


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

April 2, 2010

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-10094

Subject: MHI's Responses to 3rd round MHI US-APWR Topical Report MUAP-07007-P R3, "HSI System Description and HFE Process"

Reference: 1) 3rd round MHI US-APWR Topical Report MUAP-07007-P R3, "HSI System Description and HFE Process" dated March 4, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to 3rd round Request for Additional Information Topical Report MUAP-07007-P Revision 3 "HSI System Description and HFE Process"

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. Responses to 3rd round Request for Additional Information Topical Report MUAP-07007-P Revision 3 "HSI System Description and HFE Process"

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

DO 81
NRO

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: (421) 373-6466

Docket No. 52-021
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Enclosure 1

UAP-HF-10094
Docket No. 52-021

Responses to 3rd round Request for Additional Information Topical
Report MUAP-07007-P Revision 3 “HSI System Description and
HFE Process”

April 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/2/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: 3rd ROUND RAI TOPICAL REPORT MUAP-07007-P R3
SRP SECTION: 18 - HUMAN FACTORS ENGINEERING
APPLICATION SECTION: 18.0
DATE OF RAI ISSUE: 3/4/2010

QUESTION NO. 18.0-88

Document Availability

MUAP-07007 part 4 describes many design characteristics for the Human system Interfaces. The staff finds the design principles to be consistent with NUREG-0700. To supplement this perspective, the staff would like to review the MHI document(s) that contain the design-specific HFE design guidance. This would be the document(s) that address the guidance in NUREG-0711 section 8.4.5, "HSI Detailed Design and Integration." The staff would like to verify the design guidance contained in MHI document(s) has been consistently applied. Please make the document(s) described above available to facilitate the staff's review of part 4 of MUAP-07007.

ANSWER:

The US Basic HSI Style Guide will be available for NRC audit by the first quarter of 2010. Based on the NRC-Industry meeting of March 24 on ISG-6, the NRC is evaluating the use of a share-point server to make audit documents electronically available to the NRC via the internet. MHI will follow the NRC's progress on this issue. If possible MHI will use a share-point server to improve the efficiency of the NRC's audit process.

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

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QUESTION NO. 18.0-89

Correction/Clarification of Report Content

Please address the following:

Pg. 14, Figure 4.0-2, item 18.6 – correct spelling of Reliability

Pg 30, section 4.4.2.a, 2nd full paragraph. Please verify the reference to item (2) is correct. Figure 4.4-1 labels the "Screen list menu" as item (C).

Pg 37, section 4.5.2.a. first bullet last sentence. "unusual" vs "unusually"

Pg 44, last sentence, "rate" vs "rating"

Pg 52, First-out or Fast-out? Both terms are used. The staff would like to verify the design guidance contained in MHI document(s) has been consistently applied.

Pg 55, Table 4.7-1, Priority V – "caution" vs "cautious"; Priority VI – "plant" vs "plat"

Pg 57, section 4.7.5, first sentence: "identifies" vs "identify, "deletes" vs "delete"

Pg 85, section 4.11.4. Third sentence doesn't make sense. Should "mean" be "mode"?

Pg. 92, section 5.1.1.1 iii – Are words missing from phrase, "defined as comparison with the current workload level"?

Pg 92, section 5.1.1.2, third bullet: Sentence doesn't make sense

Pg. 93, section 5.1.1.4, word(s) missing from the phrase, "comprise all operations..."?

Pg. 96, section 5.1.3, 3rd and 4th bullet – Is reference to figure 5.1-1 correct? Figure 5.1-2 appears to be more relevant.

Pg. 100, section 5.1.4, Bolding convention not followed.

Pg. 101, section 5.1.5 iii, second sentence is incomplete

Pg. 105, section 5.3, Sentence starting with "Therefore the focus..." – phrase in parenthesis appears to need the work "be" deleted. Japanese spelling is incorrect in next sentence.

Pg 175, appendix D, item 4.5.2: Please resolve the internal (MHI) comment that has been included in the third column.

ANSWER:

MHI will revise the topical report MUAP-07007 to include the following(changes are underlined):

Pg. 14, Figure 4.0-2, item 18.6
Human Reliability Analysis

Pg 30, section 4.4.2.a, 2nd full paragraph
Any operational displays can be also requested from a screen list menu display. (item (C) in the figure)

Pg 37, section 4.5.2.a. first bullet last sentence
The popup window can be moved by the operator in the unusual case that other information relevant to the operation may be hidden.

Pg 44, last sentence
Standard controls, indications and alarms for cascaded control functions, and controllers with additional features such as rate of change controls, are defined in the Component Control and Monitoring Circuit Basic Design Guide (Reference 43).

Pg 52, Figure 4.7-1 item (1)
(1) First-out Alarms display area
Each first-out alarm of "ECCS Actuation", "Reactor Trip", "Turbine Trip" and "Generator Trip" is displayed respectively.

Pg 55, Table 4.7-1, Priority V
Alarms concerning caution system monitoring (including partial trip)

Pg 55, Table 4.7-1, Priority VI
Alarms concerning plant maintenance

Pg 57, section 4.7.5, first sentence
'Acknowledging' means the operator identifies and confirms the individual new alarm concretely and 'Resetting' means the operator deletes the cleared alarms.

Pg 85, section 4.11.4, third sentence

The enabling of the DHP is governed by a procedure. The I&C systems design ensures priority is given to signals that maintain the safety functions. The operator uses procedures and the DHP to maintain the following safety functions, as a minimum:

Pg. 92, section 5.1.1.1 iii

The plant design and allocation of functions always provide operator vigilance and acceptable workload levels. Functional requirement analysis and Functional allocation address operator's significant monitoring parameters and controls, and task analysis ensures the minimum staffing can conduct operations within acceptable workload levels. Acceptability is determined by ensuring tasks can be accomplished within time and performance criteria, and by comparing workload levels to that of conventional plants.

Pg 92, section 5.1.1.2, third bullet

Human system interface requirements must be consistent with the control and instrumentation capabilities of the plant process systems (i.e. the process systems of the US-APWR or the process systems of operating plants for upgrades).

Pg. 93, section 5.1.1.4

The applicable HSIs, procedures, and training for the HFE Program encompass all operations and accident management, and maintenance, test, inspection and surveillance interfaces (including procedures) for safety significant equipment.

Pg. 96, section 5.1.3, 3rd and 4th bullet

Equipment design changes are conducted using the Review record sheet in accordance with the process flow shown in Figure 5.1-2.

Design team review of HFE products is conducted in accordance with the process flow shown in Figure 5.1-2.

Pg. 100, section 5.1.4

5.1.4 Human Factors Engineering Issues Tracking

Pg. 101, section 5.1.5 iii, second sentence

Dynamic graphic displays driven by high fidelity plant model simulators are used to validate the completely integrated HSI design. Verification activities, using static graphic displays are conducted prior to dynamic validation activities with high fidelity plant simulator models.

Pg. 105, section 5.3, Sentence starting with "Therefore the focus..."

Therefore the focus of this HFE effort is to identify any changes from historical practices (i.e., a detailed evaluation of unchanged practices is not be conducted).

[There are no misspellings in the next sentence.]

"Historical practices" refers to practices in Japanese PWRs which are essentially the same as practices in operating Westinghouse PWRs in the US. The FRA/FA will identify any differences in historical practices that are pertinent to the analysis.

Pg 175, appendix D, item 4.5.2, "Plant Specific HSI" column

Item a. Calling Up Switches

~~Design of specific displays with fixed controls, and the grouping of fixed controls set based on the phase 1 results is verified using task analysis None.~~

Item b. Controller and Mode Selector

Design of specific displays with fixed controls, and the grouping of fixed controls are based on task analysis.

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

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QUESTION NO. 18.0-90

Provide Milestones

Guidance: NUREG 0711 section 2.4.3(4) - HFE milestones should be identified so that evaluations of the effectiveness of the HFE effort can be made at critical check points and the relationship to the integrated plant sequence of events is shown. A relative program schedule of HFE tasks showing relationships between HFE elements and activities, products, and reviews should be available.

Section 5.1.3d indicates that Figure 5.1-3 shows milestones but the figure is designed to show the overall design process with feedback typical of an iterative process. There is not enough specificity in this figure to determine when a milestone is actually accomplished. Please provide milestones that clearly define the objective.

ANSWER:

The HFE milestone is provided in part 1 section 8 of the technical report MUAP-09019. The section 8 includes the high-level logic including the correlation between HFE elements. Figure 4.0-2 shows the schedule milestone of the documentation for the HFE elements.

The US-APWR MCR development is divided into three phases.

1. Phase 1 yields the generic US Basic HSIS.
2. Phase 2 combines the US-APWR Inventory with the US Basic HSIS to yield the generic US-APWR HSIS.
3. Phase 3 makes minor site specific changes to the US-APWR HSIS to yield a site specific HSIS.

Section 5.1.3d second sentence will be revised as follows:

A relative schedule of HFE tasks showing relationships between HFE elements and activities, products, and reviews is also shown in Figure 4.0-2. The Phased Implementation Plan for the complete HFE program is described in Appendix C.

For the remaining US-APWR program elements, additional milestone details will be provided in the program element implementation plans which will be submitted by April 30, 2010.

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

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QUESTION NO. 18.0-91

Simulator/Mockup Clarification

Appendix B of MUAP-07007, part a, second paragraph, contains the sentence, "In step II, "Dynamic Validation", a mockup control board was setup and actual plant situations were simulated iteratively using the plant simulator."

Please provide more detail on the following:

1. Is the plant simulator a full scope plant simulator? Is this the same simulator described in MUAP-08014 section 2.3.1 and 2.3.2?
2. What is a "mockup" control board? How is it different from what would be included within the definition of a "full scope" simulator?
3. Dynamic validation is in quotations potentially implying some limitation exists. If this is true please explain the limitation(s) specifically. Please make the comparison against what would be achieved with a dynamic validation on a full scope simulator.
4. MUAP-08014 section 2.3.3 describes a static portable HSI system analysis tool. Where is this tool used in the block diagram provided in MUAP-07007 Appendix B?

Please clarify the following areas of MUAP-07007, Appendix B, part b:

1. "...Plant specified full scale static mockup facility." Is this the same thing as a model (plywood, cardboard, etc.) of the control room?
2. "...PC based static VDU format navigation system." Please explain what this is. How do VDU formats interface with the navigation system when the VDU formats are static? How are scenarios interfaced with PC based VDU formats?

Was an integrated system validation using a full scope simulator completed for the Japanese HSI design?

ANSWER:

1. The plant simulator is a full scope simulator and same as simulator described in MUAP-08014.
2. The control board used for Step two was a full scale full fidelity control board. The sentence will be revised as follows:

In step II, "Dynamic Validation", a full scale full fidelity control board was setup (see Figure B-2) and actual plant situations were simulated iteratively using the plant simulator.

3. The scope of the dynamic validation included all equipment in the main control room. However, some limitation exists such as Diversity HSI Panel (DHP) and STA console because there was no regulatory requirement in Japan. The US-APWR Phase 2 validation will include all main control room facilities, including the DHP, data management consoles, plant communications facilities, backup paper procedures, etc.
4. The HSI system analysis tool is used for static design verification that is step1 of the appendix B.

Appendix B, part b:

1. Yes, "...Plant specified full scale static mockup facility." is same as a model made of plywood, cardboard etc.
2. "...PC based static VDU format navigation system." is same as the HSI system analysis tool. This tool does not interface to a dynamic plant model simulator. Therefore, the displays in this tool are static (i.e. there is no updating of process variables and component status, and no ability to control components). However, the navigational links between displays are fully functional.
3. An integrated system validation using a full scope simulator was completed for the Japanese HSI design during the Development Phase. As explained in part b, since the changes from the Development Phase to the Implementation Phase were small, V&V in the generic Implementation Phase was conducted using only static facilities. However, when the standard Japanese HSI was applied to Tomari Unit 3 and Ikata Unit 1 and 2 (they are now on the commercial operation), final V&V was conducted using the actual plant equipment, which was staged at the factory and stimulated with a high fidelity dynamic plant model.

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

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QUESTION NO. 18.0-92

Provide References

Phase 1 testing is specific to the US-Basic HSI design. It is described in MUAP-07007 appendix B and C, MUAP-08014 part a, and MUAP-09019 pages 19-23. The second two documents are not referenced in the Topical Report (MUAP-07007) but contain more complete descriptions of the process used.

1. Since the Topical Report will have its own SER, the staff believes that having all related material either included or referenced within the report will facilitate understanding and application of the report material. Please provide references within the Topical Report to the relevant parts of MUAP-08014 and MUAP-09019 or explain why these references are unnecessary.
2. MUAP-09019 section 4.1 states that the Basic HSI System is defined by MUAP-07007. MUAP-09019 section 4.4 states, "The HSI System described in Reference 0 section 4 [the staff believes this is MUAP-07007- reference numbers are inconsistent] is what MHI refers to as the US Basic HSI system. MUAP-07007 uses several terms:
 - Page 11, abstract refers to Basic HSI System
 - Page 22, section 1.0 refers to MHI HSI Design
 - Page 22, section 2.0 refers to HSI system design
 - Page 32, section 4.0 refers to MHI HSI system
 - Section 5.7.3 refers to US basic HSI design

This is only a sample. Between the 3 documents cited US Basic HSI design (or system) and Basic HSI design (or system) occur interchangeably but section 5.7.3 of MUAP-07007 indicates US operator feedback is used to develop the US Basic HSI system. Please address the following:

- Identify which terms are synonymous. Or preferably, edit documents so a minimum number of terms are used, each with a specific definition. This is requested to ensure clarity.

- Ensure the US Basic HSI system is consistently used as the title for the end product of the topical report. This includes references in MUAP-09019 and MUAP-08014. This is requested to ensure the HSI system configuration approved in the Topical Report SER is clearly identified.

ANSWER:

References to Technical Reports MUAP-08014 and MUAP-09019 will be added to the appropriate sections of MUAP-07007. Sections of these reports that are generically applicable to the US Basic HSI System will be referenced directly. Sections of these reports that are unique to the application of the US Basic HSI System to the US-APWR will be referenced and described as “typical for all applications of the US Basic HSI System”; subsequent applications of the US Basic HSI to other plants, will have similar documents.

MHI will revise the topical report to consistently refer to the “US Basic HSI System”. To avoid revising MUAP-08014 and MUAP-09019, the topical report will clarify that the terms “Basic HSI System” and “HSI System” in these reports are synonymous with “US Basic HSI System”. The topical report will also clarify that Reference 0 in Section 4.4 of MUAP-09019 should be Reference 11.1, which is MUAP-07007. If RAI responses lead to a revision of MUAP-08014 or MUAP-09019 for more substantial reasons, these inconsistencies/errors will be corrected.

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

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QUESTION NO. 18.0-93

Clarify Workload

Guidance: NUREG-0711 criterion 5.4(2): Detailed task descriptions should address (as appropriate) the topics listed in Table 5.1. Workload is included in this table.

MUAP-07007 section 5.1.1.1 iii) states: "...task analysis ensures the estimate staffing conduct operation within acceptable workload which is defined as comparison with the current workload level.

1. Is "as comparison" the desired wording? It does not appear to follow standard English convention. The staff would like to verify the design guidance contained in MHI document(s) has been consistently applied.

Please explain why the current workload is an acceptable standard.

ANSWER:

See the rewording of this section in the response to RAI 18.0-89 (Pg. 92, section 5.1.1.1 iii).

The operator workload is analyzed through the task analysis. For the US-APWR the workload analysis is provided in technical report MUAP-09019 Part 2. The workload analysis demonstrates that tasks can be accomplished within the time and performance acceptance criteria. Additionally, during V&V phase 1a (MUAP-08014) and 1b (MUAP-09019 Part 3), the physical and cognitive workload for the US Basic HSI System (applied to a typical 4-loop PWR) was evaluated by current nuclear power plant operators. These operators compared the workload to their operating experience in conventional plants. HEDs were captured where operators found the workload to be more challenging. The converging measures from the task analysis and V&V establish a diverse basis for overall workload acceptance.

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

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QUESTION NO. 18.0-94

Clarify Minimum Inventory

Guidance: ISG-05 Design Certification Applicants section 1A: Applicants for new plant design certification should include A description of the process used to develop the MCR and RSF minimum inventories of HSIs.

MUAP-07007 section 4.12 d, last paragraph states, "there is no specific process for identifying the minimum Class 1E HSI inventory."

Why is class 1E inventory being addressed as part of minimum inventory? This sentence appears to mix class 1E equipment qualifications with the concept of minimum inventory. Please clarify paragraph so that it cannot be interpreted as, "There is no specific process for identifying the minimum HSI inventory" (which would conflict with the previous paragraph)

ANSWER:

SECY-92-053 defines minimum inventory as the set of "**fixed** alarms, displays, and controls". MUAP-07007 addresses this through SDCV HSI. However, ISG-05 defines minimum inventory as the set of HSI "that the operator always needs available". Only Class 1E HSI can be considered "always available", since no other HSI meets the single failure, software quality and equipment qualification criteria, which ensure availability under all plant conditions. The following sentence will be revised as follows and will be relocated to the end of Section 4.12d, since it is applicable to all minimum inventory:

The design of the minimum inventory HSI (SDCV and Class 1E) is developed and evaluated through the HFE design process described in section 5.

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

This concludes MHI's responses to the NRC's RAIs.