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October 6, 2011

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-11342

Subject: MHI's Responses to US-APWR DCD RAI No.823-5933 Revision 3 (SRP 19)

References: 1) "Request for Additional Information No. 823-5933 Revision 3, SRP Section: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation," dated September 6, 2011.

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. 823-5933 Revision 3".

Enclosed are the responses to all of the RAIs 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.

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NRO

Enclosure:

1. Responses to Request for Additional Information No. 823-5933 Revision 3

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-11342
Docket Number 52-021

Responses to Request for Additional Information No.823-5933
Revision 3

October, 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

10/05/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: NO. 823-5933 REVISION 3
SRP SECTION: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation
APPLICATION SECTION: 19
DATE OF RAI ISSUE: 09/06/2011

QUESTION NO.: 19-549

Based on the US-APWR DCD Chapter 8, it states, "In the US-APWR design, power to the shutdown buses can be restored from the AAC sources within 60 minutes." Given a SBO event in POS 4-3 and POS 8-1, the time to RCS boiling is 20 minutes and 40 minutes respectively, as documented in the revised response to RAI 19-493. Therefore, following restoration of the AAC source or offsite power, the RCS could be boiling. The event tree for loss of offsite power with 1E CTG failure credits RHR recovery without the need for standby RCS injection. The staff believes that RCS injection from either charging or SI will be needed to restore RCS level and to permit recovery of the RHR function. Please modify the event trees to require SI or charging before RHR recovery. This change will require the loss of offsite power events to be resolved and requantified. Please update the DCD and the PRA as appropriate with the revised loss of offsite power results.

ANSWER:

MHI acknowledges the reasoning above and will update the loss of offsite power events low-power and shutdown (LPSD) PRA model accordingly.

The following is an analysis and re-quantification of the resulting impact on CDFs for each POS.

In response to this RAI, MHI has revised the event tree (DCD Figure 19.1-20) for loss of offsite power; see the revised Figure 19.549-1 below. In the revised event tree, an event heading "MC" (RCS makeup provided by a charging pump) has been added between event headings "PR" (CCWS restart) and "RH" (heat removal by standby containment

spray/residual heat removal [CS/RHR] pumps). The total core damage frequency (CDF) during LPSD operation was re-quantified using the revised event tree, Figure 19.549-1, and the following analysis conditions:

1. In mid-loop operation states preceding and following refueling, POSs 4 and 8 respectively, RCS boiling is conservatively assumed to occur with a (bounding case) probability of 1.0 during a SBO event; disregarding the likely success for AAC power or offsite power recovery prior to the RCS boiling.

2. Failure of replenishing RCS makeup via charging pump (event heading "MC") followed by a loss of heat removal via standby CS/RHR pumps (event heading "RH") in POSs 4 and 8 due to the absence of any RCS inventory.

3. For POSs 3, 9, and 11, in which Class 1E ac buses are supplied AAC power or offsite power prior to RCS boiling, the frequency for core damage scenarios #19, and #32 are considered to be zero because RCS makeup for RHR restart is not necessary for these scenarios. Failure of action to replenish the RCS inventory during these POSs will have no impact on the heat removal capability via CS/RHR pumps.

4. Failure to replenish RCS makeup by charging pump (event heading "MC") would result in failure for RCS injection by charging pump (event heading "CV") because of use of a common system.

5. The dependency between operator actions for RCS makeup by the charging pump and safety injection pumps is estimated to be low. See DCD Figure 19.1-3 "*Decision Tree to Determine the Dependency Level between Multiple Human Failure Events*".

Table 19.549-1, a revision of DCD Table 19.1-89 incorporating the quantified results using the event tree depicted in Figure 19.549-1, shows the CDFs for each POS. The total CDF is re-estimated to be 1.84E-07/RY, approximately 2% higher than the corresponding CDF stated in US-APWR DCD Rev.3 (1.80E-07/RY). The changes to the PRA model in response to this RAI have a small impact on the LPSD CDF because the most dominant core damage scenario for loss of offsite power events is the loss of heat removal and RCS injection functions following Class 1E GTG success (Scenario #6). The risk profiles, such as the sensitivity analyses and importance analysis discussions in the latest DCD revision are still applicable and correspond appropriately with the re-quantified CDF values in this response.

The re-quantified results, including Figure 19.549-1 and Table 19.549-1, will be reflected in Subsections 19.1.6.1 and 19.1.6.2 after closure of other RAIs regarding PRA model changes.

Impact on DCD

Subsections 19.1.6.1 and 19.1.6.2 will be revised to reflect the revised PRA model and results after closure of other RAIs regarding PRA model changes. The table summarizing CDFs for each POS (Table 19.1-89) and the event tree for loss of offsite power (Figure 19.1-20) will be replaced with Table 19.549-1 and Figure 19.549-1 in DCD chapter 19, respectively.

Impact on R-COLA

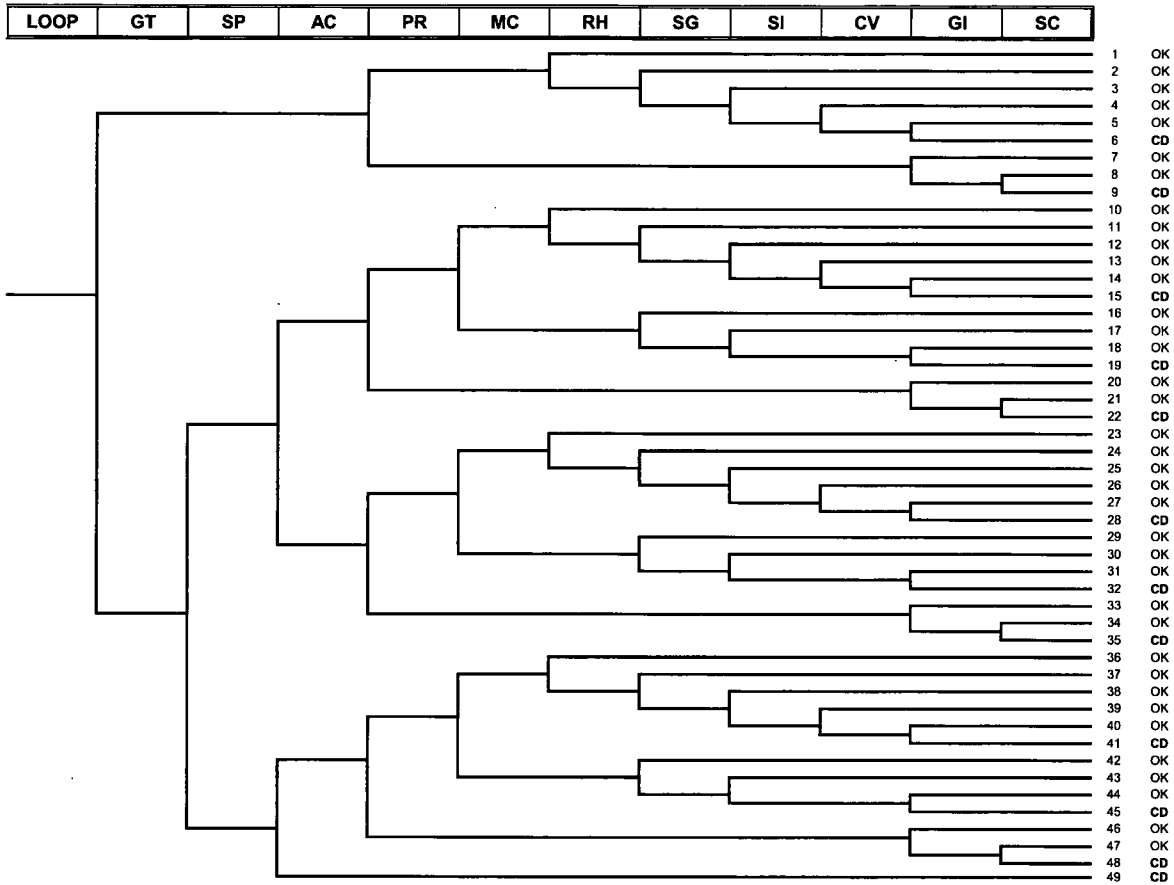
There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

The loss of offsite power event tree for the LPSD PRA model will be updated to Figure 19.549-1 reflecting the response to this RAI. The model change does not have a significant effect on the LPSD PRA results or PRA insights such as the dominant core damage scenarios, importance measures, or uncertainty analysis results.



Event	Description
LOOP	: Loss of offsite power
GT	: Power supply by class 1E GTG
SP	: Power supply by AAC
AC	: Offsite power recovery
PR	: CCWS restart
MC	: RCS makeup by charging pump

Event	Description
RH	: Heat removal by standby CS/RHR pumps
SG	: Heat removal via SGs
SI	: Injection by HHIS
CV	: Injection by CVCS
GI	: Gravitational injection
SC	: Injection by CVCS using alternate component cooling

Figure 19.549-1 Loss of Offsite Power Event Tree

Table 19.549-1 Core Damage Frequency for LPSD PRA

IE	Event description	POS3[2]	POS4-1[2]	POS4-2[2]	POS4-3[1]	POS8-1[1]	POS8-2[2]	POS8-3[2]	POS9[2]	POS11[2]	Total
LOCA	Loss of coolant accident	3.7E-09	2.6E-09	9.4E-10	6.0E-09	3.5E-08	9.4E-10	2.6E-09	8.8E-10	5.1E-09	5.8E-08
OVDR	Loss of RHRS due to over-drain	N/A	6.5E-10	N/A	N/A	1.8E-09	N/A	N/A	N/A	N/A	2.4E-09
FLML	Loss of RHRS caused by failing to maintain water level	N/A	N/A	3.2E-10	3.0E-09	N/A	3.2E-10	4.4E-10	N/A	N/A	4.1E-09
LORH	Loss of RHRS caused by other failures	2.3E-10	4.0E-10	2.9E-10	1.6E-09	3.8E-09	2.9E-10	2.3E-10	7.7E-11	3.2E-10	7.2E-09
LOCS	Loss of CCW/essential service water	3.0E-09	4.5E-09	5.5E-11	8.3E-10	8.1E-09	1.1E-10	1.1E-09	3.8E-10	4.1E-09	2.2E-08
LOOP	Loss of offsite power	6.2E-09	5.1E-09	3.8E-09	2.3E-08	3.2E-08	3.9E-09	6.1E-09	2.0E-09	8.3E-09	9.0E-08
TOTAL		1.3E-08	1.3E-08	5.4E-09	3.5E-08	8.0E-08	5.5E-09	1.1E-08	3.3E-09	1.8E-08	1.8E-07