MITSUBISHI HEAVY INDUSTRIES, LTD.
16-5, KONAN 2-CHOME, MINATO-KU
TOKYO, JAPAN

February 9, 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-11032

Subject: MHI's Response to NRC's Request for Additional Information No. 677-5325 Revision 2 (SRP 07.08)

References: 1) "REQUEST FOR ADDITIONAL INFORMATION 677-5325 REVISION 2", dated January 10, 2011.

Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") the document entitled "MHI's Response to NRC's Request for Additional Information No. 677-5325 Revision 2 (SRP 07.08)". The enclosed materials provide MHI's responses to the NRC's Request for Additional Information ("RAI") (Reference 1). The responses to all of the questions in Reference 1 are included in the enclosed documents.

As indicated in the enclosed materials, Enclosure 2 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.

This letter includes a copy of the proprietary version of the RAI response (Enclosure 2), a copy of the non-proprietary version of the RAI response (Enclosure 3), and the Affidavit of Yoshiki Ogata (Enclosure 1) which identifies the reasons MHI respectfully requests that all material designated as "Proprietary" in Enclosure 2 be withheld from 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 this submittal. His contact information is provided below.

Sincerely,

Atsushi Kamaki for

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

D081
xRS

Enclosures:

1. Affidavit of Atsushi Kimaki
2. MHI's Response to NRC's Request for Additional Information No. 677-5325 Revision 2 (SRP 07.08) (proprietary)
3. MHI's Response to NRC's Request for Additional Information No. 677-5325 Revision 2 (SRP 07.08) (non-proprietary)

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

Contact Information

C. Keith Paulson, Senior Technical Manager
Mitsubishi Nuclear Energy Systems, Inc.
300 Oxford Drive, Suite 301
Monroeville, PA 15146
E-mail: ck_paulson@mnes-us.com
Telephone: (412) 373-6466

ENCLOSURE 1

Docket No. 52-021

MHI Ref: UAP-HF-11032

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Atsushi kumaki, being duly sworn according to law, depose and state as follows:

1. I am Group Manager, Licensing Promoting Group in 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 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 documents entitled "MHI's Response to NRC's Request for Additional Information No. 677-5325 Revision 2 (SRP.07.08)" dated February 9, 2011, and have determined that the document contains proprietary information that should be withheld from public disclosure. The first page of the documents and the label on the OSM indicates that information identified as "Proprietary" should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

3. The basis for holding the referenced information confidential is that it describes the unique design of the safety analysis, developed by MHI (the "MHI Information").

4. The MHI Information is not used in the exact form by any of MHI's competitors. This information was developed at significant cost to MHI, since it required the performance of research and development and detailed design for its software and hardware extending over several years. Therefore public disclosure of the materials would adversely affect MHI's competitive position.

5. The referenced information has in the past been, and will continue to be, held in confidence by MHI and is always subject to suitable measures to protect it from unauthorized use or disclosure.

6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information.

7. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of supporting the NRC staff's review of MHI's application for certification of its US-APWR Standard Plant Design.

8. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without the costs or risks associated with the design and testing of new systems and components. Disclosure of the information identified as proprietary would therefore have negative impacts on the competitive position of MHI in the U.S. nuclear plant market.

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 9th day of February, 2011.

Atsushi Kumaki

Atsushi kumaki
Group Manager- Licensing Promoting Group in APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

ENCLOSURE 3

UAP-HF-11032
Docket No. 52-021

MHI's Response to NRC's Request for Additional Information
No. 677-5325 Revision 2 (SRP 07.08)

February 2011

(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.677-5325 REVISION 2**
SRP SECTION:	**07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS**
APPLICATION SECTION:	**TECHNICAL REPORT MUAP-07014**
DATE OF RAI ISSUE:	**1/10/2011**

QUESTION NO. : 07-08-6

Regulatory Guidance: BTP 7-19, Section B.3, states that, "Displays and manual controls provided for compliance with Point 4 of the NRC position on D3 should be sufficient both for monitoring the plant state and to enable control room operators to actuate the systems that will place the plant in a hot shutdown condition." DI&C-ISG-05, Part 3, section 1.A, states that the HFE analysis must demonstrate that the operator(s) can perform the actions correctly and reliably in the time available. Responses to the following questions are necessary to support the staff making a final safety determination on these general acceptance criteria.

Question: MUAP-07014-P(R2), Section 3.4, pg 3-6 regarding CCF immediate post-trip actions states, "Perform event specific immediate action(s) based on the first-out indication." The staff requests MHI address the following with respect to this action:

Is the diverse reactor trip actuation alarm always the "first-out indication" mentioned above? (List of prompting alarms on page 3-5 seems to imply it is. Section 3.5.4 says that operators will be trained to respond to DAS prompting alarms, regardless of other control room indications. This appears to be a different strategy than responding to the "first-out indication". Please explain this apparent difference. If multiple first-out indications will exist explain why additional time is not required to diagnose the event associated with the particular alarm. (Currently all the time estimates appear to assume the proper procedure will be readily apparent.)

ANSWER:

The diverse reactor trip actuation alarm is not always the first alarm generated by the diverse HSI panel (DHP). As described in DCD Subsection 7.8.1.1.2 and shown in Figure 6.2-1 of MUAP-07006-P(R2), the DHP generates one diverse actuation summary audible alarm tone, which indicates the DAS output demand for any DAS automatic actuation (reactor trip, turbine trip, MFW isolation or EFW actuation). In addition, there are three first out alarm tiles, which indicate the specific input condition (low pressurizer pressure or high pressurizer pressure or low SG level) for the DAS automatic actuation. Other abnormal plant conditions, without DAS automatic actuation, are also indicated by individual alarm tiles on the DHP; the same alarm tone previously described

for DAS automatic actuations is also generated for any of these other alarm conditions. The DHP alarm list on MUAP-07014-P(R2) page 3-5 will be corrected to describe this design, as follows:

- DAS automatic actuation (summary audible, with first out indication of initiating input condition)
- Main steam line radiation (N-16)
- Low-low pressurizer pressure

All of these DHP alarms are considered to be DHP prompting alarms for which operators will be trained to recognize a CCF and initiate mitigating actions from the DHP. The CCF response strategy is to respond to the DHP prompting alarm, which, depending on the specific event, may or may not include one of the first out indications associated with DAS automatic actuation.

All DHP alarms, including the DAS automatic actuation alarms, are blocked if the PSMS/PCMS functions correctly. Functioning correctly for automatic actuations means that the actuated plant components have repositioned correctly. Functioning correctly for plant conditions that are only alarmed means that the PCMS has generated the corresponding prompting alarm. The blocking logic for alarms corresponding to DAS automatic actuations is described in Section 6.2.2.2 of MUAP-07006. The blocking logic is also shown in DCD Figures 7.8-2 and 7.8-3. In response to NRC requests regarding consideration of partial CCF conditions, additional actuation/alarm blocking logic is described in various sections of MUAP-07014.

For partial CCF conditions, it is possible that other non-prompting alarms may be generated from the PSMS/PCMS or some parameter indications may be available on the PSMS/PCMS displays, even when DHP prompting alarms are generated. However, since DHP alarms have been generated, operators will be trained to assume that a CCF exists, that the PSMS/PCMS alarms and indications cannot be trusted, and to enter the DHP procedures. Therefore, regardless of any other PSMS/PCMS alarms or indications, operators will be trained to respond to any DHP alarm by initiating special event EOPs for CCF conditions. To support this operator training strategy, DHP prompting alarms have two alarm processing circuits arranged in a two-out-of-two configuration to prevent spurious DHP alarms. Therefore, it is not necessary for operators to check other alarms or indications in the control room to enter the DHP procedures, when a DHP alarm is generated.

In conclusion, MUAP-07014(R2) Section 3.5.4 is correct as written "operators will be trained to respond to DAS prompting alarms, regardless of other control room indications". However, the operator response description in Section 3.4, pg 3-6 regarding CCF immediate post-trip actions will be corrected as follows:

> Based on the unique DHP prompting alarm (including the first-out indication), the operator starts taking "immediate CCF event specific actions" using the indications and controls on the diverse HSI panel (DHP). For the US-APWR the specific DHP indications and controls are defined in Tables 7.8-2 and 7.8-4 of the DCD. After the reactor is tripped, either automatically or by manual actions, operators will monitor and control the plant as follows:
>
> - Verify both the reactor and the turbine have tripped (through neutron flux and main steam line pressure indications on the DHP)
> - Verify sufficient emergency feedwater into each steam generator (through steam generator water level indications on the DHP)
> - Control EFW flow rate using the DHP T_{cold} indicator and EFW control valves

Although most events will be mitigated or terminated upon completion of "immediate CCF event specific actions", the procedures direct the operator to continue to monitor the event, and all critical safety functions to ensure that plant conditions stabilize.

There is a unique event specific procedure for each DHP alarm. For most events concurrent with CCF there will not be multiple DHP prompting alarms. However, if multiple DHP prompting alarms are initiated, operators will be trained to prioritize their response. For example, for LBLOCA, which could result in a low-low pressurizer pressure alarm and a DAS automatic actuation summary alarm (with low pressurizer pressure first-out indication), operators will be trained to select the procedure corresponding to the low-low pressurizer pressure condition. This will result in immediate manual actuation of Safety Injection. This procedure will then direct the operator to respond to other lower priority alarms. Therefore, operators can quickly select the appropriate event specific procedure based on the DHP prompting alarms and prioritization training.

In conclusion, the CCF strategy is to respond to the unique DAS prompting alarm, which, depending on the specific event, may or may not include one of the first out indications associated with the DAS automatic actuation. Operator training will ensure that operators understand the appropriate response and procedure for handling each DAS prompting alarm. For most events there will not be multiple DHP alarms. Where multiple DHP alarms are generated, operators will be trained to prioritize their procedure selection. In either case, the event specific procedure will be readily apparent without the need for additional diagnosis time.

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

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	NO.677-5325 REVISION 2
SRP SECTION:	07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS
APPLICATION SECTION:	TECHNICAL REPORT MUAP-07014
DATE OF RAI ISSUE:	1/10/2011

QUESTION NO. : 07-08-7

Regulatory Guidance: BTP 7-19, Section B.3, states that, "Displays and manual controls provided for compliance with Point 4 of the NRC position on D3 should be sufficient both for monitoring the plant state and to enable control room operators to actuate the systems that will place the plant in a hot shutdown condition." DI&C-ISG-05, Part 3, section 1.A, states that the HFE analysis must demonstrate that the operator(s) can perform the actions correctly and reliably in the time available. Responses to the following questions are necessary to support the staff making a final safety determination on these general acceptance criteria.

Question: MUAP-07014-P(R2), Section 3.4, pg 3-6 regarding CCF immediate post-trip actions states, "Perform event specific immediate action(s) based on the first-out indication." The staff requests MHI address the following with respect to this action:

Describe how the operator knows he/she has this alarm. Is it displayed on the large display panel? Does it interface with the alarm annunciator system? What draws the operator's attention to the DHP located at the side of the control room when he/she could be experiencing very confusing indications from PSMS and/or PCMS?

ANSWER:

When DHP alarms are generated, an alarm tile is illuminated on the DHP and a unique audible alarm sound is generated in the MCR to notify the operators. The audible alarm sound has both a unique tone and unique directional orientation (i.e., from the DHP). In addition, the PCMS alarm tones are momentary, whereas the DHP alarms are continuous and must be manually silenced. Therefore, there is no potential for a DHP alarm sound to be masked by an alarm tone from the PCMS.

These DHP alarms, indicators, and audible sounds are independent of the indicators for the PCMS and PSMS, and independent of the audible sounds and indicators for the PCMS alarms. The uniqueness of these alarms, indicators, and audible sounds will ensure that the operators can clearly detect them. Operators will be trained to respond to these DHP alarms, regardless of PSMS and/or PCMS indications, since when the DHP detects a PSMS/PCMS CCF condition

(which is a prerequisite for any DHP alarm), the PSMS/PCMS indications/alarms cannot be trusted to enter the DHP procedures.

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

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	NO.677-5325 REVISION 2
SRP SECTION:	07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS
APPLICATION SECTION:	TECHNICAL REPORT MUAP-07014
DATE OF RAI ISSUE:	1/10/2011

QUESTION NO. : 07-08-8

Regulatory Guidance: BTP 7-19, Section B.3, states that, "Displays and manual controls provided for compliance with Point 4 of the NRC position on D3 should be sufficient both for monitoring the plant state and to enable control room operators to actuate the systems that will place the plant in a hot shutdown condition." DI&C-ISG-05, Part 3, section 1.A, states that the HFE analysis must demonstrate that the operator(s) can perform the actions correctly and reliably in the time available. Responses to the following questions are necessary to support the staff making a final safety determination on these general acceptance criteria.

Question: MUAP-07014-P(R2), Section 3.4, pg 3-6 regarding CCF immediate post-trip actions states, "Perform event specific immediate action(s) based on the first-out indication." The staff requests MHI address the following with respect to this action:

Good operating principles reinforce using independent indications to confirm a plant alarm prior to initiating operator action. The staff believes this is an essential part of operator training and control room activities, the need for which has been well proven by operating experience. Explain why this principle is not applicable to the prompting alarms. Within this explanation include a discussion of why it is not viable or necessary for the operators to use the DHP indications to verify the alarm condition before initiating manual actions.

ANSWER:

The DAS is designed so that highly prioritized DHP prompting alarms cannot be spuriously generated due to single failures. Therefore, it is not necessary for operators to confirm any other indicator on the DHP after highly prioritized DHP prompting alarms initiation, prior to selecting the appropriate event specific procedure and taking the "immediate CCF event specific actions". Therefore, for SBLOCA and LBLOCA, where time critical operator actions are required, procedures will direct operators to take "immediate CCF event specific actions" based only on the automatic actuation DHP prompting alarm (low pressurizer pressure first out indication or the low-low pressurizer pressure DHP prompting alarm). The immediate response actions (i.e., manual reactor trip and manual actuation of SI) can only put the plant in a safe condition, therefore this is

a more conservative strategy than delaying these actions to allow additional diagnosis. For other DHP prompting alarms, the procedures will direct the operators to confirm the alarms through other DHP indications (as may be available), prior to manual actions.

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

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	NO.677-5325 REVISION 2
SRP SECTION:	07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS
APPLICATION SECTION:	TECHNICAL REPORT MUAP-07014
DATE OF RAI ISSUE:	1/10/2011

QUESTION NO. : 07-08-9

Regulatory Guidance: NUREG-0800, Section 1.0 describes interfaces with standard designs. Included in these interfaces is the COL action [or information] item. COL action items identify certain matters that shall be addressed in the final safety analysis report by a COL applicant. The COL action items need not and should not be exhaustive. Rather, COL action items should focus on matters that may be a significant issue in any COL application referencing the DCD.

Question: MUAP-07014-P(R2), Section 3.5.4, pg 3-12 states that operators will be trained to respond to DAS prompting alarms. Will this be included in the DCD as a COL Information Item? How will MHI ensure that the COL applicant is informed of and understands the necessary training requirements?

ANSWER:

The training requirements for plant operations and maintenance personnel are described in DCD Ch. 18.9 Training Program Development. Additionally, the Training Program Development Implementation Plan, MUAP-10011, describes that training is provided for all plant conditions and exercises all procedures.

The COL applicant is informed of the necessary training requirements which are described in COLA Part 2 FSAR Ch. 18. This section of the referenced DCD Ch. 18 is incorporated by reference which means no additional requirement is applied to the COL applicant's training requirements.

To ensure there is no misunderstanding regarding the training needed for CCF conditions, the DCD will be augmented as shown below.

Impact on DCD

The following will be added to Section 18.9.2.1 of DCD Ch. 18 General Training Approach (changes are underlined):

Training addresses the following:

- The full range of degraded HSI conditions including:

  - Stable continued operation, accident mitigation and safe shutdown with only safety visual display units

  - Accident mitigation and safe shutdown with a concurrent common cause failure (i.e. operation from the Diverse HSI Panel)

  - Safe shutdown from the Remote Shutdown Room

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

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	NO.677-5325 REVISION 2
SRP SECTION:	07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS
APPLICATION SECTION:	TECHNICAL REPORT MUAP-07014
DATE OF RAI ISSUE:	1/10/2011

QUESTION NO. : 07-08-10

Regulatory Guidance: DI&C-ISG-05, Part 3, "Staff Position," states, "The vendor/licensee/applicant should commit, in the D3 submittal, to include the proposed D3 coping actions in a HFE Program consistent with that described in NUREG-0711, *Human Factors Engineering Program Review Model*, and to provide the results of the HFE program to the staff prior to implementation of the proposed action(s)."

Question: MUAP-07014-P(R2), Section 3.4, pg 3-7 states that adequate time margins between time available and time required will be validated in the integrated HSI validation tests. Is this the formal integrated system validation described in NUREG-0711? Will DAS manual actions be made explicit in the operational condition sampling section of the validation implementation plan? (The staff believes that they should be added explicitly since the validation implementation plan provides design acceptance criteria for the validation related ITAAC.)

ANSWER:

The integrated HSI validation test is the formal activity which meets the requirement in NUREG-0711. The programmatic description of the V&V is included in DCD Ch.18 and the implementation plan is described in the Verification and Validation Implementation Plan, MUAP-10012.

In the ITAAC of Tier 1, the acceptance criteria for V&V activities in Section 2.9 include the requirement that the V&V activities be conducted in accordance with the requirements of the V&V Implementation Plan. Section 4.3.1, Test Objectives, of the implementation plan (MUAP-10012) explicitly includes the validation of the accident management and safe shutdown with a common cause failure of digital systems.

To clarify the acceptance criteria for CCF, the bullet pertaining to CCF in Section 4.3.1 of the implementation plan (MUAP-10012) will be modified as follows (changes are underlined):

- Validate accident management and safe shutdown with common cause failure of digital systems, demonstrating that there is adequate time margin between the time required for credited operator actions and the time available, as defined in MUAP-07014.

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

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	NO.677-5325 REVISION 2
SRP SECTION:	07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS
APPLICATION SECTION:	TECHNICAL REPORT MUAP-07014
DATE OF RAI ISSUE:	1/10/2011

QUESTION NO. : 07-08-11

Regulatory Guidance: DI&C-ISG-05, Part 3, Section 1.B, last bullet states that, "The analysis of the action sequence identifies credible operator errors and the estimate of time required includes sufficient margin for recovery from any single credible operator error."

Question: MUAP-07014-P(R2), Section 5 outlines the analyses supporting credited manual operator actions. These sections generally state that the time margin for the manual action is sufficient to accommodate operator errors. Credible operator errors are not specifically identified. The time margin is also not addressed.

Identify credible operator errors for the credited manual actions evaluated in MUAP-07014. Identify appropriate time margins for the events or explain why the margin is unnecessary.

ANSWER:

Section 4.3.1 of the Verification and Validation Implementation Plan, MUAP-10012, includes test objectives that require the following activities.

-Validate that the HSI supports human error reduction and recovery activities

-Validate that personnel tasks can be successfully performed in the required time within performance limits, under normal and degraded HSI system conditions

Therefore, evaluations of the credible operator errors for the credited manual actions are addressed in the implementation plan.

MUAP-07014-P (R2) provides both the time available and the time required for the events concurrent with CCF which require the performance of manual actions. Table 7.11 below summarizes the times from the topical report and lists the corresponding time margin available for correcting potential operator errors. Adequacy of the time margin will be validated in the integrated HSI validation tests. Credited operator actions must meet the timing requirements specified in the validation implementation plan. The training program will be developed to ensure the operators are well trained. The validation and operator training are encompassed by the existing HFE Inspection, Test, Analysis and Acceptance Criteria (ITAACs).

Table 7.11: Time Margin for Each Event Concurrent with CCF

Event	Time Available (minutes)	Time Required (minutes)	Time Margin (minutes)
Boron Dilution	61.2 (PCMS disabled) 73.0 (PCMS unaffected)	31.5	29.7 41.5
CVCS Malfunction	> 60	31.5	> 28.5
Failure of Small Lines with Primary Coolant	180	31.5	148.5
SG Tube Rupture	15	15	(Note 1)
Small Break LOCA	10	2	8 (Note 2)
Large Break LOCA	6	2	4 (Note 2)

Notes:

1 The time available from initiation of the SGTR event to the manual reactor trip from the DHP is 15 minutes, which is the same as the DCD safety analysis assumption. This is because the operator can perform a manual reactor trip based on equivalent indication and alarm on the DHP using an equivalent SGTR DHP procedure.

2 Additional information about the determination of the response time and corresponding time margin for LOCA events is provided in the response to Question No. 07-08-14.

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

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	NO.677-5325 REVISION 2
SRP SECTION:	07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS
APPLICATION SECTION:	TECHNICAL REPORT MUAP-07014
DATE OF RAI ISSUE:	1/10/2011

QUESTION NO. : 07-08-12

Regulatory Guidance: DI&C-ISG-05, Part 3, Section 2.A states that preliminary validation should provide independent confirmation of the validity of the "time required" estimate derived in the Phase 1 Analysis.

Question: MUAP-07014-P(R2), Section 3.4 indicates final integrated HSI tests will be conducted but does not describe any preliminary validation activity to confirm the "time required" estimate.

Identify and explain any preliminary validation activity or why such activity is unnecessary for operator manual action response times less than 30 minutes and for local control actions where a generic 30-minute response time was assumed.

ANSWER:

The preliminary validation was conducted to confirm the "time required" estimate during the D3 analysis based on the sequence of operator actions as required by ISG-05. The tabletop analysis and walk-through/talk-through analysis has been conducted by experts including operation, system design, I&C/HFE design, safety analysis, and PRA experts. These personnel verified that the analysis is logical for its purpose, contains a sufficient level of detail, and presents no physical or spatial difficulty for performance.

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

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	NO.677-5325 REVISION 2
SRP SECTION:	07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS
APPLICATION SECTION:	TECHNICAL REPORT MUAP-07014
DATE OF RAI ISSUE:	1/10/2011

QUESTION NO. : 07-08-13

Regulatory Guidance: DI&C-ISG-05, Part 3, "Staff Position," states, "A diversity and defense-in-depth (D3) analysis should include the justification of any operator actions that are credited for response to an AOO/PA concurrent with a BTP 7-19 software CCF. Manual operator actions for these scenarios should be based upon, and ultimately included within, the Emergency Operating Procedures (EOPs) and executed from the main control room (MCR).

Question: MUAP-07014-P(R2), Section 5 outlines the analyses supporting credited manual operator actions. Several event sequences credit local control manual action. The staff requests MHI provide the safety case for why this alternate method from that described in the guidance is acceptable.

ANSWER:

MUAP-07006-P(R2) Section 6.1 describes the methodology used to allocate functions for automation, for manual actions in the MCR, and for manual actions outside the MCR. In the methodology described in Table 6.1-2, indications and manual controls provided outside the MCR (local controls) may be utilized for any manual action performed after 30 minutes. Assuming an acceptable HFE analysis that demonstrates sufficient margin for error recovery between the time required for these actions and the time available for these actions, this is consistent with the guidance of ISG-05.

MUAP-07014-P(R2) describes manual actions utilizing local controls outside the MCR.

Actions employing local controls are assumed to occur no sooner than 30 minutes after entry into the DHP procedure that directs these actions. For this stage in the US-APWR design, this is a reasonable assumption since the specified local actions do not require special clothing or access to equipment in restricted locations. The times for the performance of these actions will be verified using table top walk-throughs, and validated using a high fidelity dynamic simulator that includes simulation of local control actions. Verification and validation activities will employ senior reactor operators and HFE experts.

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

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	NO.677-5325 REVISION 2
SRP SECTION:	07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS
APPLICATION SECTION:	TECHNICAL REPORT MUAP-07014
DATE OF RAI ISSUE:	1/10/2011

QUESTION NO. : 07-08-14

MHI Program Guidance: MUAP-07006-P(R2), Section 8.2 states, "Operator action time to mitigate the event is measured from the prompting DAS alarm. The target minimum operator action time is 10 minutes. If action is needed earlier than 10 minutes the function is generally automated."

Question: MUAP-07014-P(R2), Section 5.6.5.1 (LBLOCA), states that the time available to initiate safety injection flow is six minutes. The staff requests MHI explain in more detail how a response time of six minutes for manual initiation of safety injection flow was determined (Figure 5.6.5.1-1 does not provide sufficient information) and why it was implemented as an exception to your internal documentation (MUAP-07006-P(R2). Also, provide additional information regarding how a response time of at least ten minutes for manual initiation of safety injection flow was "expertly judged" as stated in section 5.6.5.2 (SBLOCA).

ANSWER:

MUAP-07006-P(R2), Section 6.1, states "Safety functions which have less than 10 minutes allowable time to actuate are automatically actuated by DAS". MUAP-07006-P(R2), Section 8.1, states a LBLOCA can be mitigated based on "Early detection of small leaks in the RCS and manual operator actions" and this method of coping with LBLOCA and concurrent CCF in the PSMS is based on "Remote probability of the combination of a LBLOCA with a CCF". However, the NRC did not accept the above probabilistic D3 coping strategy for the LBLOCA scenario concurrent with CCF. The NRC requested a deterministic strategy for addressing a LBLOCA concurrent with a CCF for the US-APWR design in the SER for MUAP-07006-P(R2) as an Application-Specific Action Item (ASAI).

MHI utilized the 10 minutes criteria to select functional design features for DAS automation in MUAP-07006-P(R2) in consideration of sufficient time margin. MHI takes exception to providing automated SI in DAS actuation based on the following evaluation in order to avoid an unnecessarily complicated system.

MUAP-07014-P(R2) evaluates both the time available (6 minutes) and the time required (2 minutes) to perform manual SI initiation for the LBLOCA event to address the ASAI. Although the time available is less than 10 minutes, the manual SI initiation is a simple immediate operator action based on the low-low pressurizer pressure DHP prompting alarm and procedures (see the response to Question No. 07-08-6). Therefore, MHI believes this manual action has sufficient time margin to preclude the need for complex DAS automation.

LBLOCA Time Available

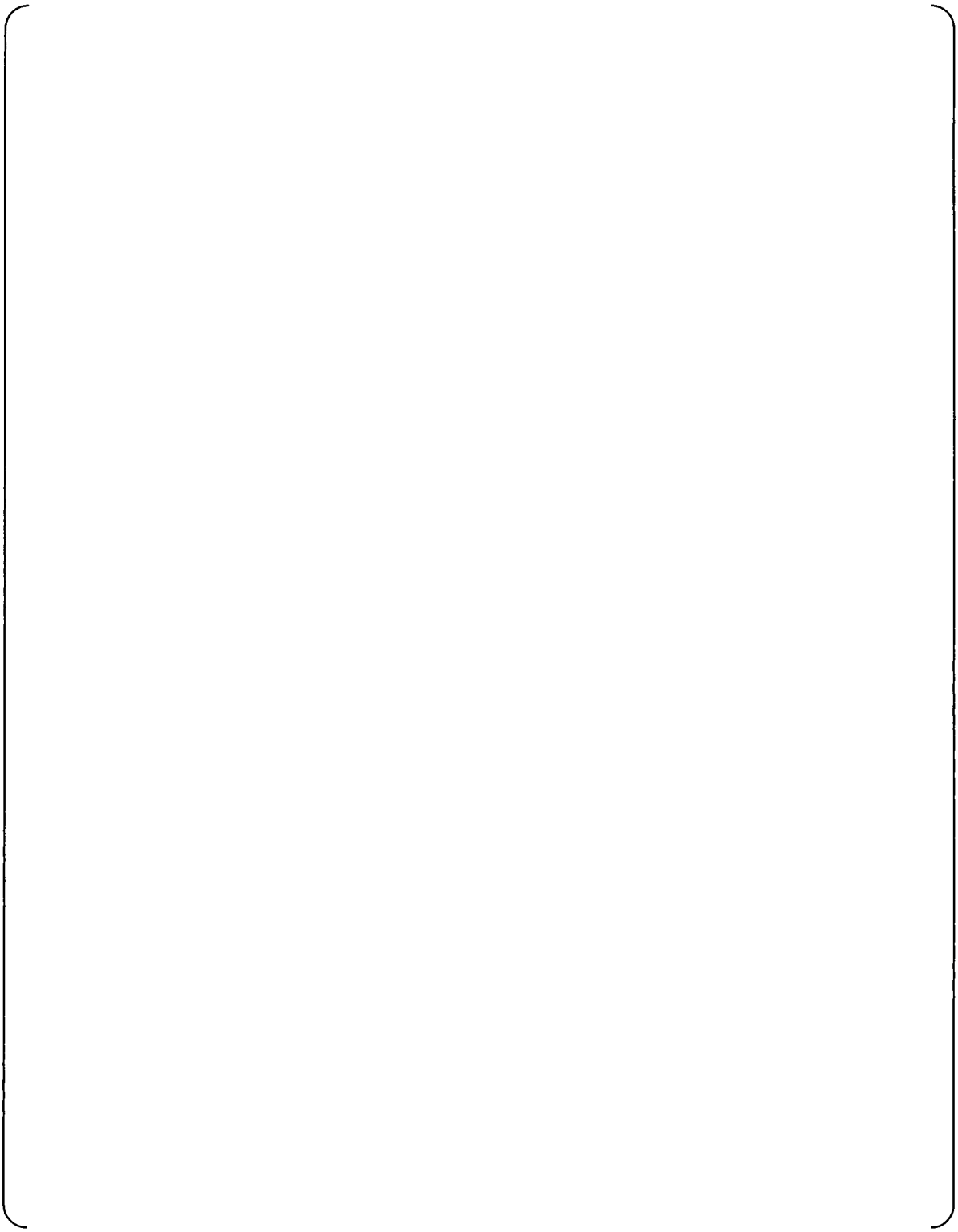
The time available (six minutes after the accident occurrence) to initiate safety injection flow was determined based on the results of the LBLOCA sensitivity analyses for the safety injection start time. The safety criteria and analyses conditions for this LBLOCA safety evaluation are as described below.

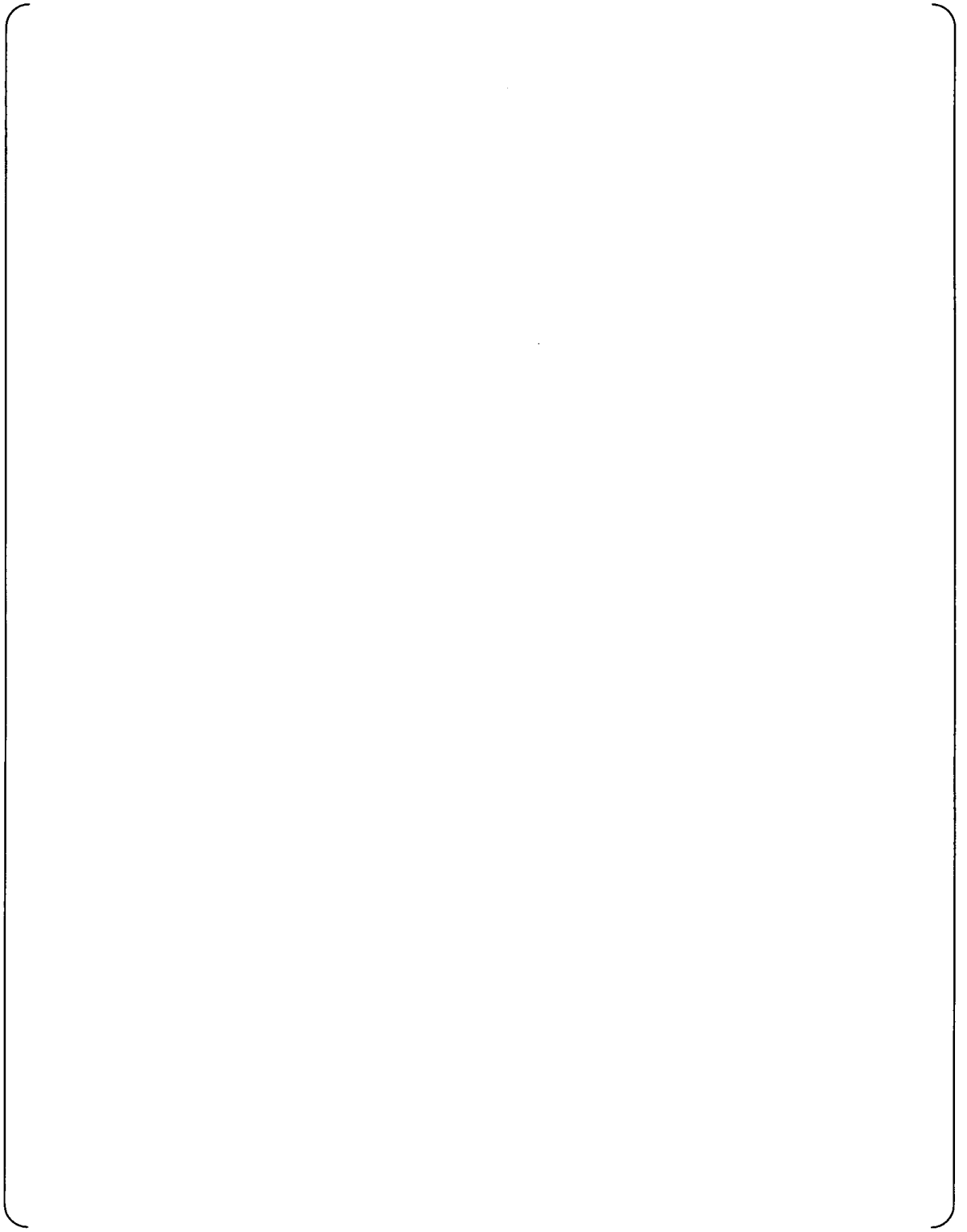
SBLOCA Time Available

Safety injection is required to prevent core damage; hence safety injection has to be initiated before the core is uncovered. The time available for initiation of safety injection can therefore be evaluated by reviewing the time when the core is uncovered for various LOCA sequences.

MHI has performed several accident progression analyses for LOCA sequences, which include success criteria analysis for PRA and severe accident progression analysis, documented in Chapter 5 and Chapter 14 of the PRA technical report (MUAP-07030-P(R2)), respectively. Analysis results are summarized in Table 5A.1.4-1 and Tables 14-3 to 14-11. The earliest time for core uncovery is 30 minutes after initiation of a LOCA with an 8 inch diameter hot leg break. It is generally observed that the hot leg break scenario shows quicker accident progression and core uncovery than a cold leg break LOCA which takes longer than 2 hours. This is because the RCS is more rapidly depressurized for the hot leg break scenario as shown in Figure 5A.1.4-1(2) and Figure 14-28. Accumulator water will be depleted more quickly for the hot leg break scenario since the RCS is rapidly depressurized, and accordingly the time for core uncovery becomes earlier.

Reviewing these analysis results, the 8 inch diameter hot leg break scenario can be considered as the bounding case for various small break LOCA scenarios, and 30 minutes for core uncovery is the shortest time available for safety injection. Therefore, no necessity of automated SI actuation in DAS for SBLOCA is expertly judged.





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

2/9/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	NO.677-5325 REVISION 2
SRP SECTION:	07.08 – DIVERSE INSTRUMENTATION AND CONTROL SYSTEMS
APPLICATION SECTION:	TECHNICAL REPORT MUAP-07014
DATE OF RAI ISSUE:	1/10/2011

QUESTION NO. : 07-08-15

Regulatory Guidance: BTP 7-19, Section B.3, states that, "Displays and manual controls provided for compliance with Point 4 of the NRC position on D3 should be sufficient both for monitoring the plant state and to enable control room operators to actuate the systems that will place the plant in a hot shutdown condition." DI&C-ISG-05, Part 3, section 1.A, states that the HFE analysis must demonstrate that the operator(s) can perform the actions correctly and reliably in the time available. Responses to the following questions are necessary to support the staff making a final safety determination on these general acceptance criteria.

Question: MUAP-07006-P(R2), Section 8.2 states, "The time zero for any operator action is assumed to be any of the prompting alarms provided on the DHP."

If the CCF occurs before the PA/AOO, what operator action is expected? Provide the basis for whatever operator action is expected. If no action is expected describe why this is acceptable.

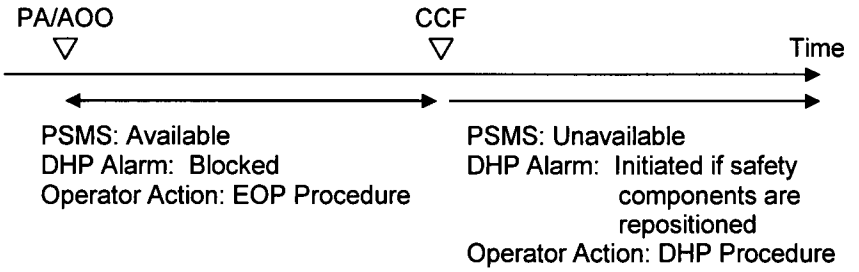
If the CCF occurs after the PA/AOO occurs how does this impact the availability of the prompting alarms?

ANSWER:

First consider the case where a CCF occurs prior to the occurrence of a PA/AOO. If the CCF is detected before the PA/AOO occurs, the plant should be shutdown in accordance with plant procedures. If the CCF affects only the PSMS, the operators can safely shut down using the PCMS. If the CCF affects the PSMS and the PCMS, the operators can safely shut down using the DHP. Operators will detect a CCF, through routine surveillance of plant parameters during routine control of plant equipment.

Next consider the case where a CCF occurs after a PA/AOO is already in progress. Between "after the PA/AOO" and "before the CCF", the PSMS actuates automatic functions and blocks the DAS prompting alarms. These PSMS automatic actuations preclude the need for time critical manual actions. Based on the PSMS alarms and indications, the operators respond to the PA/AOO using the Emergency Operating Procedures (EOPs). During EOP execution, operators

will detect the CCF based on plant instrumentation and control anomalies. If the CCF results in repositioning plant safety components to their pre-actuated state, then the DAS prompting alarms will be generated. (See the following figure.)



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.