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June 20, 2013

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-13139

Subject: **MHI's Amended Response to US-APWR DCD RAI No. 688-5273 Revision 2 (SRP 07.07)**

References: 1) "Request For Additional Information 688-5273 Revision 2, SRP Section: 07.07 – Control Systems, Application Section: 07.07" dated January 31, 2011, ML110310237.
2) "MHI's Responses to US-APWR DCD RAI for Chapter 7," UAP-HF-12052, dated February 27, 2012, ML12062A136.
3) "MHI's Amended Responses to US-APWR DCD RAI for Chapter 7, Response to the Additional Questions from the NRC," UAP-HF-11352, dated October 12, 2011, ML11287A072.
4) "MHI's Responses to US-APWR DCD RAI for Chapter 7 and mark up of Tier 1 and Chapter 7 on Revision 3," UAP-HF-11159, dated May 31, 2011, ML11160A118.
5) "MHI's Responses to US-APWR DCD RAI No. 688-5273 Revision 2 (SRP Section 07.07)," UAP-HF-11055, dated March 2, 2011, ML110660154.

With this letter, Mitsubishi Heavy Industries, Ltd. (MHI) transmits to the U.S. Nuclear Regulatory Commission (NRC) a document entitled "Amended Response to Request for Additional Information No. 688-5273 Revision 2."

Enclosed is the amended response to a question contained within Reference 1.

Please contact to Mr. Joseph Tapia, General Manager of Licensing Department, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

Sincerely,

Yoshiki Ogata,
Executive Vice President
Mitsubishi Nuclear Energy Systems, Inc.
On behalf of Mitsubishi Heavy Industries, LTD

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NRO

Enclosures:

1. Amended Response to Request for Additional Information No. 688-5273 Revision 2

CC: J. A. Ciocco
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Contact Information
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Enclosure 1

Docket No. 52-021
UAP-HF- 13139

Amended Response to Request for Additional Information No. 688-5273 Revision 2

June 2013

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/20/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.688-5273 REVISION 2**
SRP SECTION:	**07.07 – CONTROL SYSTEMS**
APPLICATION SECTION:	**07.07 – CONTROL SYSTEMS**
DATE OF RAI ISSUE:	**01/31/2011**

QUESTION NO. : 07.07-32

In subsection 7.7.2.6, "Use of Digital Systems," of the US-APWR DCD, it states that "*The PCMS and PSMS utilize the same basic software. In addition, the PCMS application software is developed using a structured process similar to that applied to development of the PSMS application software.*" Similarly, in subsection 5.1.8 of MUAP-07004 (Revision 5), "Safety I&C System Description and Design Process," it states that "*The MELTAC platform that is applied to the PCMS is essentially the same as the MELTAC platform applied to the PSMS.*"

In the Abstract of MUAP-07005 (Revision 6), "Safety System Digital Platform – MELTAC -," it states that "*the MELTAC Platform has been developed using a rigorous safety related design process that ensures suitable hardware and software quality and reliability for critical applications such as the Reactor Protection System or Engineered Safety Features Actuation System.*" SRP Section 7.7, "Control Systems;" under the section "Review Procedures," states that "*To minimize the potential for control system failures that could challenge safety systems, control system software should be developed using a structured process similar to that applied to safety system software. Elements of the review process may be tailored to account for the lower safety significance of control system software. Refer to SRP Appendix 7.0-A and SRP Appendix 7.1-D for guidance on digital system review.*" Please clarify what exactly are the differences between the MELTAC platform for the PCMS compared to that of the PSMS?

Also, identify which functions in the PCMS are important to safety, if any? If so, what are the additional requirements, and the process, beyond the non-safety (software and hardware) PCMS which will be applied? Ensure that the function discussed in MUAP- 07004 (Revision 5), "Safety I&C System Description and Design Process," Appendix A, section A.6.3 is included in your response.

ANSWER:

1. The differences between the MELTAC Platform for the PCMS compared to that of the PSMS are quality assurance methods including software life cycle processes.

2. Certain I&C equipment and activities that are non-safety but support safe and reliable plant operations or are required to meet other specific NRC guidance are assigned to Equipment Classifications where special design requirements or augmented quality controls are applied. These processes for non-safety design requirements and quality controls are described in DCD Sections 3.2.2 and 17.5. For I&C systems, the scope of these special design and quality requirements and associated Equipment Classifications are described in Tables 7.1-5 and 7.1-6 (Attachments 1 and 2). Software life cycle requirements, including V&V, are provided in Appendix D of "Software Program Manual, MUAP-07017 Rev. 4" (Attachment-3).
3. Section 7.1.3.20 of the DCD Rev. 4 will be revised to incorporate the function discussed in A.6.3 of "Safety I&C System Description and Design Process, MUAP-07004 Rev. 5".

Impact on DCD
DCD Section 7.1.3.20 and Tables 7.1-5 and 7.1-6 will be added as described in the Attachments 1 and 2.

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 Reports
There is no impact on the Technical / Topical Reports.

7.1.3.18 Quality Assurance Program

The overall quality assurance program (QAP) for the US-APWR I&C systems is described in Chapter 17. The specific QAP for the MELTAC platform is described in MUAP-07005 Section 6.0. These QAPs address all requirements of Title 10, Code of Federal Regulations (CFR), Part 50, Appendix B (Reference 7.1-19), and IEEE Std 7-4.3.2-2003 (Reference 7.1-20).

7.1.3.19 Identification

I&C equipments identification follows the guidance of RG 1.75, which endorses IEEE Std 384~~.~~-1992 (Reference 7.1-23). The following color coding is provided on tags used for the identification of I&C system cabinets and for stand alone components, such as field instruments. DCD_07.01-30

Identification shall not require frequent use of reference material.

- Train A: Red with white lettering
- Train B: Green with white lettering
- Train C: Blue with white lettering
- Train D: Yellow with ~~B~~black lettering DCD_07.01-30
- Non-safety train: White with ~~B~~black lettering

This color coding is consistent with the color coding defined in Subsection 8.3.1.1.8 identification of class 1E electrical equipment and cables.

For computer-based systems, the configuration management plan describes the identification process for software. To ensure that the required computer system hardware and software are installed in the appropriate system configuration, the system meets the following identification criteria specific to software systems:

- Firmware and software identification ensures that the correct software is installed in the correct hardware component.
- The software has a means to retrieve identification from the firmware by using software maintenance tools.
- Physical identification requirements of the digital computer system hardware are in accordance with the identification requirements in IEEE Std 603-1991.

The configuration identification management is addressed in Technical Report MUAP-07017.

7.1.3.20 ~~Augmented Quality Systems~~Non-safety I&C Systems Requiring Special Design or Quality Requirements DCD_07.01-27 DCD_07.07-32 DCD_07.07-32 S04

Certain I&C equipment and activities that are non-safety but support safe and reliable plant operations or are required to meet other specific NRC guidance are assigned to

Equipment Classifications where special design requirements or augmented quality controls are applied. These processes for non-safety design requirements and quality controls are described in DCD Subsection 3.2.2 and Section 17.5. For I&C systems, the scope of these special design and quality requirements and associated Equipment Classifications are described in Tables 7.1-5 and 7.1-6.~~The System Quality Group Classifications are described in Subsection 3.2.2.5. The actual scopes of augmented quality systems and the regulatory requirements applied for each system are shown in Table 7.1-5. These systems are classified as Equipment Class 5. On the other hands, systems that have impact on continuous power generation are classified as Class 9.~~ DCD_07.01-27 DCD_07.07-32 DCD_07.07-32 S04

~~The quality assurance requirement and equipment qualification requirement to Class 5 and 9 systems are as follows:~~

~~(1) Quality Assurance Requirements~~

- ~~The pertinent QA requirement of 10 CFR 50, Appendix B is applied to Class 5 and 9 systems as described in Subsection 3.2.2.5.~~
- ~~For application software of Class 5 systems, Appendix D of the US-APWR Software Program Manual (Reference 7.1-18) is applied. This Appendix D establishes augmented quality requirements for the application software of the Equipment Class 5 systems and for the integration of the application software, basic software and hardware through integration testing.~~

~~(2) Equipment Qualification~~

- ~~Equipment Qualification Program (Reference 7.1-25) is applied to Class 5 systems.~~
- ~~Industry standards are applied to Class 9 systems.~~

7.1.4 Safety-Related Digital I&C Design Conformance to Essential Safety Criteria

DCD_07.01-25

A key design basis of the US~~R~~-APWR is to apply digital I&C technology to the PSMS. The purpose of this section is to describe overview of the PSMS design conformance to the following four essential safety criteria and one subjective attribute-simplicity. MIC-03-07-00011

1) Redundancy

2) Independence

3) Determinism (to ensure response time of data processing and communication)

4) Diversity

5) Simplicity

The above safety criteria are embodied in the underlying basis of IEEE Std 603-1991 (Reference 7.1-15). This section does not address conformance with all of the other IEEE Std 603-1991 criteria nor all of the other applicable regulatory guidance, codes, and

DCD_07.07-32

Table 7.1-5 Scope of the Augmented Quality Systems

Items	Specific requirements for non-safety system	Augmented Quality
Safety Functions Controlled by O-VDUs	DI&C-ISG-04	Required
Safety Parameter Display System (SPDS)	10 CFR 50.34 (f)(2)(iv), "Additional TMI-Related Requirements" regarding the SPDS Control	Required
	NUREG 0737 Supplement 1, "Clarification of TMI Action Plan Requirements - Requirements for Emergency Response Capability", with respect to SPDS	Required
Alarms for Credited Manual Operator Actions	SECY-93-087, Item II. T, "Control Room Annunciator (Alarm) Reliability"	Required
Signal Selection Algorithm (SSA)	RG 1.153, "Criteria for Safety Systems"	Required
	IEEE 603-1991, Clause 6.3 "Interaction between the Sense and Command features and other Systems"	Required
Risk-significant non-safety I&C system	Risk-significant non-safety I&C system identified in Table 17.4-1	Required
Diverse Instrumentation and Control System	BTP 7-19, "Guidance for Evaluation of Diversity and Defense-in-Depth in Digital Computer-Based Instrumentation and Control Systems"	Required
	Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment That Is Not Safety-Related"	Required

Note)

1. Bypass and Inoperable Indication (BISI): There is no augmented quality requirement.
2. Post Accident Monitoring Instrumentation: Type A, B, C and D are implemented in the PSMS and there is no augmented requirement for Type E.
3. Leak Detection System: Seismic required systems are implemented in the PSMS and there is no augmented requirement for others.

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Table 7.1-6 Classification of I&C systems (Sheet 1 of 3)

Systems and Components	Equipment Class	Location	Quality Group	Quality[1] Assurance Classification	Codes and Standards[2]	Seismic[3] Category	Notes[4]
1. PSMS							
Reactor Protection System	3	R/B	N/A	Q	1	I	
ESF Actuation System	3	R/B	N/A	Q	1	I	
Safety Logic System	3	R/B	N/A	Q	1	I	
Safety VDU Processor	3	R/B	N/A	Q	1	I	
Communication System	3	R/B	N/A	Q	1	I	
Safety Bus	3	R/B	N/A	Q	1	I	
2. PCMS (DCS)							
Reactor Control System	5	A/B	N/A	A	2	NS	4, 6
CRDM Control System	9	A/B	N/A	N	2	NS	
Radiation Monitoring System	9	A/B	N/A	N	2	NS	
Rod Position Indication System	9	PCCV	N/A	N	2	NS	
Incore Nuclear Instrumentation System	9	A/B	N/A	N	2	NS	
BOP Control System	9	A/B	N/A	N	2	NS	
Turbine Protection System	9	A/B	N/A	N	2	NS	
Turbine EHG Control System	9	A/B	N/A	N	2	NS	
Electrical Control System	9	A/B	N/A	N	2	NS	
Unit Bus	5	R/B, A/B	N/A	A	2	NS	1, 2, 3, 4

Table 7.1-6 Classification of I&C systems (Sheet 2 of 3)

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Systems and Components	Equipment Class	Location	Quality Group	Quality[1] Assurance Classification	Codes and Standards[2]	Seismic[3] Category	Notes[4]
3. PCMS (HSIS)							
Alarm VDU Computer	5	A/B	N/A	A	2	NS	3
Operational VDU Computer (for OC)	5	A/B	N/A	A	2	NS	1, 2
Operating Procedure VDU Computer (for OC)	10	A/B	N/A	N	2	NS	
Large Display Computer (for LDP)	10	A/B	N/A	N	2	NS	
Alarm Logic Computer	5	A/B	N/A	A	2	NS	3
Process Recording Computer	10	A/B	N/A	N	2	NS	
Unit Management Computer	10	A/B	N/A	N	2	NS	
Operational VDU Computer (for TSC)	10	AC/B	N/A	N	2	NS	
Large Display Computer (for TSC)	10	AC/B	N/A	N	2	NS	
Supervisor Console	10	R/B	N/A	N	2	II	
Shift Technical Advisor Console	10	R/B	N/A	N	2	II	
Large Display Panel	10	R/B	N/A	N	2	II	
Station Bus	10	A/B	N/A	N	2	NS	
4. PSMS/PCMS							
Operator Console	3	R/B	N/A	Q	1	I	
Remote Shutdown Console	3	R/B	N/A	Q	1	I	

Table 7.1-6 Classification of I&C systems (Sheet 3 of 3)

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Systems and Components	Equipment Class	Location	Quality Group	Quality[1] Assurance Classification	Codes and Standards[2]	Seismic[3] Category	Notes[4]
5. DAS							
Diverse Automatic Actuation System	5	R/B	N/A	A	2	II[5]	5
Diverse HSI Panel	5	R/B	N/A	A	2	II[5]	5
6. Local							
Reactor Trip Breaker	3	R/B	N/A	Q	1	I	
MG Set	5	R/B	N/A	A	2	NS	5

Notes:

(1) Quality Assurance Classification: The designation "Q" indicates that the quality assurance requirements of 10 CFR 50, Appendix B, are applied in accordance with the quality assurance program described in Chapter 17. The designation "A" indicates that augmented quality assurance requirements are applied as described in Table 3.2-2 of the DCD Chapter 3. In addition, Equipment Class 5 I&C systems, Appendix D of "Software Program Manual" (MUAP-07017) is applied.

(2) Identification number for "Code and standards"

1. IEEE603 Class 1E
2. Codes and Standards as defined in design basis.

(3) Following augmented qualification requirements are applied concurrent with SSE. An SSE will not result in a failure of these systems. The seismic qualification method is equivalent to that for seismic category I qualification of safety-related I&C equipment.

- Reactor Control System shall retain the function described in Note (4) 4, 6.
- Operational VDU Computer shall retain the function described in Note (4) 1, 2.
- Alarm VDU Computer and Alarm Logic Computer shall retain the function described in Note (4) 3.
- Unit Bus shall retain the functions described in Note (4) 1, 2, 3, 4.
- Diverse Actuation System and Diverse HSI Panel shall retain the function described in Note (4) 5.

(4) Identification number for "Note"

1. Safety Functions Controlled by O-VDU
2. Safety Parameter Display System (SPDS)

3. Alarms for Credited Manual Operator Actions
4. Signal Selection Algorithm (SSA)
5. Diverse Instrumentation and Control System
6. Risk-significant non-safety I&C system

(5) The DAS is categorized as Equipment Class 5 in accordance with its required non-safety function to cope with software common cause failure which is a beyond design basis event. On the other hand, the DAS is designed as Seismic Category II and powered by Class 1E UPSs, to cope with software common cause failure concurrent with seismic events. An SSE will not result in a failure of the DAS that adversely affects the PSMS. The seismic qualification method is equivalent to that for seismic category I qualification of safety-related electrical cabinets.

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Appendix D Software Program Manual for Augmented Quality Systems

1. Scope

The basic and application software of the PSMS is classified as Class 1E as defined in IEEE Std 603-1991, and the basic and application software is classified as software integrity level 4 in accordance with Chapter 1 of RG 1.168 Rev. 1. The PSMS application software complies with this US-APWR Software Program Manual.

The Plant Control and Monitoring System (PCMS) is classified as a non- safety related system, but several subsystems and components in the PCMS have specific regulatory requirements. Therefore, these PCMS subsystems and components are classified as augmented quality. The System Quality Group Classifications are described in DCD Section 3 "Design of Structures, Systems, Components, and Equipment." The PCMS subsystems and components classified as augmented quality are categorized as Equipment Class 5, whereby they must meet selected QA requirements of 10 CFR 50 Appendix B as described in Section 3.2.2.5 of the DCD.

The equipment classes of all systems are listed in Table 3.2-2 of DCD Chapter 3, and the systems which are categorized as Equipment Class 5 require the augmented quality classification. The actual scopes of the augmented quality systems and the applied regulatory requirements for each system are described in Table 7.1.5 of DCD Chapter 7.

2. Software Life Cycle Requirements

The software life cycle processes of the PCMS application software selected for the augmented quality systems are listed in Table D-1.

2.1 Basic Software

For the hardware and basic software of the augmented quality PCMS subsystems and components, the pertinent QA requirements of 10 CFR 50, Appendix B as described in Section 3.2.2.5 of the DCD are required in the same manner as other Equipment Class 5 SSCs, such as structures, structural components, non digital I&C and electrical components.

The augmented quality program for the selected PCMS subsystem and component application software, which includes integration and final validation testing, encompasses the basic software and hardware. Therefore a unique basic software and hardware augmented quality program is not required.

2.2 Application Software

For the application software of the augmented quality PCMS subsystems and components, the software life cycle control requirements which are specified by this US-APWR Software Program Manual are applied as described in Table D-1.

Table D-1: Applicability of US-APWR SPM to Application Software of PCMS functions with augmented quality

Software Plans	Applicability
Software Management Plan (SMP)	A
Software Development Plan (SDP)	A
Software Quality Assurance Plan (SQAP)	N/A(1)
Software Integration Plan (SIntP)	A
Software Installation Plan (SInstP)	A
Software Maintenance Plan (SMaintP)	A
Software Training Plan (STrngP)	A
Software Operations Plan (SOP)	A
Software Safety Plan (SSP)	N/A
Software Verification and Validation Plan (SVVP)	A(2)
Software Configuration Management Plan (SCMP)	A
Software Test Plan (STP)	A
Output Documents	A(3)
Appendix C	A

Note: A-applicable N/A-not applicable

(1) Based on QA requirements for Equipment Class 5 Systems in Section 3.2.2.5 of the DCD.

(2) All V&V activities are conducted. However activities may be conducted by the Design Team or the V&V Team, and V&V independence is not required.

(3) Documents provided by VVT are not applicable.