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TOKYO, JAPAN

May 26, 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-10147

Subject: MHI's Responses to US-APWR DCD RAI No.577-4482 Revision 2

References: 1) "Request for Additional Information No. 577-4482 Revision 2, SRP Section: 19.01 – Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Application," dated April 26, 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. 577-4482 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,

Atsushi Kumaki for.

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

Enclosure:

1. Responses to Request for Additional Information No. 577-4482 Revision 2

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-10147
Docket Number 52-021

Responses to Request for Additional Information No.577-4482
Revision 2

May, 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

05/26/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO. 577-4482 REVISION 2**
SRP SECTION:	**19 – Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed**
APPLICATION SECTION:	**19**
DATE OF RAI ISSUE:	**04/26/2010**

QUESTION NO. : 19.01-1
APWR DCD Chapter 5 Section 5.4.7.2.3.6,revision 3, Mid-loop and Drain Down Operations, states:

" D. Interlock for abnormal water level decrease
When the water level of RCS drops below the mid-loop level, low pressure letdown lines are isolated automatically. This interlock is useful to prevent loss of reactor coolant inventory"

APWR DCD Chapter 19, Revision 3, page 109, Loss of RHR due to over-drain, states, " For the US-APWR, low-pressure letdown line isolation valves are installed. One normally closed air-operated valve is installed in each of two low-pressure letdown lines that are connected to two of four RHR trains. .....These valves are automatically closed and the CVCS is isolated from the RHRS by the RCS loop low-level signal to prevent loss of RCS inventory at mid-loop operation during plant shuudown. "

Based on staff review of DCD Chapter 16, Revision 2, Table 3.3.2-1 Engineered Safety Feature Actuation System Instrumentation, the staff could not find a reference of CVCS automatically being isolated in Modes 5 and 6, cold shutdown and refueling, on low level. Please clarify this inconsistency and please revise Chapter 5 of the DCD and the Loss of RHR due to overdrain (OVDR) in Chapter 19 of the DCD as appropriate.

Answer:

As pointed out by the staff, descriptions in Chapters 5 and 19 regarding interlock for abnormal water level decrease is inconsistent with Chapter 16. The interlock for abnormal water level decrease is risk-important, and therefore, the specification of this interlock will be incorporated into the Technical Specification (TS) according to criterion 4 of 10CFR50.36. In this manner, inconsistencies among Chapter 16 and Chapters 5 and 19 materials will be resolved.

The operability of the low-pressure letdown line isolation valve will be added in the limiting condition for operation (LCO) of the Reactor Coolant System, described in Section 3.4 of the TS. According to the

definition of OPERABLE in the TS, operability of related instruments and controls are also included in the operability of the valve. To make this clear, a description stating that this valve automatically closes upon receipt of RCS loop low-level signal will be added in the TS BASES.

Markups of the TS and its BASES are provided in Attachment A and Attachment B, respectively.

Impact on DCD
Chapter 16 will be revised as shown in the mark-ups provided in Attachment A and Attachment B.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.8 RCS Loops - MODE 5, Loops Not Filled

LCO 3.4.8 Three residual heat removal (RHR) loops shall be OPERABLE and two RHR loops shall be in operation, and low-pressure letdown line isolation valve shall be OPERABLE.

----------NOTES----------

1. One CS/RHR pump may be removed from operation for ≤ 15 minutes when switching from one loop to another provided:

   a. The core outlet temperature is maintained > 10°F below saturation temperature,

   b. No operations are permitted that would cause introduction of coolant into the RCS with boron concentration less than required to meet the SDM of LCO 3.1.1; and

   c. No draining operations to further reduce the RCS water volume are permitted.

2. One required RHR loop may be inoperable for ≤ 2 hours for surveillance testing provided that the other two RHR loops are OPERABLE and in operation.

APPLICABILITY: MODE 5 with RCS loops not filled.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required RHR loop inoperable.	A.1 Initiate action to restore RHR loop to OPERABLE status.	Immediately
B. One low-pressure letdown isolation valve inoperable.	B.1 Initiate action to restore low-pressure letdown line isolation valve to OPERABLE status.	Immediately

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~B~~C. Less than two required RHR loops OPERABLE. OR Less than two Required RHR loops in operation.	~~B~~C.1 Suspend operations that would cause introduction of coolant into the RCS with boron concentration less than required to meet SDM of LCO 3.1.1. AND ~~B~~C.2 Initiate action to restore two RHR loops to OPERABLE status and operation.	Immediately Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.8.1	Verify required RHR loops are in operation.	[12 hours OR In accordance with the Surveillance Frequency Control Program]

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.4.8.2	----------NOTE---------- Not required to be performed until 24 hours after a required pump is not in operation. ---------- Verify correct breaker alignment and indicated power are available to each required CS/RHR pump.	[7 days OR In accordance with the Surveillance Frequency Control Program]
SR 3.4.8.2	Perform a complete cycle of each low-pressure letdown line isolation valve.	[24 months OR In accordance with the Surveillance Frequency Control Program]

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.8 RCS Loops - MODE 5, Loops Not Filled

BASES

BACKGROUND	In MODE 5 with the RCS loops not filled, the primary function of the reactor coolant is the removal of decay heat generated in the fuel, and the transfer of this heat to the component cooling water via the residual heat removal (CS/RHR) heat exchangers. The steam generators (SGs) are not available as a heat sink when the loops are not filled. The secondary function of the reactor coolant is to act as a carrier for the soluble neutron poison, boric acid. In MODE 5 with the RCS loops not filled, only CS/RHR pumps can be used for coolant circulation. The number of pumps in operation can vary to suit the operational needs. The intent of this LCO is to provide forced flow from at least two CS/RHR pumps for decay heat removal and transport and to require that three paths be available to provide redundancy for heat removal. In MODE 5 with the RCS loops not filled, low-pressure letdown line isolation valves are automatically closed upon detection of RCS loop low-level signal to prevent loss of RCS inventory. The function is effective to prevent core damage during plant shutdown, based on probabilistic risk assessment.
APPLICABLE SAFETY ANALYSES	In MODE 5, RCS circulation is considered in the determination of the time available for mitigation of the accidental boron dilution event. The RHR loops provide this circulation. The flow provided by two RHR loops is adequate for heat removal and for boron mixing. RCS loops in MODE 5 (loops not filled) satisfies Criterion 4 of 10 CFR 50.36(c)(2)(ii).
LCO	The purpose of this LCO is to require that at least three RHR loops be OPERABLE and two of these loops be in operation. An OPERABLE loop is one that has the capability of transferring heat from the reactor coolant at a controlled rate. Heat cannot be removed via the RHR System unless forced flow is used. A minimum of two running CS/RHR pumps meets the LCO requirement for two loops in operation. An additional RHR loop is required to be OPERABLE to meet single failure considerations. The LCO requires the low-pressure letdown line isolation valves to be OPERABLE to mitigate the effects associated with loss of RCS inventory. Note 1 permits one CS/RHR pump to be removed from operation for ≤ 15 minutes when switching from one loop to another. The circumstances for stopping one CS/RHR pump is to be limited to

situations when the outage time is short and core outlet temperature is maintained > 10°F below saturation temperature. The Note prohibits boron dilution with coolant at boron concentrations less than required to assure SDM of LCO 3.1.1 is maintained or draining operations when RHR forced flow is stopped.

BASES

LCO (continued)

Note 2 allows one RHR loop to be inoperable for a period of ≤ 2 hours, provided that the other two required loops are OPERABLE and in operation. This permits periodic surveillance tests to be performed on the inoperable loop during the only time when these tests are safe and possible.

An OPERABLE RHR loop is comprised of an OPERABLE CS/RHR pump capable of providing forced flow to an OPERABLE CS/RHR heat exchanger. CS/RHR pumps are OPERABLE if they are capable of being powered and are able to provide flow if required.

APPLICABILITY

In MODE 5 with loops not filled, this LCO requires core heat removal and coolant circulation by the RHR System.

Operation in other MODES is covered by:

LCO 3.4.4, "RCS Loops - MODES 1 and 2,"
LCO 3.4.5, "RCS Loops - MODE 3,"
LCO 3.4.6, "RCS Loops - MODE 4,"
LCO 3.4.7, "RCS Loops - MODE 5, Loops Filled,"
LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation - High Water Level" (MODE 6)," and
LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation - Low Water Level" (MODE 6)".

ACTIONS

A.1

If one required RHR loop is inoperable, redundancy for RHR is lost. Action must be initiated to restore a third loop to OPERABLE status. The immediate Completion Time reflects the importance of maintaining the availability of three paths for heat removal.

B.1

If one low-pressure letdown isolation valve is inoperable, the automatic isolation function to prevent loss of RCS inventory is lost. Action must be initiated to restore the valve to OPERABLE status. The immediate Completion Time reflects the importance of maintaining the availability of three paths for heat removal.

~~B~~C.1 and ~~B~~C.2

If less than two required loops are OPERABLE or less than two required loops in operation, except during conditions permitted by Note 1, all operations involving introduction of coolant into the RCS with boron concentration less than required to meet the minimum SDM of LCO 3.1.1

must be suspended and action must be initiated immediately to restore two RHR loops to OPERABLE status and operation. The required margin to criticality must not be reduced in this type of operation. Suspending

BASES

ACTIONS (continued)

the introduction of coolant into the RCS of coolant with boron concentration less than required to meet the minimum SDM of LCO 3.1.1 is required to assure continued safe operation. With coolant added without forced circulation, unmixed coolant could be introduced to the core, however coolant added with boron concentration meeting the minimum SDM maintains acceptable margin to subcritical operations. The immediate Completion Time reflects the importance of maintaining operation for heat removal. The action to restore must continue until two loops are restored to OPERABLE status and operation.

SURVEILLANCE REQUIREMENTS

SR 3.4.8.1

This SR requires verification every 12 hours that the required loops are in operation. Verification includes flow rate, temperature, or pump status monitoring, which help ensure that forced flow is providing heat removal. [The Frequency of 12 hours is sufficient considering other indications and alarms available to the operator in the control room to monitor RHR loop performance. OR The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.]

SR 3.4.8.2

Verification that each required CS/RHR pump is OPERABLE ensures that an additional pump can be placed in operation, if needed, to maintain decay heat removal and reactor coolant circulation. Verification is performed by verifying proper breaker alignment and power available to each required pump. Alternatively, verification that a CS/RHR pump is in operation also verifies proper breaker alignment and power availability. [The Frequency of 7 days is considered reasonable in view of other administrative controls available and has been shown to be acceptable by operating experience. OR The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.]

This SR is modified by a Note that states the SR is not required to be performed until 24 hours after a required pump is not in operation.

SR 3.4.8.3

SR 3.4.8.3 requires a complete cycle of each low-pressure letdown isolation valve. Operating a low-pressure letdown isolation valve through one complete cycle ensures that the low-pressure letdown isolation valve can be automatically actuated to mitigate the effects from loss of RCS inventory. [The Frequency of 24 months is based on engineering judgment, taking into consideration the conditions required to perform the

Surveillance, and is intended to be consistent with expected fuel cycle length. This equipment is not at risk of imminent damage as it is designed to remain functional and in good condition while in operation, thus significant degradation due to a longer surveillance interval should not be of major concern. The design reliability is, therefore, maintained by taking these considerations into account based on sound engineering judgment. OR The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.]

REFERENCES None.