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July 9, 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-10197

Subject: MHI's Responses to US-APWR DCD RAI No. 594 COLP-4429 REVISION 0

Reference: 1) "Request for Additional Information No. 594 COLP 4429 REVISION 0, SRP Section: 18 - Human Factors Engineering, Application Section: 18.3" dated June 8, 2010.

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. 594 COLP-4429 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,

Y. Ogata

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

Enclosure:

1. Responses to Request for Additional Information No. 594 COLP-4429 REVISION 0

D081
NRO

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

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Enclosure 1

UAP-HF-10197
Docket No. 52-021

Responses to Request for Additional Information No. 594 COLP-4429
REVISION 0

July 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

7/9/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 594 COLP 4429 REVISION 0**
SRP SECTION:	**18 - HUMAN FACTORS ENGINEERING**
APPLICATION SECTION:	**18.3 FUNCTIONAL REQUIREMENTS ANALYSIS AND FUNCTION ALLOCATION**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO. 18-69

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted." Additionally, NUREG-0711Criterion 1 states,

(1) Functional requirements analysis and function allocation should be performed using a structured, documented methodology reflecting HFE principles. The functional requirements analysis and function allocation may be graded based on:

- The degree to which functions of the new design differ from those of the predecessor
- The extent to which difficulties related to plant functions were identified in the plant's operating experience and will be addressed in the new design.

In the case of MHI's submittal of the functional requirements analysis (FRA) and function allocation (FA) portion of the Human Factors Engineering Program for the US-APWR design, overall, the staff does not have sufficient information to determine that the function requirements analysis and function allocation (FRA/FA) that supports the design was performed using an acceptable structured, documented methodology incorporating HFE principles. Therefore, 10 CFR 52.47 and the NUREG-0711 criterion have not been satisfactorily addressed for this aspect of the US-APWR design. MHI should provide a level of detail commensurate with an implementation plan for all NUREG-0711 FRA/FA criteria except the following: 2 (related to keeping the FRA/FA current over the design life cycle); 3 (related to description of functions and systems); 6 (related to documenting the FA technical basis); and 7 (related to FA modifications). As an example, the staff considers the following general level of detail characteristics that an implementation plan should contain, at a minimum:

- The implementation plan methodology is complete; i.e., the

scope, inputs, analyses to be performed, outputs, and documentation are described in the plan.

- The methodology is described in a step-by-step format. This level of detail supports the determination that design personnel can reliably use the implementation plan and that consistent results will be achieved by knowledgeable engineering personnel.
- The methodology is "executable," i.e., a) applying the methodology
- leads to results that the staff can review using NUREG-0711, Rev. 2, criteria and, b) the methodology provides sufficient description of the quality standards that products will meet and,
- The methodology can be used to provide acceptance criteria for verifying ITAAC completion.

The MHI US-APWR application needs to be revised to reflect the applicant's response to this question.

Note: Questions following are exemplars of why the MHI FRA/FA implementation plan methodology is incomplete.

ANSWER:

For the answer regarding NUREG-0711 criterion 4, 5 and 8, please refer to the answer to RAI No. 18-70 to 73.

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. 18-70

NUREG-0711, criterion 4 states,

> (4) A description should be provided for each high-level function which includes:
>
> - purpose of the high-level function
> - conditions that indicate that the high-level function is needed
> - parameters that indicate that the high-level function is available
> - parameters that indicate the high-level function is operating (e.g., flow indication)
> - parameters that indicate the high-level function is achieving its purpose (e.g., reactor vessel level returning to normal)
> - parameters that indicate that operation of the high-level function can or should be terminated
>
> Note that parameters may be described qualitatively (e.g., high or low). Specific data values or setpoints are not necessary at this stage.

The DCD, Section 18.3.3indicates that a description is provided for each high-level function that includes, specifically, the six items of NUREG-0711 criterion 4. The Technical Report (MUAP-090019), Section 1.4.1, acknowledges that a functional requirements analysis determines that each high-level function should be described to include the six items stated in the above NUREG-0711 criterion. Figure 1.4-2 of the Technical Report also provides a graphical depiction of the MHI (US-APWR) functional requirements hierarchy. MHI indicates that the Figure is associated with Appendix 1.8.1 of the Technical Report, which provides the results of the functional requirements analysis for each of the high-level functions of the MHI design. The Appendix provides an assessment of essential plant functions using several criteria (e.g., plant system,

parameter of concern, parameter response time, actions needed to return the parameter to its acceptable state). However, the staff's review of Appendix 1.8.1 determined that the Appendix does not address all of the six items in the criterion above. For example, the Appendix does not provide parameters that indicate that the high-level function is available or parameters that indicate the high-level function is achieving its purpose. Please explain how Appendix 1.8.1 addresses the six items in the above NUREG-0711 criterion or why the Appendix does not address the item. Also, please clarify the statement made in DCD Section 18.3.3 that, "A description is provided for each highlevel function and includes the following [the six items of the NUREG-0711 criterion]...." Where is the description provided?

MHI's application for the US-APWR needs to reflect the response to this RAI.

ANSWER:

The purpose of high-level function is included in the title of the table "Function" in Appendix 1.8.1. The reference document of each functions are included in "Source Document ID" column and "Comments and Details" column in Appendix 1.8.1. The "Source Document ID" shows relevant DCD documents. (See Table 1.8.2 FRA Information Sources) The "parameter" column includes the parameter of concern (temperature, pressure, flow, reactivity, vibration) that indicates availability (commercial generation of electricity) or safety (fission product boundary) may be degraded (not optimal) or lost. The "Operating Conditions" shows the operating conditions, as described in the associated reference to which this system/parameter/action applies. However, MHI will revise the MUAP-09019 Part 2 Appendix 1.8.1 to associate the conditions and parameters for each of the 14 US-APWR functions with the NUREG criteria clearly.

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. 18-71

In accordance with NUREG-0711, criterion 5, The technical basis for modifications to high-level functions in the new design (compared to the predecessor design) should be documented.

MHI's submittal of the functional requirements analysis (FRA) and function allocation (FA) portion of the Human Factors Engineering Program for the US-APWR design does not satisfactorily address this NUREG-0711 criterion. The MHI Technical Report (MUAP−09019, Rev 0, states in sub-section 1.2, "The details of the technical basis for modifications to high-level functions in the new design (compared to the predecessor design) as stated in Reference 1.7.1-1 Subsection 18.3.3, [DCD] are documented." The Technical Report (MUAP-09019), in Section 1.4.1 (and DCD in sub-section 18.3.3 and Topical Report in Section 5.3), indicates that there are two changes from conventional PWR plant functions, the use of automatic emergency feedwater isolation of a faulted steam generator and the elimination of recirculation of the ECCS and Spray. DCD subsection 18.3 provides an explanation of these changes. The DCD states that, "A detailed description of differences in high-level functions, and the technical basis, between the current Japanese PWR design and the US-APWR design is provided in the Technical Report (MUAP-07007)." However, the staff was unable to identify the "detailed description of differences..." in the Technical Report (MUAP-09019). Please clarify where in the Technical Report the "detailed description of differences in high-level functions, and the technical basis, between the current Japanese PWR design and the US-APWR design" exists or provide the descriptions.

ANSWER:

There are no differences in high level functions. The following description is described in part 2 section 1.4.1 Function Requirement Analysis in the Technical Report MUAP-09019:

"The objectives (goals), goal statements, and functions of US-APWR are the same as the previous FRA for conventional PWR that are depicted in Figure 1.4-2 and listed in Appendix 1.8.1.
The only changes from the convention PWR plant's functions are;
- An automatic Emergency Feedwater isolation of the broken SG.
- Elimination of recirculation of ECCS and Spray
Although the following major system configuration changes exist, they do not affect plant function change;
- Four train system configuration (Contribute for high reliability, redundancy)
- Advanced steam generators and accumulators, other improved design equipment, gas turbine generator for backup system
(Improved design but the function to support higher-level is the same.)"

Since there are no significant changes between conventional PWR and US-APWR during conducting FRA, the detail description is not provided.

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. 18-72

In accordance with NUREG-0711 criterion 8, The allocation analysis should consider not only the primary allocations to personnel, but also their responsibilities to monitor automatic functions and to assume manual control in the event of an automatic system failure.

MHI's submittal of the functional requirements analysis (FRA) and function allocation (FA) portion of the Human Factors Engineering Program for the US-APWR design does not satisfactorily address this NUREG-0711 criterion for the US-APWR design. The DCD, sub-section 18.3.2.2 and the Technical Report (MUAP-09019), Section 1.4.2, state that, "The function allocation analysis considers not only the primary allocations to personnel, but also their responsibilities to monitor automatic functions and to assume manual control in the event of an automatic system failure." While the DCD and Technical Report (MUAP-09019) acknowledge that the FA considers not only the primary allocations to personnel, but also their responsibilities to monitor automatic functions and to assume manual control in the event of an automatic system failure, neither document explains how the MHI FA accomplishes this criterion. MHI provides some explanation of conducting a function allocation analysis in Section 1.4.2 of the Technical Report (and provides related results in Appendix 1.8.4). However, MHI does not relate the results to a method or process that demonstrates how the FA analysis addresses the primary allocations to personnel and their responsibilities to monitor automatic functions and to assume manual control in the event of an automatic system failure. MHI should explain the process MHI uses in the US-APWR FA to consider not only the primary allocations to personnel, but also their responsibilities to monitor automatic functions and to assume manual control in the event of an automatic system failure.

MHI's application for the US-APWR design needs to reflect the response to this RAI.

ANSWER:

The US-APWR applies redundant system for Plant Control and Monitoring System (PCMS) with digital technologies, that has enough reliability, as describe in the DCD Section 7.7.
Within the US-APWR control system "manual" control and "automatic" control are different modes or methods for the operator to control the plant. The manual control is not a failure backup for automatic control. Failure backup is provided by controller internal redundancy. Therefore, both the manual control mode and the automatic control mode are available to the operator all the time. If for some reason an alarm is initiated during the automation, operator identifies the cause and takes the controller to "manual" mode as needed. The controller used for automation is described in topical report MUAP-07007 Section 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

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QUESTION NO. 18-73

In accordance with NUREG-0711 criterion 9, a description of the integrated personnel role across functions and systems should be provided in terms of personnel responsibility and level of automation.

MHI's submittal of the functional requirements analysis (FRA) and function allocation (FA) portion of the Human Factors Engineering Program for the US-APWR design does not satisfactorily address this NUREG-0711 criterion for the US-APWR design. The Technical Report (MUAP-09019), Section 1.4.3, states that the results of the functional requirements analysis and function allocation are documented in the 1.8. Appendices to the Report and that, from Appendices 1.8.4 and 1.8.5 descriptions of the integrated personnel role across functions and systems is provided in terms of personnel responsibility and level of automation can be obtained. The staff has reviewed the Appendices and cannot determine how this criterion is addressed by either MHI's process description or the results portion of the report. As well, Technical Report (MUAP-09019) does not contain an Appendix 1.8.5. Please clarify and explain the discrepancy.

MHI's application for the US-APWR design needs to reflect the response to this RAI if information has been omitted.

ANSWER:

The tables of page 86 to 90 of MUAP-09019 were intended to be represented as Appendix 1.8.5, but the title is missing. MHI will correct and append the title "Appendix 1.8.5" to the above pages.
The Appendix 1.8.5 shows the evaluation of function allocation for each of the 14 US-APWR functions. And MUAP-09019 will be revised at the same timing of the next DCD revision, and reflect Staff's comment to address descriptions of the integrated personnel role across functions and systems is provided in terms of personnel responsibility and

level of automation in Appendix 1.8.5.

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

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QUESTION NO. 18-74

In accordance with NUREG-0711 criterion 10, the functional requirements analysis and function allocation should be verified such that: 1)all the high-level functions necessary for the achievement of safe operation are identified, 2) all requirements of each high level function are identified, 3) the allocations of functions result in a coherent role for plant personnel.

The staff has reviewed applicable sections related to FRA/FA in the DCD, Topical Report (MUAP-07007), and Technical Report (MUAP-09019), and determined that these documents do not address this criterion nor provide reference to another section of the DCD or other documents that addresses this criterion. MHI, however, in the "US-APWR HFE Program NUREG-0711 Compliance Roadmap" (MUAP-09024, Revision 0) indicates that verification of FRA/FA "will be included in [a] revision of technical report MUAP-09009-P, R0)." For the MHI US-APWR design certification review, the staff interprets the statement in MUAP-09024 as an MHI commitment to verify the FRA/FA as intended by the NUREG-0711 criterion in a subsequent revision to the Technical Report that will be submitted to the staff for review and approval prior to design certification. Therefore, this is a **Confirmatory Item.**

The MHI US-APWR application needs to be revised to reflect the response to this RAI.

ANSWER:

MHI will revise MUAP-09019 to reflect all the RAIs NO. 594 COLP 4429 REVISION 0 to comply all the criteria of NUREG-0711. MUAP-09019 will be revised at the same timing of the next DCD revision.

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. 18-75

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG-0711 criteria, the staff has the following technical questions which are related to the DCD and the Topical Report. An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) Please clarify the following statements in DCD sub-section 18.3.2.1: Detailed guidance on the analytical methodology used is provided in Reference 18.3-1, Appendix A.3. Additional detailed information on function allocation is focused in Reference 18.3-2 to supplement Reference 18.3-1, as required. Reference 18.3-3, Subsection 5.3.2, provides the criteria that Mitsubishi Heavy Industries, Ltd. (MHI) employed in determining function allocation for the reference plants. Specifically, how did MHI use the "detailed guidance" from Reference 18.3-1 (IEC 964) to develop the FRA/FA for the US-APWR?

2) Also in the DCD, what is meant by the sentence, "Additional detailed information on function allocation is focused in Reference 18.3-2 to supplement Reference 18.3-1, as required?

3) In addition, MHI states that the Topical Report (Reference 18.3-3, Subsection 5.3.2) "provides the criteria that Mitsubishi Heavy Industries, Ltd. (MHI) employed in determining function allocation for the reference plants." Did MHI use the same criteria for the US-APWR? Also, in the context of the sentence (i.e., the sub-section is related to

functional requirements analysis), does MHI mean "function allocation" or, "functional requirements analysis?"

The MHI application for the US-APWR needs to be revised to reflect the responses to these questions.

ANSWER:

1) MHI used the IEC 964 as an informative guidance to develop the FRA/FA in addition to NUREG-0711 guidance. For example, identification of the functions on the functional analysis, the goal of the function (safety and availability) and the sub-goals described in IEC 964 standard are referred to develop the FRA.

2) MHI used the NUREG/CR-3331 as an informative guidance to develop the FRA/FA in addition to NUREG-0711 guidance. The examples MHI used are described in the answer to the RAI 18-84.

3) MHI uses the same criteria for the US-APWR. Section 5.3.2 of the Topical Report MUAP-07007 is related to function allocation.

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. 18-76

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG-0711 criteria, the staff has the following technical question which is related to the DCD.
An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) Please clarify the following: DCD page 18.3-4, MHI makes the statement, "The functional details are described in the FRA/ FA report." What is "the FRA/ FA report?"

ANSWER:

The FRA/FA result summary report is included in technical report MUAP-09019 Part 2 Section 1.

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. 18-77

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG-0711 criteria, the staff has the following technical question which is related to the Topical Report. An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) Please clarify which report is being cited in the following sentence contained in Topical Report MUAP-07007, Section 5.3, "The function analysis and allocation report will document the function allocation for major plant functions, with the primary focus on functions of safety significance."

MHI's application for the US-APWR design needs to be revised to reflect the response to this RAI.

ANSWER:

The function analysis and allocation report cited in Topical Report MUAP-07007 Section 5.3 is Technical Report MUAP-09019 Part 2 Section 1.

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. 18-78

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG-0711 criteria, the staff has the following technical question which is related to the Topical Report. An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) In Figure 5.3-1 of Topical Report MUAP-07007, please explain how this figure was derived.

ANSWER:

The Functional Requirements Hierarchical Structure is a structure of functional requirements that are demanded by the power plant such that the plant will achieve its planned / desired functions of 'generating electricity' and 'protect the health and safety of the public', which is derived from the US-APWR plant design.

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. 18-79

In accordance with 10 CFR 52. 47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG-0711 criteria, the staff has the following technical question which is related to the Topical Report. An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) Please clarify the meaning of the following sentence in sub-section 5.3.2.2 of Topical Report MUAP-07007, as it appears incomplete: "Particular operating demands (Other case by case criteria for automation)."

MHI's application for the US-APWR design needs to be revised to reflect the response to this RAI.

ANSWER:

Section 5.3.2.2 first paragraph last sentence of the topical report MUAP-07007 will be deleted as follows (changes are underlined):

If line-up of mechanical systems is not considered to be on the critical path for plant start-up, there is no impact on plant operation, and there are no complicated links between the different line-up actions, the corresponding actions are generally not automated. ~~Particular operating demands (Other case by case criteria for automation)~~

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. 18-80

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG-0711 criteria, the staff has the following technical question which is related to the Technical Report. An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) Please clarify in Technical Report MUAP-09019: Part 2 HFE Analysis (Phase 2a), Section 1.1 states, "The purpose of this document [the Technical Report] is to describe the procedure for how the FRA/FA will be conducted and the results for the US-APWR, using the structured and documented methodology contained herein, that reflects human factors principles to meet the final goal." If, as stated, the purpose of the document is to describe the procedure for how the FRA/FA will be conducted (and the results for the US-APWR), the staff interprets this statement to mean that the US-APWR FRA/FA has not been performed. As well, if the FRA/FA for the US-APWR has not been performed, how can the document contain the "results for the US-APWR" FRA/FA? Please reconcile these discrepancies. [The staff notes that the same theme carries through in Section 1.2, which states that, "A FRA/FA process was conducted previously for the development of the standard Japanese Human System Interface (HSI) System. The FRA/FA for the US-APWR <u>will be based</u> [emphasis added] on that performed for the Japanese APWR design, and <u>will include</u> [emphasis added] analyses to address differences in the US-APWR design from the predecessor plant." Again, the staff interprets this statement to mean that MHI will (sometime in the future) base the FRA/FA for the US-APWR on the methodology that the Japanese previously used for the Japanese (i.e., reference)

plants.]

ANSWER:

Part 2 Section 1.1 second sentence will be revised to include the following (changes are underlined):

The purpose of this document is to describe the procedure for how the FRA/FA was ~~will be~~ conducted and the results for the US-APWR, using the structured and documented methodology contained herein, that reflects human factors principles to meet the final goal.

Part 2 Section 1.2 second paragraph second sentence will be revised to include the following (changes are underlined):

The FRA/FA for the US-APWR was ~~will be~~ based on that performed for the Japanese APWR design, and ~~will~~ includes analyses to address differences in the US-APWR design from the predecessor plant.

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

7/9/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 594 COLP 4429 REVISION 0**
SRP SECTION:	**18 - HUMAN FACTORS ENGINEERING**
APPLICATION SECTION:	**18.3 FUNCTIONAL REQUIREMENTS ANALYSIS AND FUNCTION ALLOCATION**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO. 18-81

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG-0711 criteria, the staff has the following technical question which is related to the Technical Report. An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) Please clarify where Appendix 1.8.5 is located in the Technical Report, MUAP-09019. Figure 1.4-1 refers to it but it does not appear in the Appendix.

MHI's application for the US-APWR design needs to be revised to reflect the response to this RAI.

ANSWER:

Please see the answer to RAI NO. 18-73.

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

7/9/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 594 COLP 4429 REVISION 0**
SRP SECTION:	**18 - HUMAN FACTORS ENGINEERING**
APPLICATION SECTION:	**18.3 FUNCTIONAL REQUIREMENTS ANALYSIS AND FUNCTION ALLOCATION**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO. 18-82

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG-0711 criteria, the staff has the following technical question which is related to the Technical Report. An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) Technical Report MUAP-09019, Figure 1.4.1 identifies the FRA/FA report as "Final Output." Please clarify what this report is and where and when it is available to the staff.

ANSWER:

The FRA/FA result summary report consists of Part 2 Section 1.1 through 1.8 of the technical report MUAP-09019. So, the "Final Output" corresponds to Part 2 Section 1 of the technical report, Revision 0 of which was submitted to the staff in June 2009.

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

7/9/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 594 COLP 4429 REVISION 0**
SRP SECTION:	**18 - HUMAN FACTORS ENGINEERING**
APPLICATION SECTION:	**18.3 FUNCTIONAL REQUIREMENTS ANALYSIS AND FUNCTION ALLOCATION**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO. 18-83

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG−0711 criteria, the staff has the following technical question which is related to the Technical Report. An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) Part 2, Section 1.4 of Technical Report MUAP-09019 states, "The methodology for performing the FRA/FA and documentation to support the HFE analyses are described in this section. This methodology is based on that provided in References 1.7.1-2. Please explain how the methodologies used by MHI to develop and perform the FRA/FA for the US-APWR are based on these references. Examples of the specific use of these references are requested.

MHI's application for the US-APWR design needs to be revised to reflect the response to this RAI.

ANSWER:

MHI referred NUREG/CR-3331 as guidance to approach methods following contents shown in the NUREG report;

2.1 Defining Allocations of Control Functions
2.2 The Design Process

2.3 The System Approach
2.4 Defining Functions
2.5 The Multivariative Setting
2.6 Information Setting and Information Processing Behavior
2.9 The Role of a Man
2.10 The progression of Allocation Function

The table contents of page 86 to 90 of MUAP-09019 does not exactly corresponds to above described sections, but MHI considered that it is useful to define contents of the table.

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

7/9/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 594 COLP 4429 REVISION 0**
SRP SECTION:	**18 - HUMAN FACTORS ENGINEERING**
APPLICATION SECTION:	**18.3 FUNCTIONAL REQUIREMENTS ANALYSIS AND FUNCTION ALLOCATION**
DATE OF RAI ISSUE:	**6/8/2010**

QUESTION NO. 18-84

In accordance with 10 CFR 52.47, "The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted."

In addition to the questions the staff asked that were directly related to specific NUREG-0711 criteria, the staff has the following technical question which is related to the Technical Report. An acceptable response to the question will help assure that the MHI application contains a level of design information sufficient to allow the staff to judge MHI's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted:

1) Part 2, Section 1.4 of Technical Report MUAP-09019 states, "Since the Japanese HSI System forms the basis of the US-APWR HSI System, the US-APWR FRA/FA documentation shall include a summary description of the Japanese FRA/FA process, and the significant findings from the Japanese FRA/FA that influenced the design of the Japanese HSI System." Please identify where the summary description of the Japanese FRA/FA process is located in the documents submitted to the staff for review.

ANSWER:

The summary description of the Japanese HFE process is included in the MHI submittal document UAP-HF-09020 dated January 28, 2009.
According to the UAP-HF-09020 Enclosure 1, "1. PWR Plant Critical Function Hierarchy Analysis", MHI identified availability goal four sub-goals in a predecessor plant;

- Bring the plant to each operational power stage (i.e., Cold shut down, Hot shut down and each output power stage)
- Control nuclear heat and steam supply according to electrical power demand

- Convert nuclear heat and steam supply to electrical power with practicable efficiency and availability
- Conduct refueling

And Essential critical functions to support maintaining the barrier integrity are identified as follows;

- Reactivity control
- Reactor coolant inventory control
- Reactor coolant system integrity control
- Core heat removal control
- Heat sink control

The same approach is conducted in MUAP-09019 in accordance with the US-APWR design and NUREG-0711 criteria.

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