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

July 27, 2010

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-10218

Subject: MHI's Responses to US-APWR DCD RAI No.601-4747 Revision 2

References: 1) "Request for Additional Information No. 601-4747 Revision 2, SRP Section: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation," dated June 25, 2010.

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. 601-4747 Revision 2".

Enclosed are the responses to the RAI 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. Responses to Request for Additional Information No. 601-4747 Revision 2

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

Contact Information
C. Keith Paulson, Senior Technical Manager
Mitsubishi Nuclear Energy Systems, Inc.
300 Oxford Drive, Suite 301
Monroeville, PA 15146
E-mail: ck_paulson@mnes-us.com
Telephone: (412) 373-6466

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Enclosure 1

UAP-HF-10218
Docket Number 52-021

Responses to Request for Additional Information No.601-4747
Revision 2

July, 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

07/26/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO. 601-4747 REVISION 2**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**CH 19 PRA**
DATE OF RAI ISSUE:	**06/25/2010**

QUESTION NO. : 19-436

Supplemental RAI to RAI 19-402
The staff has reviewed MHI's response to RAI 19-402. Regarding MHI's response to part (c), this response is inconsistent with the "expeditious actions" to be implemented prior to operating in a reduced inventory condition that are outlined in Generic Letter 88-17. These expeditious actions include, "provide at least two independent, continuous temperature indications that are representative of the core exit conditions whenever the RCS is in a mid-loop condition." Furthermore, since the MHI design has no automated RCS injection, the operator alone is responsible for providing this action given a loss of the RHR function. The core exit thermocouples (CETs) are critical for operators performing this action reliably. Therefore, the statement that CETs do not impact the shutdown core damage frequency is inaccurate since a total loss of RHR function will result in a loss of temperature indication of the RCS vessel without the CETs. Based on this information, the staff is requesting MHI to:

a. Update Table 19.1-119, "Key Insights and Assumptions," to include each of the "Expeditious Actions'" outlined in GL 88-17. In the disposition section of the table, please include appropriate references to the instrumentation sections of the DCD when applicable.
b. Provide a revised response to RAI 19-402 that is consistent with GL 88-17.
c. Please correct the inconsistency on page 19.1-106 regarding temperature indication following a loss of the decay heat removal function.

ANSWER:

a. Table 19.1-119 will be revised as shown in the markup to include expeditious actions outlined in Generic Letter 88-17.

b. Administrative controls will be established in the shutdown operations procedures to ensure required instrumentation is available prior to evolving to mid-loop condition. Two independent, continuous temperature indications that are representative of the core exit conditions will be available whenever the RCS is in a mid-loop condition and the reactor vessel head is located on top of the reactor vessel. This insight will be added in Table 19-119 along with the disposition of this insight .

c. Description in page 19.1-106 regarding temperature indication following a loss of the decay heat removal function will be revised as follows:

Two types of instruments are provided in US-APWR design to measure the temperature representative of the core exit whenever the reactor vessel head is located on top of the reactor vessel. The first one is core exit thermocouples located inside the RV. The second is resistance temperature detectors in the reactor coolant hot leg. These two independent instruments will be available whenever the RCS is in a mid-loop condition and the reactor vessel head is located on top of the reactor vessel. This will be assured by implementation of the maintenance rule and associated administrative procedures.

Impact on DCD

Table 19-119 will be revised to incorporate the key insights and their dispositions shown in the table below to address the expeditious actions outlined in Generic Letter 88-17.

Key Insights and Assumptions	Dispositions
The following actions described as expeditious actions in Generic Letter 88-17 are important to plant safety and should be implemented prior to operating in a reduced inventory condition. The expeditious actions applicable to the US-APWR design are the followings:	
1. Discuss the Diablo Canyon event, related events, lessons learned, and implications with appropriate plant personnel. Provide training shortly before entering a reduced inventory condition.	COL 13.5(7)
2. Implement procedures and administration controls that reasonably assure that containment closure will be achieved prior to the time at which a core uncover could result from a loss of decay heat removal coupled with an inability to initiate alternate cooling or addition of water to the RCS inventory. These procedures and administrative controls should be active and in use prior to entering a reduced RCS inventory condition.	COL 13.5(7)
3. Provide at least two independent, continuous temperature indications that are representative of the core exit conditions whenever the RCS is in a mid-loop condition and the reactor vessel head is located on top of the reactor vessel.	COL 13.5(7)
Two types of instruments provided in the US-APWR design to measure RV temperature are core exit thermocouples located inside the RV and the resistance temperature detectors in the reactor coolant hot leg.	7.5.1.1.3.1 7.5.1.1.3.3

Key Insights and Assumptions	Dispositions
4. Provide at least two independent, continuous RCS water level indications whenever the RCS is in a reduced inventory condition.	COL 13.5(7)
Two types of instruments are provided in US-APWR design to measure RCS water level are the middle range RCS water level sensor and the narrow level middle range water level sensor .	5.4.7.2.3.6
5. Implement procedures and administrative controls that generally avoid operations that deliberately or knowingly lead to perturbations to the RCS and/or to systems that are necessary to maintain the RCS in a stable and controlled condition while the RCS is in a reduced inventory condition.	COL 13.5(7)
6. Provide at least two available or operable means of adding inventory to the RCS that are in addition to pumps that are a part of the normal DHR systems.	COL 13.5(7)
Means of adding inventory to the RCS in the US-APWR design can be safety injection pumps, charging pump and gravitational injection from the SFP.	6.3.2.1.1 9.3.4.2.6.1 5.4.7.2.3.6
7. Implement procedures and administrative controls that reasonably assure that all hot legs are not blocked simultaneously by nozzle dams unless a vent path is provided that is large enough to prevent pressurization of the upper plenum of the RV.	COL 13.5(7)

Description in page 19.1-106 regarding temperature indication following a loss of the decay heat removal function will be revised as follows:

- Indications of temperature

~~As for inaccurate hot leg temperature measurement after loss of decay heat removal, reactor coolant hot leg temperature instruments are located in the flow path during RHR operation, so this parameter can be accurately indicated.~~ Two types of instruments are provided in US-APWR design to measure the temperature representative of the core exit whenever the reactor vessel head is located on top of the reactor vessel. The first one is core exit thermocouples located inside the RV. The second is resistance temperature detectors in the reactor coolant hot leg. These two independent instruments will be available whenever the RCS is in a mid-loop condition and the reactor vessel head is located on top of the reactor vessel. This will be assured by implementation of the maintenance rule and associated administrative procedures.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

07/26/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO. 601-4747 REVISION 2**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**CH 19 PRA**
DATE OF RAI ISSUE:	**06/25/2010**

QUESTION NO. : 19-437

Supplemental to RAI 19-403

The staff reviewed MHI's response to RAI 19-403 on mid-loop level instrumentation. The staff found references to narrow range level instruments to be used at mid-loop in Chapter 5 of the DCD, but not Chapter 7 of the DCD. The staff could not find any references in Chapter 5 and Chapter 7 of the DCD pertaining to middle range mid-loop sensors. The staff is requesting MHI to update the DCD in Chapters 5, 7, and Chapter 19 to include the narrow and middle range mid-loop water level sensors, and the wide range level sensors. Please indicate if these sensors are permanent or temporary. Please include where the instrumentation is installed/connected to the RCS. Please ensure the discussions are consistent between chapters.

ANSWER:

The narrow and middle range mid-loop water level sensors and the wide range RCS water level sensors are permanent instruments. These instruments are described in the DCD Chapter 5 Figure 5.1-2 sheet 3. In Figure 5.1-2, LT 014-N and LT 015-N represent narrow range mid-loop water level sensors, LT 012-N represents middle range mid-loop water level sensor, and LT 011-N represents wide range RCS water level sensor, respectively.

The narrow and middle range mid-loop water level sensors are connected to the bottom of RCS cross over leg and the pressurizer spray line and measure RCS water level making reference to pressure difference between these locations. The wide range RCS water level sensor is connected to the RCS cross over leg and measures the RCS water level making reference to the pressure difference between RCS cross over leg and containment vessel.

The narrow range mid-loop water level sensors have been discussed in the DCD Chapters 5, 7 and 19. Wide range RCS water sensor is not described in the chapters since this sensor is not a main feature for mid-loop operation to enhance reliability. Regarding the middle range mid-loop water level sensor, Chapter 5 will be revised to incorporate discussions of the sensor. Descriptions of the mid-loop water level sensors in the DCD Chapters 5, 7 and 19 are summarized below.

In Section 5.4.7.2.3.6 of the DCD Chapter 5, water level sensors are discussed as important features for mid-loop operation to enhance reliability. Item C of Section 5.4.7.2.3 will be revised to describe both the narrow and middle range mid-loop RCS level sensors. Description of the additional temporally RCS level sensor described in the responses to RAIs 19-346, 19-395 and 19-403 will be documented in Section 5.4.7.2.3.6 item C as well. Please see the mark-up for the planned changes.

Contents of the US-APWR DCD Chapter 7 are based on RG1.206, and also consistent to standard review plan (SRP) Chapter 7. The contents include;

- Introduction
- Reactor Trip System
- Engineered Safety Feature Systems
- Systems Required for Safe Shutdown
- Information Systems Important to Safety
- Interlock Systems Important to Safety
- Control Systems Not Required for Safety
- Diverse Instrumentation and Control Systems
- Data Communication Systems.

Therefore, the description for narrow range mid-loop water level channel has been added as one of the interlock systems important to safety in the next revision of the DCD Chapter 7 as stated in the response RAI 19-421. The other mid-loop sensors are not specially described in the DCD Chapter 7.

Based on the response to RAI 19-421, Section 7.6.1.7 shown below has been incorporated in Chapter 7 of the DCD tracking report:

"7.6.1.7 Low-pressure letdown line isolation valve
A single normally closed air-operated valve is placed in each of the two low pressure letdown lines connected to two of the four RHR trains. During the normal plant cool down operation, one of these valves is open to divert a portion of the RCS flow to the CVCS for the purpose of purification and RCS inventory control.

Additionally at mid-loop operation during plant shutdown, these valves are automatically closed and the CVCS is isolated from the RHRS after receiving the RCS loop low-level signal to prevent loss of RCS inventory."

In the DCD Chapter 19, mid-loop water level sensors are discussed in Section 19.1.6 and in Table 19.1-119. According to the response to RAI 19-436, PRA insight that at least two independent, continuous RCS water level indications should be provided whenever the RCS is in a reduced inventory condition will be added to Table 19.1-119. It will be stated that the narrow and middle range water level sensors provide the satisfaction of this requirement. Please refer to the response of RAI 19-436 for mark up.

Impact on DCD

Section 5.4.7.2.3.6 item C in Chapter 5 will be revised as follows:

5.4.7.2.3.6 Mid-loop and Drain Down Operations

C. ~~Redundant~~ wWater level instrument

Redundant narrow range water level instrument and a mid-range water level instrument, which are shown in Figure 5.1-2 (Sheet 3 of 3), are provided to measure mid-loop water level. Installation of a redundant water narrow level instrument enhances reliability of the mid-loop operation.

A temporary mid-loop water level sensor that measures the RCS water level with reference to pressure at the reactor vessel head vent line and cross over leg is installed in addition to these permanent water level sensors to cope with surge line flooding events.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.