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TOKYO, JAPAN

January 07, 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-11001

Subject: MHI's Response to US-APWR DCD RAI No. 672-4982 Revision 2 (SRP Section 07.02)

Reference: 1) "Request for Additional Information No. 672-4982 Revision 2, SRP Section: 07.02 – Reactor Trip System - Application Section: Section 7.2.1.4.3" dated December 06, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 672-4982 Revision 2."

Enclosed is the response to a question 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. Response to Request for Additional Information No. 672-4982 Revision 2

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

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Enclosure 1

UAP-HF-11001
Docket No. 52-021

Response to Request for Additional Information No. 672-4982
Revision 2

January 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

01/07/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.672-4982 REVISION 2**
SRP SECTION:	**07.02 - REACTOR TRIP SYSTEM**
APPLICATION SECTION:	**07.2.1.4.3**
DATE OF RAI ISSUE:	**12/06 /2010**

QUESTION NO. : 07-02-3

The Equations in DCD Chapter 7, Sections 7.2.1.4.3.1, 7.2.1.4.3.2, and DCD Chapter 16, Table 3.3.1-1, Notes 1&2 were revised in Revision 2 and are now different from the equations in NUREGG 1431, Table 3.3.1-1, Notes 1&2.

Responses to RAI 167-1769, questions 16-212 (#6500) and 16-213 (#6501), did not provide the justification for making those changes. The response was more of consistency between Chapter 7 and 16.

Either submit a previously approved reference supporting the changes to the OTΔT and OPΔT trip functions or submit a reference that supports the changes from DCD Revision 1 to Revision 2. Provide a description of the equations in DCD Tier 2 Sections 7.2.1.4.3.1 and 7.2.1.4.3.2 for the over-temperature and over-power delta-T algorithms regarding the lead-lag processing of core heat removal protection trips, including the purpose of the processing. The algorithms shown in DCD Tier 2 Sections 7.2.1.4.3.1 and 7.2.1.4.3.2 for the over-temperature and over-power delta-T calculations only describe the calculation of the trip setpoints under normal conditions. Discuss the limiting events for the core heat removal trip response. The lead-lag signal processing, described in Sections 7.2.1.4.3.1 and 7.2.1.4.3.2 and shown in Figure 7.2.2, depends on the time history of the input signal and so presents a more complicated effect for timing and errors. Discuss the special operation conditions for lead-lag signal processing such startup of the signal processing module, lost data, restart of the module while operating, and any other special operating modes for lead-lag signal processing modules.

The response should be coordinated with Chapter 16 PM and SRSB.
Relates to question numbers, 6500 (16-212), 6501 (16-213), 6502 (16-214), and 6533 (16-236) of RAI 167-1769.

Reference: MHI's Amended Response to US-APWRD DCD RAI 167-1769; MHI Ref: UAP-HF-09354; dated July 3, 2009; ML091890964.

ANSWER:

The equation of over-temperature ΔT in DCD Chapter 16 Table 3.3.1-1 Note 1 was corrected from DCD Rev. 1 to DCD Rev. 2 by multiplying the right-hand side of each equation by ΔT_0. This typographical revision made this equation consistent with the equation provided in NUREG-1431. The inequality sign in the equation in DCD Chapter 16 Table 3.3.1-1 was revised as described in the RAI response to Question No. 16-212 of RAI No. 167-1769. The revised equation describes a reactor trip plant condition. Although the equation in Rev. 1 DCD Chapter 16 Table 3.3.1-1 Note 1 and NUREG-1431 shows a plant condition of reactor not tripped, there is no technical difference.

Although the equation of over-power ΔT in DCD Chapter 16 Table 3.3.1-1 Note 2 should be corrected similar to the correction for the equation in DCD Chapter 16 Table 3.3.1-1 Note 1; Notes 1 and 2, including the equations, will be deleted from Tech Spec Section 3.3.1. These notes were originally intended to explain how to calculate allowable values, however, this information was removed from US-APWR DCD Chapter 16. This deletion was agreed upon with the NRC Chapter 16 reviewer at the NRC meeting held on 12/14/2010 and 12/15/2010. The equation of over-power ΔT in DCD Section 7.2.1.4.3.2 was corrected between DCD Rev. 1 and DCD Rev. 2 by multiplying the right-hand side of each equation by ΔT_0.

For the measurement of primary coolant temperature, the lag processing of the measured RCS average temperature is deleted since the US-APWR will utilize a well-type resistance temperature detector (RTD) instead of the RTD with bypass-line used in some operating plants. Lag processing which is also included in the equations in NUREG-1431, for the measured RCS average temperature was previously used for noise filtering because the RTD with bypass-line responds relatively quickly to changes in temperature. On the other hand, Lag processing for noise filtering of the measured RCS average temperature in the US-APWR is no longer necessary because the installed RTD responds slower due to the thermal mass associated with the RTD enclosure. Therefore, the equations for the US-APWR contain no lag processing of the RCS average temperature measurement since this processing is not necessary for the US-APWR primary coolant temperature measurement system.

Over-temperature ΔT provides primary protection for both the departure from nucleate boiling (DNB) limit and core exit boiling limit. In NUREG-1431, a single setpoint covers both the DNB limit and core exit boiling limit. However, US-APWR DCD Chapter 16 Rev. 1 / Rev. 2 Table 3.3.1-1 Note 1 and DCD Tier 2 Section 7.2.1.4.3.1, utilize two separate setpoints (ΔT_{sp1}, ΔT_{sp2}) to protect the DNB limit and core exit boiling limit, respectively.

The cold leg and hot leg temperature measurement systems are located on the cold leg and hot leg, respectively. Cold leg temperature and hot leg temperature measurements include system piping delay from the reactor core and the temperature measurement systems. Therefore, the corresponding equations of over-temperature ΔT and over-power ΔT include lead/lag processing to compensate for the system piping delay.

The limiting condition of the lead-lag processing is system startup since the output of the processing module which has dynamic characteristics generally differs from a stationary value at the time of the CPU-restart including initial CPU startup.
Since RPS is bypassed at the time of system startup and then shifted to normal operation after ensuring that all outputs of processing have achieved a stable condition, the limiting condition does not impact the reactor trip functions.

In addition, the abnormality of the processing output due to loss of data from memory can be detected by the self-diagnosis for the RPS CPU module. This is considered as a system failure, and it is not the limiting condition of the lead-lag processing.

Impact on DCD
The following description will be the last paragraph of DCD Chapter 7 Section 7.2.1.

> RPS should be shifted to normal operation from bypass mode, after ensuring that all outputs of the processing have achieved a stable condition, in order to eliminate the influence of dynamic characteristics.

Impact on COLA
There is no impact on the COLA

Impact on PRA
There is no impact on the PRA

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

01/07/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 672-4982 REVISION 2**
SRP SECTION:	**07.02 - REACTOR TRIP SYSTEM**
APPLICATION SECTION:	**07.2.1.4.3**
DATE OF RAI ISSUE:	**12/06/2010**

QUESTION NO. : 07-02-4

DCD Chapter 7, Section 7.2.1 states "The reactor trip (RT) system, which achieves the all RT functions, consists of the following Class 1E systems: Safety sensors, RPS, RTB, and Safety grade HSIS." The response to RAI 166-1784, question 16-158, (6623) states, "Chapter 16 bases documents describes the system as segmented into three distinct but interconnected modules as illustrated in Chapter 7."

Provide clarification and consistency between the two chapters.

Reference: MHI's Amended Response to US-APWRD DCD RAI 166-1784; MHI Ref: UAP-HF-09354; dated July 3, 2009; ML091890964.

ANSWER:

In order to make consistency between DCD Chapter 7 and 16, DCD Chapter16, B 3.3.1 will be revised.

Impact on DCD

DCD Chapter16, B 3.3.1 will be revised as follows.

The RTS instrumentation is segmented into ~~three~~ four distinct ...

1. Field transmitters, process sensors or field contacts: ...
2. The RPS, including Nuclear Instrumentation System (NIS): ...
3. Reactor trip breakers (RTBs): ...
4. <u>Manual Reactor Trip switches: provide the manual reactor trip initiation in the control room.</u>

Impact on COLA
There is no impact on the COLA

Impact on PRA
There is no impact on the PRA