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August 19, 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-11267

Subject: MHI's Response to US-APWR DCD RAI No.780-5888 Revision 3 (SRP 18)

References: 1) "Request for Additional Information No. 780-5888 Revision 3, SRP Section: 18 – Human Factor Engineering Application Section: 18.1.1.2" dated July 14, 2011.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 780-5888 Revision 3".

Enclosed is the response to 1 RAI contained within Reference 1.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittals. His contact information is below.

Sincerely,

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

Enclosure:

1. Response to Request for Additional Information No. 780-5888, Revision 3

CC: J. A. Ciocco
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Docket No. 52-021
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Enclosure 1

UAP-HF-11267
Docket Number 52-021

Response to Request for Additional Information
No. 780-5888, Revision 3

August, 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/19/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 780 COLP 5888 REVISION 3**
SRP SECTION:	**18. - HUMAN FACTORS ENGINEERING**
APPLICATION SECTION:	**18.1 – HFE PROGRAM MANAGEMENT**
DATE OF RAI ISSUE:	**7/20/2011**

QUESTION NO. : 18-129

Regulatory Guidance: NUREG-0711 Criterion 2.4.1(3) states, *"Applicable Facilities—The HFE program should address the main control room, remote shutdown facility, technical support center (TSC), emergency operations facility (EOF), and local control stations (LCSs)."*

Evaluation: The response to Question 18-8 from RAI 295-2341, Revision 1 stated, "The same approach as the NUREG-0711 program is applied to the process for EOF/TSC. However, processes other than the task analysis, such as the function allocation or the staffing, etc, [are] very clear and therefore needless to analyze for EOF/TSC."

Question 18-108 from RAI 728-4534 Revision 2 included a concern that this was not a sufficient description of how the HFE design of the EOF is being managed.

From the responses in these two RAIs the staff understands the scope of work addressed by the DCD and by the COL applicant and the acceptance criteria that will be applied. We still do not understand the process being applied to identify the EOF communication and indication requirements that are within the scope of the DCD. More specific concerns are:

- The task analysis referenced in the DCD, Section 18.1.1.2 appears to be the same task analysis being done for the Main Control Room (MCR) operators. The staff's experience is that there are some tasks unique to the EOF that would not be included in the MCR operator task analysis. Examples include integration of offsite dose readings and making protective action recommendations to government agencies.
- In the case of function allocation it is obvious that there are no automated plant controls. For other functions such as communications and information integration in support of EAL declarations, it is not obvious to the staff that no analysis is needed. In any case, the basis for not applying an element needs to be explicitly stated so the staff has a clear understanding of the process being used as it is this process rather than the final design that is the basis for our safety conclusions.

The staff acknowledges that NUREG-0711 does not provide guidance specific to the EOF but since the EOF is included in the scope of this NUREG and Human Factors is generically cited in NUREG-0696, we believe a more complete description of the process you will use for the portion of the EOF design within the DCD scope is appropriate.

Information Request:
Explain the HFE design process being used to develop the EOF HFE design. If you choose to follow the elements of NUREG-0711, explain how elements are accomplished or provide an explicit basis for why they are not used.

References:
MHI's Responses to US-APWR DCD RAI No. 295-2341; MHI Ref: UAP-HF-09225; dated April 28, 2009; ML091210213
MHI's Responses to US-APWR DCD RAI No. 728-4534; MHI Ref: UAP-HF-11125; dated April 28, 2011; ML11123A024

ANSWER:

As stated in the response to Question No.18-108 RAI No. 728-4534; MHI Ref: UAP-HF-11125; dated April 28, 2011; ML11123A024 (attached for convenience), the portion of the EOF design that is within the scope of the US-APWR HFE program is limited to the information and communication requirements only. The design and V&V of the EOF itself, is site specific and therefore outside the scope of the US-APWR HFE program. The response committed to revisions to the DCD and MUAP-09019 to clarify this scope (also attached for convenience).

In addition, per the staff's request, the response to Question No. 18-108 included a commitment to modify the DCD to clarify that the site specific portion of the EOF would be designed in accordance with NUREG-0696. MHI understood this to be a sufficient commitment within the DCD for the EOF design process, since that process itself is outside the scope of the US-APWR HFE program. Additional detail that completely defines the site specific HFE process, will be provided in site specific HFE program documentation, not in the DCD or in the US-APWR HFE program documentation. This is appropriate for a process that is within the scope of each COL applicant, since each COL applicant may use a different HFE process to design their EOF.

In developing the response to this RAI, Question 18-129, MHI identified additional revisions to the DCD that are necessary to avoid confusion regarding the scope of the US-APWR HFE program with respect to the EOF; these are identified below for Sections 18.7.3.2 and 18.10.1.

Within the scope of the US-APWR HFE program, the information and communication requirements for the EOF will be established through the US-APWR task analysis program element. This will be clarified in Section 18.4.1 of the DCD, as shown below. The US-APWR task analysis for the information and communication requirements of the EOF will be conducted in conjunction with the development of the Severe Accident Management Guidelines. This process is similar to the task analysis conducted in conjunction with the development of the Emergency Response Guidelines and Emergency Operating Procedures. More details regarding the task analysis process and the revisions that will be made to the Task Analysis Implementation Plan will be addressed in the response to RAI NO. 781 COLP 5886 REVISION 3, which specifically addresses the Task Analysis HFE program element for the US-APWR.

EAL declarations will be manually determined for the US-APWR, as for operating plants. Since there is no change to the function allocation compared to operating plants, and there were no HEDs identified in the OER that would challenge this historical allocation, function analysis is not required for EAL declarations. The required integration of communications and information to support the manual EAL declaration process will be determined through the task analysis, as described above.

Impact on DCD

Please see Attachment-1.

Impact on R-COLA

There is no impact on the R-COLA

Impact on S-COLA

There is no impact on the S-COLA

Impact on PRA

There is no impact on the PRA

This completes MHI's response to the NRC's question.

ATTACHMENT TO MHI RESPONSE TO QUESTION NO. : 18-129

PREVIOUS MHI RESPONSE TO QUESTION 18-108 RAI NO. 728-4534; MHI REF: UAP-HF-11125; DATED APRIL 28, 2011; ML11123A024

The HFE analysis in the OER of MUAP-08014 Human System Interface Verification and Validation (Phase 1a), Part 2, and the FRA/FA/HRA/TA in MUAP-09019 HSI Design, encompass the TSC and EOF. The remaining US-APWR HFE Implementation Plans also encompass the TSC. However, the application of the US-APWR HFE Implementation plans to the EOF is limited to the communication and information requirements for the EOF, as previously defined in Section 18.1.1.2. The EOF facility, itself, will be designed in accordance with NUREG-0696.

Since the scope of the DCD licensing basis will be changed to encompass the complete EOF, as explained above, a COL Action item is not needed.
To clarify the HFE design process for the EOF, the document revisions shown below will be made.

Impact on DCD

DCD Section 18.1.1.2;
(The fifth bullet in the first paragraph)
• Emergency operations facilities (EOFs) ~~(communications and information requirements only)~~

(The third paragraph)
The ~~site specific HFE team is to design the~~ communications and information requirements of the EOF, will be designed in accordance with the US-APWR HFE program.
~~The site specific HFE team is to specify the communication system requirements; however, the~~
The US-APWR HFE team determines the EOF information that must be transmitted, in accordance with regulatory requirements and guidance, and incorporates this information in the HFE design (Sections 18.7, 18.8, and 18.9) and the V&V process (Section 18.10). The EOF facility itself, is outside the scope of the US-APWR HFE Implementation Plans. The EOF facility is designed in accordance with NUREG-0696. The EOF design process specifies the complete EOF facility design, including the method of incorporating the communications and information requirements established by the US-APWR HFE program. The HSI displays at the EOF include the following:

MUAP-09019, Part 1 Section 2.3;

This Implementation Plan ~~Procedure~~ is applicable to all HFE program elements, as defined in DCD Chapter 18, with the exception of Human Performance Monitoring (HPM). HPM is the responsibility of the license holder and ~~are~~ is, therefore, governed by the license holder's own HPM implementation procedure, which is written in accordance with the strategy developed in the HPM ~~program~~ implementation plan ~~referenced in the COL application~~. It is noted that most US-APWR COL applicants are expected to

reference the HPM program plan in Section 18.12 of the US-APWR DCD, but this is not required.
~~The license holder shall also create implementation procedures for the EOF, since the scope of the EOF encompassed by the US-APWR HFE team is limited to the design if the information displays and specification of the communication requirements.~~

The license holder shall also create implementation procedures for any HFE program elements that must be re-evaluated due to facility design changes.
The communications and information requirements of the EOF, will be established in accordance with the US-APWR HFE Implementation Plans; therefore this Implementation Procedure is applicable. However, the EOF facility itself, is outside the scope of the US-APWR HFE Implementation Plans; therefore this Implementation Procedure is not applicable.

MUAP-09019, Part 1 Section 8, the first paragraph;

The US-APWR HFE Program used for the MCR also ~~MCR development~~ applies to the Remote Shutdown Room (RSR) ~~and~~ the Technical Support Center (TSC), the communications and information requirements of the Emergency Operations facilities (EOF), and local stations since they are derivatives of the MCR.

MUAP-09019, Part 1 Section 8.2.2.3, the last sentence in the third paragraph;

The simulator shall be adaptable to encompass V&V for the Remote Shutdown Console and the information displays used at the Technical Support Center. It is noted that the HFE design team defines the information displays requirements and communication requirements for the EOF in accordance with the US-APWR HFE Implementation Plans, but the design and V&V is ~~of the EOF is the responsibility of the COL applicant~~ outside the scope of the US-APWR HFE Implementation Plans.

MUAP-09019, Part 1 Section 8.3.1 second paragraph,

The scope of the Phase 3a site-specific ~~activates~~ activities includes all facilities addressed in Phase 2, including the information and communication requirements for the EOF. The site specific design and V&V of the EOF is ~~the responsibility of the licensee~~ outside the scope of the US-APWR HFE Implementation Plans.

- Procedure development
- Operating personnel skill requirements
  - Job formation and training
  - Physical workload
  - Cognitive workload

The scope of the task analysis encompasses the MCR, RSC, TSC and LCSs. Task analysis for the EOF that is within the scope of the US-APWR HFE program is limited to (1) the information needed on displays at the EOF and (2) the EOF communication requirements with the MCR. Task analysis to address the complete EOF will be conducted in accordance with the site specific HFE program for compliance with NUREG-0696. DCD_18-129

18.4.2 Methodology

The detailed methodology for conducting the task analysis and integrating it into the HFE analyses is documented in this section and in Reference 18.4-1.

Task analyses begin on a gross or high level and involve the development of detailed narrative descriptions of what personnel have to do. The analyses define the nature of the input, process, and output needed by and from personnel.

Detailed narrative task descriptions address (as appropriate) the following topics:

- Information requirements
- Decisions making requirements
- Response requirements
- Communication requirements
- Workload
- Task support requirements
- Workplace factors
- Situational and performance shaping factors (PSFs)
- Hazard identification

The task analysis is iterative and becomes progressively more detailed over the design cycle. The task analysis is detailed enough to identify information and control requirements to enable specification of detailed requirements for alarms, displays, data

18.7.3 Results

The US-APWR HSI design results and description are documented in the HSI Design Technical Report (Reference 18.7-5).

18.7.3.1 Overview of HSI Design and Its Key Features

The HSI/HFE Topical Report (Reference 18.7-1) describes the overall HSI design concept and its rationale. This description is applicable to the MCR, remote shutdown console (RSC), and TSC. Key features of the design, such as information display, "soft" controls, CBPs, alarm processing, and control room layout, are described. The HSI Topical Report (Reference 18.7-1) includes the following:

- The detailed HSI description, including its form, function and performance characteristics
- The basis for the HSI requirements and design characteristics with respect to operating experience and literature analyses, tradeoff studies, engineering evaluations and experiments, and benchmark evaluations
- The basis of any design changes from the Japanese APWR HSI design
- The outcomes of tests and evaluations performed in support of HSI design

18.7.3.2 Safety Aspects of the HSI

The US-APWR HSI Design Technical Report (Reference 18-7-5) also describes the US-APWR specific implementation of the following safety aspects of the HSI, which are coordinated with the I&C design:

- Safety function monitoring
- Periodic testing of protection system actuation functions
- Bypassed and inoperable status indication for plant safety systems
- Manual initiation of protective actions
- Instrumentation required to assess plant and environmental conditions during and following an accident
- Setpoints for safety-related instrumentation
- HSIs for the ~~emergency response facilities (~~TSC~~ and EOF, where TSC and EOF utilize common technologies)~~ DCD_18-129

The information needed to be displayed at the EOF is identified through the US-APWR HFE program. However, the actual design of HSIs for the site specific EOF is outside the

scope of the US-APWR HFE program. These HSIs will be designed in accordance with the site specific HFE program for compliance with NUREG-0696. DCD_18-129

In addition, the HSI Design Technical Report (Reference 18.7-5) describes the minimum Inventory of HSIs for the US-APWR, which includes:

- Fixed position continuously visible HSI provided by:
  - The fixed area of the LDP (Table 18.7-1) - Section 4.9 "Large Display Panel" of Reference 18.7-1 provides the design basis and description of all LDP indications and alarms, which includes:
    - Bypassed and inoperable status indication (BISI) parameters
    - Type A and B post monitoring (PAM) variables (Section 7.5, Table 7.5-3)
    - Safety parameter displays including status of critical safety functions and performance of credited safety systems and preferred non safety systems
    - Prompting alarms for credited manual operator actions and risk important HAs identified in the HRA
  - PAM displays for Type A and B variables on the safety VDUs (Subsection 7.5.1.1)
  - Conventional switches on the MCR operator console for system level actuation of safety functions such as reactor trip, engineering safety features actuation system (ESFAS) actuation, etc. (Tables 7.2-6 and 7.3-5)
- Class 1E HSI for control of all safety-related components and monitoring of all safety-related plant instrumentation is provided on the safety VDUs, located on the MCR operator console and the remote shutdown console (Section 7.1).
- Minimum inventory for degraded HSI conditions - Section 4.11 "Response to HSI Equipment Failures" of Reference 18.7-1 provides the design basis and description of redundant and diverse HSI which supports the following degraded operating conditions:
  - Degraded operations based on loss of non safety HSI. The plant is maintained in a stable condition through continued operation of normal automatic control systems and monitoring and controlling of critical safety functions through safety VDUs.
  - Degraded operations based on loss of safety and non safety HSI due to common cause failure. HSI for accident mitigation and achieving safe shutdown is provided by the DHP (Subsection 7.8.3).
  - Degraded operations based on evacuation of the MCR. Safe shutdown is achieved through HSI at the RSC (Subsection 7.4.1.5).

18.10 Verification and Validation

18.10.1 Objectives and Scope

V&V evaluations comprehensively determine that the US-APWR design conforms to HFE design principles and that it enables plant personnel to successfully perform their tasks to achieve plant safety and other operational goals. The V&V methodology has the following four major activities:

- Operational conditions sampling
- Design verification
- Integrated system validation
- HEDs Resolution

The scope of the V&V activity encompasses the MCR, RSC, TSC~~, EOF (information requirements and communications),~~ and LCSs. V&V of the EOF is outside the scope of the US-APWR V&V program; V&V will be conducted in accordance with the site specific HFE program to confirm compliance to NUREG-0696. All aspects of the MHI US-APWR V&V program are controlled by the appropriate sections of Reference 18.10-1. DCD_18-129

18.10.2 Methodology

The V&V methodology addresses the following topics:

- Operational conditions sampling: the selection of operational scenarios to be used in V&V
- HSI design verification: the evaluation of the HSI design for meeting tasks requirements and HFE guidelines
- Integrated system validation: the evaluation of whether the integrated system (hardware, software, and crew) meets performance requirements
- HED resolution: the resolution of potential human performance issues identified in V&V evaluations

Reference 18.10-2 Section 5.10 provides a description of the US-APWR HFE V&V program, including the methodology used to develop that program. The US-APWR HFE V&V program is based on the V&V program for the Japanese APWR HFE, which encompasses the HSI design and procedure development. The Japanese and international standards, Japanese nuclear power plant operating experience, and NRC directed operating considerations have been applied to the V&V program and are discussed in Reference 18.10-2, Appendices A and B.

The US-APWR HSI and procedures are based on the Japanese APWR HSI and procedures. The changes to HSI and procedures are described in Sections 18.7 and