AMENDED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/03/2015

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**1094-7466**
SRP SECTION:	**07.01 – Instrumentation and Controls – Introduction**
APPLICATION SECTION:	**07.01 – Instrumentation and Controls – Introduction**
DATE OF RAI ISSUE:	**3/27/2014**

QUESTION NO.: 07.01-46

On December 5, 2013, Mitsubishi Nuclear Energy Services, Inc. (MNES) and NRC Staff presented the US-APWR Design Certification Document (DCD), Chapter 7, Instrumentation and Controls, and the staff's Phase 2 Safety Evaluation with Open Items to the Full Committee of the Advisory Committee on Reactor Safeguards (ACRS). In its letter to the Executive Director for Operations (EDO) dated December 24, 2013, the ACRS made the following comment regarding Chapter 7 (ML13346A732).

> The staff should ensure that sufficient design information is available to provide assurance that watchdog timers will produce the desired reactor protection and engineered safety features actuation failure state signals independently from the Mitsubishi Electric Total Advanced Controller (MELTAC) platform software.

Additional information in support of the comment was provided in the body of the letter. On February 24, 2014, the EDO responded to the ACRS (ML13365A056). That response provided the staff's view that the WDT timers will produce the desired actuation failure state signals independently from the MELTAC platform software. However, staff acknowledged that docketed information may need additional clarification to better reflect this aspect of WDT operation. It further stated that NRC staff would work with the applicant to address this issue.

Staff has completed its review of the docketed information, including the DCD and referenced technical reports, attempting to identify locations where the existing descriptions of WDT operations could be further clarified.

Staff requests the applicant to review the following sections of MUAP-07005, revision 9, "Safety System Digital Platform - MELTAC-" for clarification as identified in the table below.

Section 4.1.5 Self-Diagnosis, (pg 61) "The MELTAC platform controller is equipped with the three types of self-diagnosis features: a hardware based detection process, a software based detection process and a combination thereof."	This section does not provide enough information and detail to determine whether the hardware diagnosis circuitry which involves watchdog timer is independent of the software based detection process. Additional detail and clarification is needed.
Section 4.1.5, 1) Failure, **[** **]**	**[** **]**
Section 4.1.5.2.1 CPU Module **[** **]**	**[** **]**
Section 4.1.5.2.1 CPU Module **[** **]**	**[** **]**
Section 4.1.5.2.1 CPU Module **[** **]**	**[**]
Section 4.1.5.2.1 CPU Module **[** **]**	**[** **]**

Section 4.1.5.5.2 Output Module **[** **]**	**[** **]**
Figure 4.1-18, **Mechanism of WDT (CPU Module)** Figure depicts a graphical representation of the WDT mechanism; however, it does not represent detailed interactions of the WDT circuitry to the circuitry involving the platform software.	Detailed graphical depiction is needed to determine any dependencies arising from the interactions of the WDT circuitry and the platform software.
Figure 4.1-19, **WDT's Mounted in MELTAC Platform** **[** **]**	**[** **]**

ANSWER:

Independence of Watchdog Timers (WDTs) function

The watchdog timer (WDT) consists of a counter, a clock generator, and a WDT timeout monitor, which includes a predefined timer value for WDT timeout. The WDT architecture is shown in Figure 4.1-18 of MUAP-07005 (See Attachment-2).

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A failure of the software (both basic and application) and the processing system hardware circuits which execute the software of the CPU Module that performs the safety functions can be detected and the outputs forced into a predetermined fail state by the independent WDTs which are installed in the other modules.

After initialization of MELTAC, the counter of the WDT which is installed in each module starts to count up automatically.

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Subsection 7.1.3.10 “Self-Diagnostic Function” of the DCD Tier 2 Chapter 7 will be revised as shown in Attachment-1.

Behavior of safety I&C systems after a WDT timeout occurs

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The METAC controller behavior for the above two cases are described in Section 4.1.5.7.1.2 of MUAP-07005, as shown in Attachment-2. The mechanism for WDT performance and the behavior of MELTAC controllers after a WDT timeout occurs are independent from the software and hardware circuits of the CPU Module that perform safety functions.

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The detail behavior of safety I&C systems after a WDT timeout occurs are described in Section 4.1.5.7.1, Section 4.1.5.7.1.2 Figure 4.1-22 of MUAP-07005 as shown in Attachment-2.

MHI agrees with the NRC staff request to add detail and clear descriptions on the WDT as described in Table-1.

To respond to the comments and requests from the ACRS and the NRC staff, MHI will add descriptions of the independence between the WDT and the software and hardware circuits of the MELTAC controller that perform safety functions to DCD Tier 2 Chapter 7 and MUAP-07005 as shown in Attachments 1 and 2.

Additional Item-1

Appendix E of MUAP-07005 describes the Software Critical Function Analysis of the MELTAC platform basic software. It was recognized that Appendix E of MUAP-07005, Revision 9 is based on the previous specification of the MELTAC platform. The specification of the MELTAC platform was upgraded in accordance with the obsolescence of major parts of the MELTAC platform, and the specification upgrades were reflected to the current MUAP-07005. Therefore, the analysis in Appendix E of MUAP-07005 should also be updated. Appendix E of MUAP-07005 will be updated as shown in Attachment-2 based on the latest specification of the MELTAC platform as reflected in MUAP-07005, Revision 9.

The self-diagnosis items in Appendix E of MUAP-07005 are modified, integrated or added based on the specification upgrades of the MELTAC platform as described in Attachment-2. The changes are modification, integration or addition of self-diagnosis

items in accordance with the module circuit changes (including changes in memory chip and internal bus) that were made due to the replacement of parts, addition of diagnosis items for facilitating identification of the failed part. These self-diagnosis upgrades do not require changes to the basic architecture nor the performance of the MELTAC platform, because the coverage and performance of the self-diagnosis functions are the same as or improved from the old self-diagnosis functions.

Table-1: Answer to the NRC staff requests to resolve the WDT issue

References to MUAP-07005, revision 9

Section 4.1.5 Self-Diagnosis, (pg 61) "The MELTAC platform controller is equipped with the three types of self-diagnosis features: a hardware based detection process, a software based detection process and a combination thereof."	**NRC Staff Request** This section does not provide enough information and detail to determine whether the hardware diagnosis circuitry which involves watchdog timer is independent of the software based detection process. Additional detail and clarification is needed. **MHI Answer** Summary descriptions of Subsection 4.1.5.7 will be added after the second paragraph of Subsection 4.1.5. Description on the WDT mechanism independence from the software will be added in Subsection 4.1.5-a).
Section 4.1.5, 1) Failure, **[** **]**	**NRC Staff Request** **[** **]** **MHI Answer** **[** **]**
Section 4.1.5.2.1 CPU Module **[** **]**	**NRC Staff Request** **[** **]** **MHI Answer** **[** **]**
Section 4.1.5.2.1 CPU Module **[** **]**	**NRC Staff Request** **[** **]** **MHI Answer** **[** **]**

Section 4.1.5.2.1 CPU Module **[** **]**	**NRC Staff Request** **[**] **MHI Answer** **[** **]**
Section 4.1.5.2.1 CPU Module **[** **]**	**NRC Staff Request** **[** **]** **MHI Answer** **[** **]**

Section 4.1.5.5.2 Output Module **[** **]**	**NRC Staff Request** **[** **]** **MHI Answer** **[** **]**
Figure 4.1-18, Mechanism of WDT (CPU Module) Figure depicts a graphical representation of the WDT mechanism; however, it does not represent detailed interactions of the WDT circuitry to the circuitry involving the platform software.	**NRC Staff Request** Detailed graphical depiction is needed to determine any dependencies arising from the interactions of the WDT circuitry and the platform software. **MHI Answer** MHI will add detailed graphical descriptions in Figure 4.1-18 and revise the description of Subsection 4.1.5.7 to explain the interactions of the WDT circuitry and the platform software.
Figure 4.1-19, WDT's Mounted in MELTAC Platform **[** **]**	**NRC Staff Request** **[** **]** **MHI Answer** **[** **]**

Impact on DCD
Descriptions for the independence between the WDT and the software and hardware circuits of the MELTAC controller that performs the safety functions have been added to DCD Tier 2, Section 7.1, as shown in Attachment-1.

Impact on R-COLA
There is no impact on the R-COLA.

Impact on PRA
There is no impact on the PRA.

Impact on Technical / Topical Report
Descriptions for the independence between the WDT and the software and hardware circuits of the MELTAC controller that performs the safety functions have been added to MUAP-07005, as shown in Attachment-2.

In addition, the self-diagnosis items in Appendix E of MUAP-07005 are modified, integrated or added based on the specification upgrades of the MELTAC platform as described in Attachment-2.