsite power since the electric equipments in the T/B are separated. This assumption is described in the response to RAI 19-103.

A sensitivity study has been performed to assess the CDF and LRF in a case which electrical equipments in the T/B are not separated and loss of offsite power may occur due to flood. In this case, if loss of offsite power has occurred and all four Class 1E gas turbine generators fail, it is not possible to switchover to alternate ac power sources to the Class 1E buses, because the alternate selector circuits are located in the electrical rooms in the T/B. The CDF and LRF of this scenario are 1.1E-06/RY and 3.1E-08/RY respectively as described in the DCD Revision 1 subsection 19.1.5.3.2. The total CDF and LRF will increase to 2.4E-06/RY and 3.1E-07/RY respectively by replacing this scenario with the reference case.

(3) Other sensitivity study
Another sensitivity study has been performed in the DCD Revision 1 subsection 19.1.5.3.2. In this case, it is assumed that all water barrier doors except the controlled barriers such as R/B separation between the east side and west side and high energy compartment are invalid as a bounding sensitivity case. The total CDF and LRF of this case are 2.6E-06/RY and 6.1E-07/RY respectively. This sensitivity analysis shows that even if several local watertight doors are remained open, the increasing of risk is not large.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

PRA report revision 1(MUAP-07030(R1)) involve s the additional information.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/18/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: NO.53-956 REVISION 0

SRP SECTION: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation

APPLICATION SECTION: 19.1.5.3

DATE OF RAI ISSUE: 8/21/2008

QUESTION NO. : 19-105

DCD FSAR Chapter 19, Section 19.1.5.3.2, Results from the Internal Flooding Risk Evaluation and MUAP-07030(R0)- Proprietary Document, US-APWR Probabilistic Risk Assessment, Chapter 22, Section 22.6, Flood Scenario Quantification:

Top ten dominant scenarios contributing to CDF and LRF are presented and the values of CDF and LRF are also listed. Dominant cutsets for these ten scenarios are also presented in Table 19.1-67 (same as Table 22.6-5 in US-APWR PRA).

Please provide explanation/procedures on how the values of CDF/LRF are calculated using the results of these dominant cutsets.

ANSWER:

The reference process to calculate the internal flooding risk (CDF/LRF) is to sum up risk from each flood scenario, which is calculated by multiplying the [1] frequencies of initiating event caused by pipe failure of each flood scenario and [2] CCDP/CLRP (conditional core damage probability / conditional large relief frequency), as shown in equation (1).

CDF by internal flood
= ∑{ ([1] Frequency of the initiating event caused by the pipe failure of each flood scenario) x ([2] CCDP of each flood scenario } (1)

Also, CDF/LRF can be calculated using the dominant cutsets (limited to the top 95%//90% of the sequences), which have been used for the uncertainty calculations.

1. CDF/LRF from the dominant cutsets

Table 1 shows the example of the dominant cutsets. Notes of Table 1 describe the identifiers and cutsets of sequence 1 as an example. Items of each row in the table are described below:

- The first row is the dominant sequence numbers,
- The second row is the CDF of this sequence,
- The third, the fourth, and the fifth rows are the identifier of cutsets, the frequency or probability of each cutset and the description of each cutset. The first cutset is the initiating event frequency caused by the flood. The folloiwing cutsets are the basic events such as SSC failures and human errors.

For example, the items in the row titled "Cutsets" are, (1) "241401-SLBI-3-M01" the initiating events (SLBI) caused by the major flood in the flood area FA2-414-01, (2) and (3) the basic events that represent random failures.

CDF of sequence 1 is the result of multiplication of initiating events and basic events in the cutsets, which are (1), (2) and (3). The result is 1.1E-07/ry as shown in the second row. The CDFs of other sequences are calculated using the same process.

Total CDF (top 95% cutsets) will be gotten from the summing up of frequencies of all sequences.

2. CDF/LRF from the reference process

Reference process to calculate the internal flooding risk (CDF/LRF) has been performed using equation (1).

This section describes the procedures on how the values of CDF/LRF are calculated using "flood scenario FA2-414-01" as an example. Table 2 is the summary of flood scenario of FA2-414-01 (Major Flood).

[1] Frequency of the initiating event caused by the pipe failure of each flood scenario

The flood area FA2-414-01, main steam and feedwater piping room, is composed of various pipes and valves related to main steam lines as shown in the Table 3 (flood scenarios No. 2071 – 2174).

Flood frequency of each scenario in the FA2-414-01 is calculated by multiplying the flood frequency of the flood category by the piping length. The resulting initiating event of each scenario is also classified. Table 22.5-3 "Internal Flood PRA piping of Each Zone and Failure Rate" of the revised PRA report MUAP-07030(R1) will involve detail information.

[2] CCDP of each flood scenario

The same initiating events in the FA2-414-01 are gathered and the frequencies are summed up as shown in Table 2.

CCDP for each initiating event is calculated using the event trees in the Risk Spectrum® model considering boundary conditions, which represent the impact of flood. In the model, the boundary condition "True (=1.0)" are given to the failed systems and/or functions that are assumed to be unavailable in the flood scenario. Table 2 shows the identifier of the boundary condition and the results of CCDPs. The examples of the calculated CCDP and the boundary conditions are shown in Table 4-1 and Table 4-2 respectively.

Detail information of the boundary condition identifier and the results of CCDPs will be described in the Attachment 22B in the revised PRA report MUAP-07030(R1).

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

PRA report revision 1(MUAP-07030(R1)) involves this information.