MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

July 16, 2009

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-10205

Subject: MHI's Responses to US-APWR DCD RAI No.593-4565 Revision 1

Reference: 1) "Request for Additional Information 593-4565 Revision 1, SRP Section: 07.21 Branch Technical Position – Guidance on Digital Computer Real-Time Performance, Application Section: Chapter 7, dates June 8, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document as listed in Enclosures.

Enclosed is the response to RAI contained within References 1.

As indicated in the enclosed materials, this document contains information that MHI considers proprietary, and therefore should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential. A non-proprietary version of the document is also being submitted with the information identified as proprietary redacted and replaced by the designation "[ ]".

This letter includes a copy of the proprietary version (Enclosures 2), a copy of the non-proprietary version (Enclosures 3), and the Affidavit of Yoshiki Ogata (Enclosure 1) which identifies the reasons MHI respectfully requests that all materials designated as "Proprietary" in Enclosures 2 be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

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.

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NRO

Enclosure:

1. Affidavit of Yoshiki Ogata

2. Response to Request for Additional Information No. 593-4565 Revision 1 (proprietary version)

3. Response to Request for Additional Information No. 593-4565 Revision 1 (non-proprietary version)

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

Contact Information
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Enclosure 1

Docket No. 52-021
MHI Ref: UAP-HF-10205

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshiki Ogata, state as follows:

1. I am General Manager, APWR Promoting Department, of Mitsubishi Heavy Industries, LTD ("MHI"), and have been delegated the function of reviewing MHI's US-APWR documentation to determine whether it contains information that should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential.

2. In accordance with my responsibilities, I have reviewed the enclosed document entitled Responses to Request for Additional Information No. 593-4565 Revision 1 dated June 2010, and have determined that portions of the document contain proprietary information that should be withheld from public disclosure. Those pages containing proprietary information are identified with the label "Proprietary" on the top of the page and the proprietary information has been bracketed with an open and closed bracket as shown here "[ ]". The first page of the document indicates that all information identified as "Proprietary" should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

3. The information identified as proprietary in the enclosed document has in the past been, and will continue to be, held in confidence by MHI and its disclosure outside the company is limited to regulatory bodies, customers and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and is always subject to suitable measures to protect it from unauthorized use or disclosure.

4. The basis for holding the referenced information confidential is that it describes the unique design and methodology developed by MHI for performing the design of the US-APWR reactor.

5. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of information to the NRC staff.

6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information. Other than through the provisions in paragraph 3 above, MHI knows of no way the information could be lawfully acquired by organizations or individuals outside of MHI.

7. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without incurring the costs or risks associated with the design of the subject systems. Therefore, disclosure of the information contained in the referenced document would have the following negative impacts on the competitive position of MHI in the U.S. nuclear plant market:
   A. Loss of competitive advantage due to the costs associated with development of

the I&C system. Providing public access to such information permits competitors to duplicate or mimic the I&C system design without incurring the associated costs.

B. Loss of competitive advantage of the US-APWR created by benefits of enhanced plant safety, and reduced operation and maintenance costs associated with the I&C system.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information and belief.

Executed on this 16th day of July, 2010.

Y. Ogata

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

Enclosure 3

UAP-HF-10205
Docket No. 52-021

Responses to Request for Additional Information No. 593-4565
Revision 1

July 2010
(Non - Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

7/16/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 593-4565 REVISION 1**
SRP SECTION:	**07-21 BRANCH TECHNICAL POSITION – GUIDANCE ON DIGITAL COMPUTER REAL-TIME PERFORMANCE**
APPLICATION SECTION:	**CHAPTER 7**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO.: 07-21 Branch Technical Position-1
Clearly identify the performance requirements for the US-APWR safety Instrumentation and Control (I&C) system.

10 CFR 52.47 states in part, that the information submitted for a design certification must include performance requirements and design information sufficiently detailed to permit the preparation of acceptance and inspection requirements by the NRC, and procurement specifications and construction and installation specifications by an applicant. It appears within Technical Report MUAP-09021, "US-APWR Response Time of Safety I&C System," the values within Section 3.4 should be changed to state "basis" for the time response requirements, not "assumptions". This should include how each of the following factors was determined, what estimates were made, and what facts ensure that these are the bounding requirements.

1. The values identified in Tables 4.0-1 and 4.0-2 as T1 through T4, and T1, T2, respectively. Clearly explain estimates madeand how they are deterministic. Provide justification that shows that the allocations can be reasonably expected to be satisfied by the plant design. Section 3.4 states "The response time allocated to the individual components (i.e., response time of sensor, digital controller) are based on MHI experience of digital I&C system in Japanese PWR plant" is not acceptable.
2. Using the Figure 4.4-1 and Figure 4.4-2, of MUAP-09005, MELTAC Topical Report, show the calculation of the maximum, and minimum, response time which is equal to each of the digital controller times, T2, by safety function presented in MUAP-09021.

   a) Identify each of the values, t1 through t10, in Figure 4.4-1 for the MELTAC Fundamental Cycle and how this can vary for each of the safety functions.

   b) Identify the differences between the typical MELTAC hardware configuration in Figure 4.4-2 and that used to determine each of the response time calculations.

ANSWER:
MHI agrees to change the word "assumptions" to "basis". Section 3.4 of MUAP-09021 will be revised as the follows.

- The detailed design is required to meet the response time requirement of the digital controller with taken into account the delay time caused by the processor loading, number loading,

number of I/O modules, number of controller nodes

- ~~The basis of the The response time allocated to the individual components (i.e., response time of sensor, digital controller) in Section 4.1 is provide in Section 4.2. are based on MHI experience of digital I&C system in Japanese PWR plant, where the processor and the I/O loading of the MELTAC platform has been considered. Base on the experience, response time is established with conservative assumptions. Then response time of the platform with actual load will be verified against response time requirement in ITAAC phase.~~
- The satisfaction of the allocated response time ~~based on MHI experience~~ is verified in water fall design process during basic design and detail design phase through MHI QA program / process, also these design process is verified through V&V process. Then response time of the platform with actual load will be verified against response time requirement in ITAAC phase.
- The basis of the response time allocated to the individual components (i.e., response times of sensors, digital controllers) in Section 4.1 is provide in Section 4.2.
- Some of the expected component response times listed in Tables 4.2-1 and 4.2-2 are based on typical equipment procured for use in the US nuclear power industry. The expected response times will be specified in the applicable procurement documents prior to making the final determination of equipment make and model, and response times will be verified prior to commercial operation.

The following description and Figures 4.2-1, 4.2-2 and 4.2-3 will be added in MUAP-09021 Section 4.2.

Allocated response times from T1 to T4 in Tables 4.1-1, 4.1-2 are determined as values which envelop the values based on the specifications of the individual equipments that applied to US-APWR. The values based on specifications are addressed in a column "Expected Response Times Based on Specification" in Tables 4.2-1 and 4.2-2.

Equipments assigned to sensor part in Tables 4.2-1 and 4.2-2 of MUAP-09021 are transmitters and RTDs of the general vendors in U.S. The response times of these sensors are addressed in the vender specifications and we can find the vender specifications in each vendor web site. The response times T1 of NIS and RCP Speed are negligible and the bases are described in MUAP-09021 Sections 5.2 and 5.3 respectively.

Response time T3 (0.1 sec) is in accordance with the specification of RTBs. The response time of RTBs applied to Japanese PWR is less than 0.1 sec. RTBs of the same specification will be applied to US-APWR.

Also, response time T4 (0.15 sec) is in accordance with the specification of CRDM as addressed in DCD Section 3.9.4.2.1.

●Case 1

Figure 4.2-1 System configuration of case 1

●Case 2

Figure 4.2-2 System configuration of case 2

●The case 3

Figure 4.2-3 System configuration of case 3

Maximum response times are calculated by the method provided in Table 4.4-1 of MUAP-07005. The system scale of digital controller is considered for estimating some of response times. To estimate the maximum response times, the system scale is determined by adding some margins to the system scale based on the DCD. The system scale applied to the estimation of maximum response times are shown in Table 1.

All estimated values above are less than 80% of response time requirement addressed in the column of allocated response times in Tables 4.2-1 and 4.2-2 of MUAP-09021. Therefore, response times T2 of the digital controller do not exceed allocated response times.

Table 1 The system scale applied to the estimation of maximum response times

Table 2 Response time calculation for maximum, minimum and safety evaluation in each component

Impact on DCD
There is no impact on the DCD.

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

7/16/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 593-4565 REVISION 1**
SRP SECTION:	**07-21 BRANCH TECHNICAL POSITION – GUIDANCE ON DIGITAL COMPUTER REAL-TIME PERFORMANCE**
APPLICATION SECTION:	**CHAPTER 7**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO.: 07-14 Branch Technical Position-2
With regards to response time guidance of BTP 7-21, a basis should be provided for systems, particularly, that have not been implemented and tested on a full scale basis. In Technical Report MUAP-09021, "Time Response of Safety I&C System," the basis should include, but not be limited to,

1. A description of the effects of adding sensors, divisions, communication links, controller, computer nodes, or actuation devices required to scale the system to full scale or that which was previously built.
2. A description of the cycle which demonstrates that the watch-dog timer is correctly implemented. The description of the WDT cycle time in MUAP-09021 is not that identified in MUAP-09005 nor that identified as typical in BTP 7-21.
3. The time required for the application modules does not exceed the allotted time given in the architecture timing budget, and diagnostics and other support modules will not cause the allotted time to be exceeded.

10 CFR 52.47 states in part, that the information submitted for a design certification must include performance requirements and design information sufficiently detailed to permit the preparation of acceptance and inspection requirements by the NRC, and procurement specifications and construction and installation specifications by an applicant. MHI is requested to provide a basis for systems that have not been implemented and tested on a full scale basis.

ANSWER:
The following description will be added to the next revision of MUAP-09021 Section 4.2 to address system scalling.

The description of the watch dog timer in MUAP-09021 Section A.6 will be revised as shown below.

~~"the watch-dog timer is set at the beginning of each cycle and reset after the completion of application module"~~

will be changed to be consistent with the description in the MELTAC Topical Report, MUAP-07005, as follows:

The hardware timer is set based on the calculation of T3, which is described in the RAI response above.

The following will be added to MUAP-09021 Section 4.2.

Impact on DCD
There is no impact on the DCD.

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

7/16/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

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APPLICATION SECTION:	**CHAPTER 7**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO.: 07-14 Branch Technical Position-3
Regarding Technical Report MUAP-09021, "US-APWR Response Time of Safety I&C System," in each application where T2 is described, MHI is to identify, in the document, how the response time analysis accounts for all types of missed digital communication messages and specifically what those are and how they will not affect the time response performance allocation. (Example: Failed data integrity test, corrupted, late, etc.)

10 CFR 52.47 states in part, that the information submitted for a design certification must include performance requirements and design information sufficiently detailed to permit the preparation of acceptance and inspection requirements by the NRC, and procurement specifications and construction and installation specifications by an applicant.

ANSWER:
ISG-04 states, "The safety system response time calculations should assume a data error rate that is greater than or equal to the design basis error rate and is supported by the error rate observed in design and qualification testing.". The following added to MUAP-09021 Section A.4.

Impact on DCD
There is no impact on the DCD.

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

7/16/2010

US-APWR Design Certification

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APPLICATION SECTION:	**CHAPTER 7**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO.: 07-14 Branch Technical Position-4
In Technical Report MUAP-09021, "US-APWR Response Time of Safety I&C System," MHI is to correct the list of variables in Table 4.0-1 or the list of variables in Table 7.2-3 of the DCD so that they are specifically consistent.

Table 7.2-3 of the DCD provides a list of reactor trip variables, ranges, accuracies, response times, and setpoints. Similarly, Table 4.0-1 in MUAP-09021 provides a list of reactor trip variables and their response times. However, the list of variables in Table 4.0-1 in the MUAP-09021 do not agree with the list of variables in Table 7.2-3 of the DCD. Also, Table 4.0-1 in Technical Report MUAP-09021 includes the ECCS signal, which is not listed in Table 7.2-3. On the other hand, Table 7.2-3 includes high source range and high intermediate range neutron signal, and high positive and high negative rate of change of the power range flux signal. None of these signals are listed in Table 4.0-1 of Technical Report MUAP-09021. In the response to the RAI, MHI is to explain why these were different and which table will be revised.

ANSWER:
Table 7.2-3 of the DCD provides the response times of all RT variables. So, the item ECCS actuation will be added to Table 7.2-3 of the DCD. On the other hand, Table 4.1-1 in MUAP-09021 provides response times of typical RT variables assumed for the transient analyses in Table 15.0-4 of the DCD as described in MUAP-09021 Section 1.2. ECCS is included because it is a reactor trip initiator included in Table 15.0-4. The response times of the variables which are addressed in Table 7.2-3 of the DCD and not addressed in Table 15.0-4 of the DCD, are determined based on the response times of the variables in Table 4.1-1 of MUAP-09021 and Table 15.0-4 of the DCD. The response times T2, T3 and T4 are common to the variables only addressed in Table 7.2-3 of the DCD and the variables addressed in Table 15.0-4 in the DCD. The response time T1 of the variables addressed only in Table 7.2-3 of the DCD also can be decided from response time T1 of the variables which are addressed in Table 15.0-4 in the DCD and have sensors of the same type. Therefore, it should not pose any problem even if list of variables in Table 4.1-1 in MUAP-09021 does not agree with list of variables in Table 7.2-3 of the DCD.

Impact on DCD
The item ECCS actuation will be added to Table 7.2-3 of the DCD as follows.

Table 7.2-3 Reactor Trip Variables, Ranges, Accuracies, Response Times, and Setpoints (Nominal) (Sheet 2 of 2)

RT Function	Variables to be monitored	Range of Variables	Instrument Accuracy*1,2	Response Time*1,2	Setpoint *3
Over Power ΔT	(a) ΔT	0 to 150%	Total 5.2% RTP	Total 6.0 sec	110.6*5% RTP
	(b) Reactor Coolant Cold Leg Temperature (T_{cold})	510 to 630°F			
	(c) Reactor Coolant Hot Leg Temperature (T_{hot})	530 to 650°F			
	(d) Neutron Flux (difference between top and bottom power range neutron flux detectors)	-60 to +60% (ΔI)			
Low Reactor Coolant Flow	Reacter Coolant Flow	0 to 120% of rated flow	3% of rated flow	1.8 sec	90% of rated flow
Low RCP Speed	RCP Speed	0 to 120% of rated pump speed	0.5% of rated pump speed	0.6 sec	95.5% rated pump speed
Low Pressurizer Pressure	Pressurizer Pressure	1700 to 2500 psig	2.5% of span	1.8 sec	1865 psig
High Pressurizer Pressure	Pressurizer Pressure	1700 to 2500 psig	2.5% of span	1.8 sec	2385 psig
High Pressurizer Water Level	Pressurizer Water Level	0 to 100% of span	3% of span	1.8 sec	92% of span
Low SG Water Level	SG Water Level	0 to 100% of span (narrow range taps)	3% of span	1.8 sec	13% of span
High-High SG Water Level	SG Water Level	0 to 100% of span (narrow range taps)	3% of span	1.8 sec	70% of span
Manual Reactor Trip Actuation	Switch Position	N/A	N/A	N/A	N/A
ECCS Actuation	Pressurizer Pressure	1700 to 2500 psig	2.5% of span	3.3 sec	1765 psig
	Main Steam Line Pressure	0 to 1400 psig	3% of span	3.3 sec	525 psig
	Containment Pressure	-7 to 80 psig	2.8% of span	3.3 sec	6.8 psig
Turbine Trip	Turbine Emergency Trip Oil Pressure	0 to 3500psig	2% of span	1.0 sec	1000 psig
	Main Turbine Stop Valve Position	N/A	N/A	1.0 sec	5% open

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

7/16/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

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APPLICATION SECTION:	**CHAPTER 7**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO.: 07-14 Branch Technical Position-5
MHI should correct the tables and discuss why Table 4.0-2 of Technical Report MUAP-09021, "Response Time of Safety I&C System," and Table 7.3-4 in the DCD do not contain the same set of ESF actuation signals.

Table 7.3-4 of the US-APWR DCD provides a list of the ESF actuation variables, ranges, accuracies, response times, and setpoints. Similarly, Table 4.0-2 of the MUAP-09021 provides a list of the response time of ESF actuation signals. However, Table 4.0-2 of Technical Report MUAP-09021 and Table 7.3-4 in the DCD do not contain the same set of ESF actuation signals. Included in this issue is why the two tables are different with regard to the number of ESF functions listed. In particular, Technical Report MUAP- 09021 lists five (5) ESF actuation functions, while Table 7.3-4 lists ten (10) ESF functions. For those ESF functions that are listed in both tables, some variables listed in Table 7.3-4 in the DCD are missing in Table 4.0-2 of Technical Report MUAP-09021. An example is the High Main Steam Line Pressure Negative Rate signal for the ESF function of Main Steam Line Isolation.

ANSWER:
Table 7.3-4 of the DCD provides the response times of all ESF variables. On the other hand, Table 4.1-2 in MUAP-09021 provides response times of typical ESF variables assumed for the transient analyses in Table 15.0-4 of the DCD as described in MUAP-09021 Section 1.2. The response times of the variables which are addressed in Table 7.3-4 of DCD and not addressed in Table 15.0-4 of DCD, are determined based on the response times of the variables in Table 4.1-2 of MUAP-09021 and Table 15.0-4 of the DCD. The response times T2, T3 and T4 are common to the variables addressed only in Table 7.3-4 of the DCD and the variables addressed in Table 15.0-4 in the DCD. The response time T1 of the variables addressed only in Table 7.3-4 of the DCD also can be decided from response time T1 of the variables which are addressed in Table 15.0-4 in the DCD and have sensors of the same type. Therefore, it should not pose any problems even if the list of variables in Table 4.2-1 in MUAP-09021 does not agree with list of variables in Table 7.3-4 of the DCD.

Impact on DCD
There is no impact on the DCD.

Impact on COLA
There is no impact on the COLA.

Impact on PRA
There is no impact on the PRA