

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

March 31<sup>st</sup>, 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-09134

**Subject: MHI's Responses to US-APWR DCD RAI No. 281-2338 Revision 0**

**Reference:** 1) "Request for Additional Information No. 281-2338 Revision 0, SRP  
Section: 18 - Human Factors Engineering, Application Section:  
18.1.1.1 Assumptions and Constraints Identification," dated March 18<sup>th</sup>,  
2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 281-2338 Revision 0."

Enclosed is the response to the 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. 281-2338 Revision 0

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

DO81  
NRC

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](mailto:ck_paulson@mnes-us.com)  
Telephone: (412) 373-6466

Docket No. 52-021  
MHI Ref: UAP-HF-09134

Enclosure 1

UAP-HF-09134  
Docket No. 52-021

Responses to Request for Additional Information No. 281-2338  
Revision 0

March 2009

---

---

**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

---

---

3/31/2009

**US-APWR Design Certification  
Mitsubishi Heavy Industries  
Docket No. 52-021**

**RAI NO.:** NO. 281-2338 REVISION 0  
**SRP SECTION:** 18 - HUMAN FACTORS ENGINEERING  
**APPLICATION SECTION:** 18.1.1.1 ASSUMPTIONS AND CONSTRAINTS IDENTIFICATION  
**DATE OF RAI ISSUE:** 3/18/2009

---

**QUESTION NO. 18-6**

The topical report section 5.1.1.2, "Assumptions and constraints", which is not referenced, contains the 4 additional assumptions and constraints listed below:

- Program must conform to regulations and rules related to safety and human factors design.
- Program must meet the requirements of utility operators.
- Human system interface requirements are to be met (by) the plant system of the US- APWR.
- State-of-the-art human factors practices and computer technologies must be utilized. However, hardware restrictions are taken into account in the human system interface design.
- The response to RAI 4 from the topical report included the following two specific examples that are not included in the DCD:
  - MHI uses Safety VDUs for safety related HSI. To meet the software quality requirements, the software for these devices must be kept very simple. As a result, these devices have primitive graphics and navigational capabilities.
  - To meet the D3 (Defense-In Depth and Diversity) requirements, MHI uses conventional HSI components, such as analog indicators, status lights, alarm tiles and switches. These devices do not have the same dynamic capabilities as digital VDU HSI devices.

Why are these assumptions and constraints not included or referenced in the DCD?

---

**ANSWER:**

Topical Report MUAP-07007, "HSI System Description and HFE Process" Subsection 5.1.1.2 "Assumptions and constraints" will be revised to include the digital and analog technology constraints identified in the response to RAI 4. This revision will reflect all HSI System changes resulting from Phase 1b V&V testing, and will be submitted by June 30, 2009. In addition, DCD subsection 18.1.1.1 will be revised to reference the topical report MUAP-07007, "HSI System Description and HFE Process" Subsection 5.1.1.2.

**Impact on DCD**

The first paragraph of DCD subsection 18.1.1.1 will be revised as follows:

The assumptions and constraints of the design, such as a specific staffing plan or the use of specific HSI technology inherent in are inputs to the HFE program rather than the result of HFE analyses and evaluations. The design assumptions and constraints of the Basic HSI System are clearly identified in Section 5.1.1.2 of Reference 18.1-1. The regulatory requirements applicable to the US-APWR HFE program are listed in Reference 18.1-1, Section 3.0, "Applicable Codes, Standards and Regulatory Guidance".

The Attachment 1 page 18.1-2 shows the above change.

**Impact on COLA**

There is no impact on the COLA

**Impact on PRA**

There is no impact on the PRA

This completes MHI's responses to the NRC's questions.

US-APWR HFE design in the site-specific as-built plant. The site specific HFE processes and procedures will be used for HSI design changes after the certified US-APWR design responsibility is officially turned over to the site specific HFE Team.

#### 18.1.1.1 Assumptions and Constraints Identification

~~The assumptions and constraints of the design, such as a specific staffing plan or the use of specific HSI technology inherent in are inputs to the HFE program rather than the result of HFE analyses and evaluations. The design assumptions and constraints of the Basic HSI System are clearly identified in Section 5.1.1.2 of Reference 18.1-1. The regulatory requirements applicable to the US-APWR HFE program are listed in Reference 18.1-1, Section 3.0, "Applicable Codes, Standards and Regulatory Guidance". The assumptions and constraints of the design, such as a specific staffing plan or the use of specific HSI technology inherent in are inputs to the HFE program rather than the result of HFE analyses and evaluations. The design assumptions and constraints are clearly identified. The regulatory requirements applicable to the US-APWR HFE program are listed in Reference 18.1-1, Section 3.0, "Applicable Codes, Standards and Regulatory Guidance".~~

A fundamental US-APWR HFE design assumption is that it is possible to operate the plant with just one reactor operator (RO) and one senior reactor operator (SRO) in the main control room (MCR) during postulated plant operating modes (Reference 18.1-1, Section 4.1.f, Design Basis, MCR Staff). This MCR staffing meets the regulatory requirements of 10 CFR 50.54(m)(2)(iii) (Reference 18.1-2). The normal MCR staff is supplemented by one additional SRO and one additional RO that is to be at the plant to accommodate unexpected design conditions, including conditions where the human-system interface system (HSIS) is degraded. This overall plant staffing meets the regulatory requirements of 10 CFR 50.54(m)(2)(i) (Reference 18.1-2). While the HSIS is designed to accommodate the minimum MCR and plant staffing described above, the space and layout of the MCR are designed to accommodate the foreseen maximum number of operating and temporary staff.

Reference 18.1-1 describes the US-APWR HSIS design and the HFE design process. The HSIS has been developed and tested for application in both new and existing operating plants in Japan. The functional requirement specification for the Japanese Advanced Pressurized-Water Reactor (APWR) HSIS design serves as the initial source of input to the HSIS design effort. The US-APWR HSIS design is a direct evolution from the predecessor standard Japanese PWR. However, due to differences between existing Japanese nuclear plants and the US-APWR, and the potential for cross-cultural HFE issues, specific changes in the design are addressed in the US-APWR design.

The development of the integrated US-APWR HSIS, as described in Sections 18.7, 18.8, and 18.9 ("Human-System Interface Design," "Procedure Development," and "Training Program Development"), are conducted in an HFE development facility. In addition to HSIS development and testing (Reference 18.1-1, Subsection 5.7.3.3, "HSI Tests and Evaluations"), the verification and validation (V&V) process described in Section 18.10 are conducted in this facility (Reference 18.1-1, Subsection 5.10.2.2.4.b, "Integrated System Validation", "Validation Test Facility"). This facility provides the updated proof-of-