MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

April 10, 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-09169

Subject: **MHI's Responses to US-APWR DCD RAI No. 151-1824 Revision 1**

Reference:
1) "Request for Additional Information No. 151-1824 Revision 1, SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation, Application Section: 19.1," dated January 12, 2009.
2) Letter MHI Ref: UAP-HF-09045 from Y. Ogata (MHI) to U.S. NRC, "MHI's Responses to US-APWR DCD RAI No. 151-1824," dated February 6, 2009.
3) Letter MHI Ref: UAP-HF-09086 from Y. Ogata (MHI) to U.S. NRC, "MHI's Responses to US-APWR DCD RAI No. 151-1824," dated March 13, 2009.

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

Enclosed are the third responses to two RAIs, RAI19-288 and 19-289, contained within Reference 1. In the first responses submitted with Reference 2, MHI committed to submit responses to 19-285, 19-286 and 19-290 within 60 days and to submit responses to 19-288 and 19-289 within 90 days after RAI issue date.

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 "[ ]".

This letter includes a copy of the proprietary version (Enclosure 2), a copy of the non-proprietary 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. 151-1824 Revision 1 (proprietary version)

3. Responses to Request for Additional Information No. 151-1824 Revision 1 (non-proprietary version)

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

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ENCLOSURE 1

Docket No. 52-021
MHI Ref: UAP-HF-09169

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.151-1824 Revision 1" dated April 2009, 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 10th day of April 2009.

Y. Ogata

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

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Enclosure 3

UAP-HF-09169
Docket Number 52-021

Responses to Request for Additional Information No. 151-1824
Revision 1

April 2009
(Non-proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/10/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO.151-1824 REVISION 1**

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

APPLICATION SECTION: **19.1**

DATE OF RAI ISSUE: **1/12/2009**

QUESTION NO. : 19-288

In Section 19.1.7.6 of the US-APWR design control document (DCD) it is stated: "At the design stage, PRA results have been used as input in the development of the technical specifications (Chapter 16). PRA insights are utilized to develop risk-managed technical specifications (RMTS) and surveillance frequency control program (SFCP)." Please discuss in more detail (e.g., by providing a few examples) how the PRA results were used at the design stage in the development of TS. In addition, for demonstration purposes, please include at least one example of using the US-APWR PRA to apply the RMTS guidance (NEI 06-09). The terms LERF (large early release frequency) and ILERP (incremental large early release probability) in the NRC- approved NEI guidance can be substituted with the terms LRF (large release frequency) and ILRP (incremental large release probability) used in the US-APWR PRA. The selected example(s) should be realistic but "challenge" the process with respect to PRA key assumptions, the use of insights from external events, and the presence of uncertainties. A good example for implementing NEI 06-09 could be the following: While the plant operates at power with one emergency ac power gas turbine generator (GTG), one alternate ac (AAC) GTG, and one turbine-driven (T-D) emergency feedwater (EFW) pump out for preventive maintenance, one of the two motor-driven (M-D) EFW pumps is found to be inoperable. Suppose that neither one of the M-D or the T-D pumps can be returned to service within the required completion time (CT) and NEI 06-09 guidance is used to extend the CT. While the plant is at power in the above described configuration within the extended CT, HVAC is lost to the room where the remaining M-D EFW pump is located. Please provide results showing the ICDP and ILRP values versus time. In your discussion, include (1) specific compensatory risk management actions that may be credited in the calculations, (2) key modeling assumptions that are important to ensure that the RMTS decision-making process is robust, and (3) any important assumptions made in the external events calculations and how it is determined that the PRA models for internal fires and flooding ensure reliable or bounding results consistent with NEI guidance and, thus, suitable for use in the RMTS decision-making process.

ANSWER:

The description of the use of PRA in the development of TS was written to state that the RMTS and SFCP, which needs to be supported by the PRA, is an option in the US-APWR TS. There are no specific portions of the TS that have been developed utilizing inputs from the PRA. The PRA can be use for demonstrating the RMTS like this RAI during the design stage.

Example demonstrating RMTS program

Two examples cases of RICT calculations were performed to demonstrate the RMTS program. PRA to support RMTS will be developed and completed during plant construction stage. In order to perform RICT calculations based on the DCD PRA model, following approach were applied for this example case.

- LRF is applied as a substitute for LERF

- The total CDF from internal and external events CDF_{total}, was estimated based on the results of internal events. Since the annual CDF quantified as the base case for DCD show that risk from fire and flood are in the same order of magnitude with internal events, risk from fire and flood events were assumed to be equal to that of internal events. CDF_{total} was calculated based on simply assuming CDF_{total}= 3 x $CDF_{internal}$. Total LRF_{total}, from internal and external events were also estimated in the same manner. ICDP and ILRP are calculated by CDF_{total} and LRF_{total}, and the acceptance criteria shown in NEI 06-09, respectively.

- Common cause failure (CCF) probabilities are consistent with the CCF group size that is operable. CCF between the component that has been found to be inoperable and the remaining operable pumps are not considered. Actions to confirm that CCF has not occurred whenever a component is found to be inoperable and LCO is violated, are taken credit.

Zero maintenance risk was quantified by removing all the annual unavailability of components from the fault tree model of the DCD PRA. Resulting internal events at power CDF and LRF were 1.1E-6 /RY and 9.1E-8 /RY. Estimated CDF_{total} and LRF_{total} values based on the assumption that fire and flood risk are approximately equal with internal events are 3.2E-6 /RY and 2.7E-7 /RY, respectively. This zero maintenance CDF_{total} and LRF_{total} are used for RICT calculation.

The example case cited in the staffs question was not demonstrated since the RICT is not applied to EFW system. Instead, two cases described below were chosen for RICT calculation examples.

(1) Case 1

While the plant operates at power with one Class 1 gas turbine generator (GTG), one alternate ac (AAC) GTG, and one safety injection pump (SIP) out for preventive maintenance, one of the remaining SIPs is found to be inoperable. Neither one of the two SIP can be returned to service within the required completion time (CT) and RICT is applied. While the plant is at power in the above described configuration within the extended CT, another one of the remaining SIP is found to be operable.

Configuration 1-a : The plant is operating at power with Class 1 GTG of train C, AAC of train B, and SIP of train C out for preventive maintenance. In this configuration all of the systems meet its LCOs. The CDF and LRF for internal events during this plant configuration are 2.0E-6 /RY and 1.7E-7 /RY, respectively. CDF_{total} and LRF_{total} are 6.0E-6 /RY and 5.0E-7 /RY, respectively.

Configuration 1-b : At time = 0 day, SIP of train B is found to be inoperable. Two trains of the safety injection system (SIS) are now out of service and LCO 3.5.2 is not met. The CDF and LRF for internal events during this plant configuration are 3.3E-6 /RY and 1.8E-7 /RY, respectively. CDF_{total} and LRF_{total} are 9.9E-6 /RY and 5.5E-7 /RY, respectively. Neither of the SIP can be returned to service within the front stop CT and RICT is applied. The calculated RICT is 551 days according to ICDP and 1298 days according to ILRP. The 30 day backstop is applied.

Configuration 1-c : At time = 15 day, SIP train D is found to be inoperable. Three trains of the SIS are out of service. The CDF and LRF for internal events during this plant configuration are 6.8E-6 /RY and 2.7E-7 /RY, respectively. CDF_{total} and LRF_{total} are 2.0E-4 /RY and 3.1E-6 /RY, respectively. The RICT is recalculated based on the new plant configuration. The calculated RICT is 33 days according to ICDP and 143 days according to ILRP. The 30 day backstop remains.

Instantaneous CDF and LRF profile of case 1 is shown in figure 1. ICDP evolution of case 1 is shown in figure 2.

- Calculated RICT for case 1 exceeds 30days. The 30 day backstop is applied and the ICDP as well as ILRP from outages are maintained below the acceptance criteria.

- In the DCD PRA model, which is used for this analysis, small and medium size LOCA initiating is assumed to take place at the line A of the direct vessel injection (DVI) line. This asymmetric initiating event condition was applied for simplicity of the PRA model. However, for the RICT calculation, this assumption artificially increases the CDF and LRF result of Configuration 1-c. This is because LOCA event in DVI line A makes safety injection from SIP train A, which is the only operable SIP, effective. If the LOCA initiating event were modeled symmetrically for all four trains, the ΔCDF for condition 1 will be less than half, and the calculated RICT would be longer.

- Risks from external events are not calculated from PRA model and therefore have large uncertainty. The calculated RICT is not expected to be drastically shortened even assuming external event risk that were twice the value of the example case, if the symmetric initiating event described in the bullet above were to be take into account. However, RICT may be less than the 30day backstop depending on the results of external events. External event Pr model for the RICT calculation will be carefully treated during the PRA development for RMTS during post COLA.

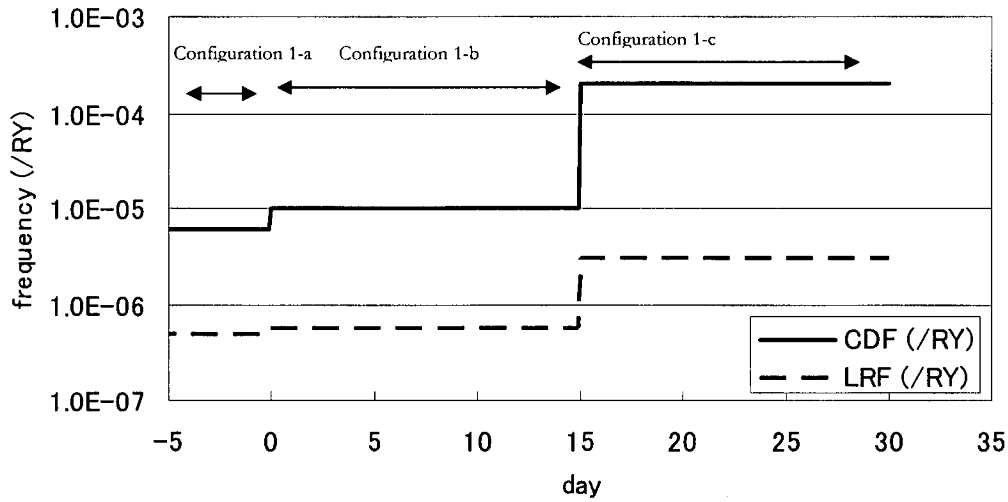

Figure 1 Instantaneous CDF_{total} and LRF_{total} profile of case 1

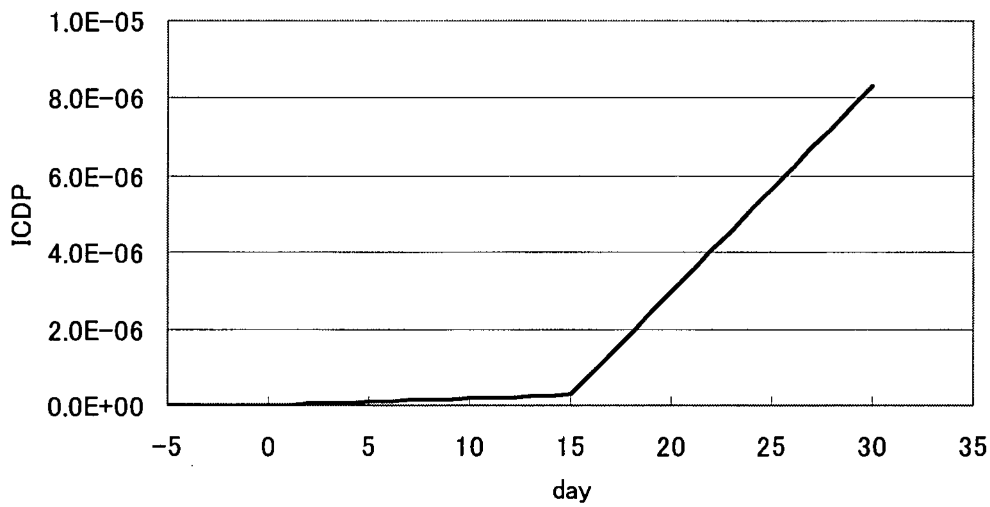

Figure 2 $ICDP_{total}$ evolution of case 1

(2) Case 2

While the plant operates at power with one Class 1 gas turbine generator (GTG), one alternate ac (AAC) GTG, and one safety injection pump (SIP) out for preventive maintenance, one of the remaining Class 1 GTG is found to be inoperable. Neither one of the two Class 1E GTGs can be returned to service within the required completion time (CT) and RICT is applied.

The plant is operating at power with Class 1 GTG of train C, AAC of train B, and SIP of train C out for preventive maintenance (Configuration 2-a). In this configuration none of the system violates the LCOs. The CDF and LRF for internal events during this plant configuration are 2.0E-6 /RY and 1.7E-7 /RY, respectively. CDF_{total} and LRF_{total} are 6.0E-6 /RY and 5.0E-7 /RY, respectively.

At time = 0 day, Class 1E GTG of train B is found to be inoperable (Configuration 2-a). Two Class 1E GTGs are out of service and LCO 3.8.1 is not met. The CDF and LRF for internal events during this plant configuration are 4.3E-6 /RY and 3.0E-7 /RY, respectively. CDF_{total} and LRF_{total} are 1.3E-5 /RY and 9.1E-7 /RY, respectively. Neither of the Class 1E GTG can be returned to service within the front stop CT and RICT is applied. The calculated RICT is 374 days according to ICDP and 575 days according to ILRP. The 30 day backstop is applied.

Instantaneous CDF and LRF profile of case 2 is shown in figure 3. ICDP evolution of case 2 is shown in figure 4.

- RICT for case 2 exceeds 30days. The 30 day back stop is applied and the ICDP as well as ILRP from outages will be maintained below the acceptance criteria with sufficient margin.
- Risks from external events are not calculated from PRA model and therefore have large uncertainty. However the calculated ICDP and ILRP at day 30 is below the acceptance criteria with sufficient margin and therefore, the uncertainty is not likely to impact the CT, which is the 30 day backstop.
- The plant condition assumed in this case has impact on the frequency of station black out (SBO) sequence. Major uncertainties in SBO sequence are the reliability parameters of GTGs and the reactor coolant pump (RCP) seal LOCA model applied to determine available time for offsite power recovery. However, the calculated ICDP and ILRP at day 30 is below the acceptance criteria with sufficient margin, and therefore, the uncertainty of GTG reliability and RCP seal model is not excepted to impact the CT, which will be the 30 day backstop.

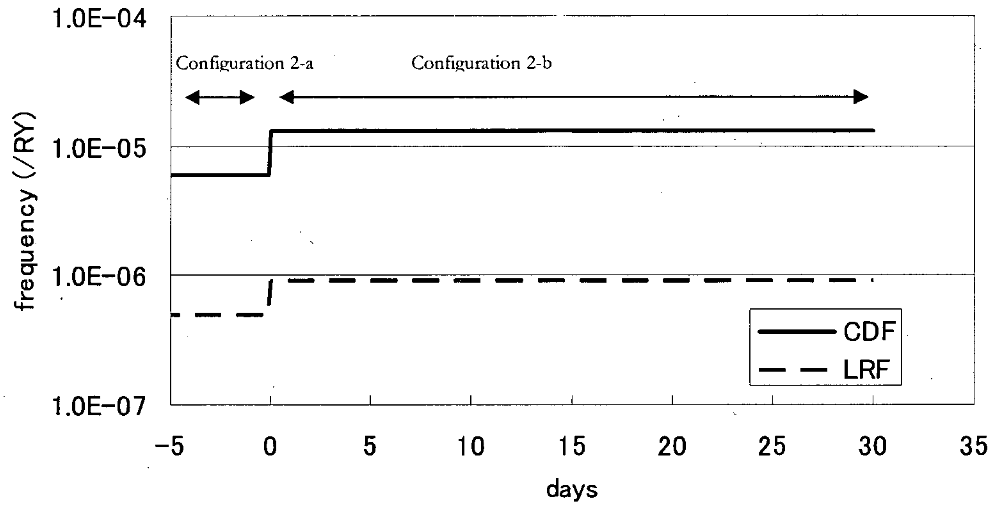

Figure 3 Instantaneous CDF_{total} and LRF_{total} profile of case 2

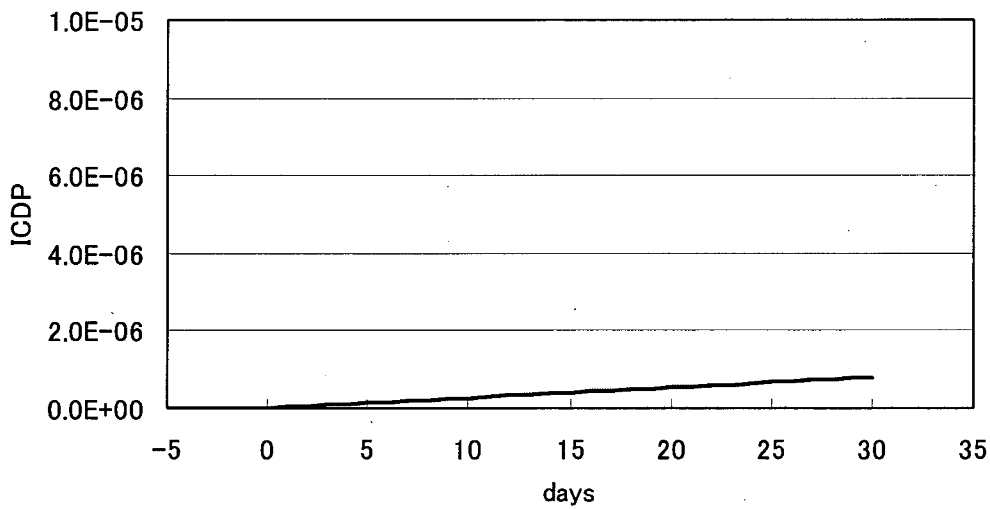

Figure 4 $ICDP_{total}$ evolution of case 2

Impact on DCD

No impact on DCD.

Impact on COLA

No impact on COLA.

Impact on PRA

No impact on PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/9/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO.151-1824 REVISION 1**

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

APPLICATION SECTION: **19.1**

DATE OF RAI ISSUE: **1/12/2009**

QUESTION NO. : 19-289

The staff has approved guidance for implementing risk-managed technical specifications (RMTS) and surveillance frequency control program (SFCP) which is applicable to operating reactors. This guidance for operating reactors is documented in NEI 06-09 for RMTS (Initiative 4b) and NEI 04-10 for SFCP (Initiative 5b). In its application for certification of the US-APWR design, Mitsubishi Heavy Industries (MHI) has indicated that the PRA submitted in support of the design certification application satisfies the requirements specified in the NEI 06-09 and NEI 04-10 that are associated with PRA technical adequacy, such as scope of PRA, level of detail to provide plant configuration specific impacts and operating modes, with the exception of site-specific information that will be provided by the COL applicant/holder. Please perform a self-assessment of the US-APWR design certification PRA quality and indicate, in the response to this request for additional information (RAI), how it satisfies the requirements specified in the NEI 06-09 and NEI 04-10 that are associated with PRA technical adequacy. Your response should address the following statement made in NEI 06-09 (Section 4): "The PRA model attributes and technical adequacy requirements for RMTS applications must be compatible with established ASME standards requirements, as modified by NRC Regulatory Guide 1.200 Rev 0...... It is expected that, in general, the PRA which supports RMTS shall meet Capability Category 2 requirements and any exceptions to meeting those requirements shall be justified." For the PRA Level 1 and 2 portions addressing internal events (including internal flooding) at power operation (Modes 1 and 2), please indicate whether and how each ASME "high level" and "supporting" requirement is met with respect to Capability Category II. For those areas that ASME requirements are not fully met, identify what is needed to be done and by whom (e.g., MHI or the COL applicant/holder) so they can meet Capability Category II requirements or justify why such a capability is not necessary for implementing RMTS and SFCP. Also, please discuss assumptions and attributes of the US-APWR internal fires, seismic analysis and other external events, and shutdown PRA models which ensure reliable or bounding results and contribute to the robustness of the RMTS and SFCP decisionmaking processes.

ANSWER:

Basically, COL holder will update the US-APWR PRA model for RMTS by fuel loading. The PRA model would be modified to meet the PRA technical adequacy requirements in the NEI 06-09. Followings are the applicability of the current PRA model used for the design certification (DC) to the PRA technical adequacy requirements in NEI 06-09.

PRA Technical Adequacy Requirements in the NEI-06-09 (Initiative 4b)	Applicability
Modeling of removal of plant SSCs from service	NA
Compliance with Capability Category 2 of ASME PRA std.	See attached table
Evaluation of CDF and LERF, Assessment of external events	PA
Capability to quantify configuration specific impact due to unavailability of equipments in CRM program	NA
Consideration of current (i.e. Seasonal or time of cycle) configuration	NA
Common cause treatment in CRM model	NA
Maintain and update PRA	NA
Satisfy software station software quality assurance requirements	NA
Arguments on use of at-power PRA to low operating modes	NA
Consideration of modeling uncertainty in the RMTS program	NA

Applicability of the US-APWR PRA for ASME PRA Standard Capability Category II is summarized in the attached Table. This table is developed referring ASME PRA Standard (RA-Sb-2005), Regulatory Guide 1.200 Revision 1, NEI 05-04 Revision 2 and NEI 00-02 Revision 1.

The columns in the table denote the following descriptions.

Column "ASME HLR-SR": Describe the identifiers of supporting requirements (SR) for the following high level requirements (HLR) to the PRA elements in the ASME PRA Standard.

(PRA elements)

IE: Initiating events analysis
AS: Accident sequence analysis
SC: Success criteria
SY: System analysis
HR: Human reliability analysis
DA: Data analysis
IF: Internal flooding
QU: Quantification
LE: LERF analysis

Column "Capability Category II": Classify the applicability for Capability Category II

A: Applicable

PA: Partially Applicable

NA: Not Applicable

Column "Basis for assessment": Describe the basis of the applicability.

Column "Supporting References": Note the references to support the "basis for assessment"

DCD: US-APWR Design Certification Document Revision 1

PRA: MUAP-07030(R1), US-APWR Probabilistic Risk Assessment

SA: MUAP-08004(R1), US-APWR Probabilistic Risk Assessment (Level 3)

No.: Section Number

Column "Action Plan to meet the Category II Requirements":

Describe the action plan to meet the capability category II.

Column "Applicant": Describe the PRA update timing and assessment applicant.

Phase-1: COLA stage

Phase-2: Construction stage, before fuel load

Phase-3: Operating stage

As Shown in the attached table, some supporting requirements are not satisfy the "Capability Category II" at DC stage because of the limited detail design information, such as plant specific procedures.

Impact on DCD

No impact on DCD.

Impact on COLA

No impact on COLA.

Impact on PRA

No impact on PRA.