

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

### APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: 196-8164  
SRP Section: 18 – Human Factors Engineering  
Application Section: 18.1, HFE Program Plan  
Date of RAI Issue: 09/02/2015

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### **Question No. 18-24**

Title 10, Section 50.34(f)(2)(iii) requires that a reactor design applicant provide a control room design that reflects state-of-the-art human factor principles prior to committing to fabrication...control room panels and layouts. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 18, "Human Factors Engineering," provides guidance for NRC staff to perform a review of the human factors engineering design portion of a reactor design. NUREG-0711, provides additional details, including detailing the review criteria to assist the staff in performing its design review.

NUREG-0711, Rev. 3, Section 2.4.3, criterion 2, "Process Management Tools," indicates that applicants should identify tools and techniques for verifying that the HFE team fulfills their responsibilities. The document APR1400-E-I-NR-14001, "Human Factors Engineering Program Plan," (HFE PP), Section 4.4.2.3, "Process Management Tools," identifies the Information Tracking System (ITS) and Review and Comment system as two tools used to management the HFE process, however, several questions remain regarding how these systems will be used. Additional information is necessary regarding the processes used to ensure that the HFE team adequately fulfills their responsibilities.

#### 1. Clarification of use of Review and Comment System

Appendix A of the HFE PP indicates that Section 4.4.2.3 should have the information necessary to fulfill this criterion. A review of this section has identified two tools used for process management: the review and comment system and the issue tracking system (ITS). Additional information is needed regarding how the Review and Comment System is used to fulfill this criterion.

Please provide additional information about how the review and comment system is to be used. Specifically include descriptions about:

- Any processes used to review comments and opinions entered in the review and comment system
- Any processes used to resolve comments and opinions entered in the review and comment system
- Any interactions between the review and comment system, the ITS, and the Corrective Action Program

## **Response**

APR 1400 design drawings and documents are issued through an interdepartmental design review process using the review and comment system.

Documents prepared by responsible engineers are registered in the review and comment system, and the comments and opinions of personnel in the responsible department and interfacing departments are resolved and incorporated. The final version of drawings and documents are distributed to the applicable departments. This process is tracked and stored by the review and comment system, and also by hard copy.

The review and comment system ensures the quality of products by using the integrated system that ensures the interdisciplinary review, comment resolution, document quality review by quality group, storage of the document, and tracking of the comment and resolution.

### **1. Issuing Process of Design Documentation**

- Preparation and Registration

The responsible engineer prepares drawings and documents and registers them in the review and comment system.

- Design Review Request

The responsible engineer requests an interface review using a Document Review Notice. The responsible group leader and supervisor review the appropriateness of documentation before signing and distribution for interface review. This process is tracked by the review and comment system, and hard copies are also distributed if necessary.

- Interface Review

The reviewing department reviews the suitability of the documentation, prepares the review results, and then returns the documentation to the responsible department, possibly with signatures and dates. If there are no comments, the reviewer is to indicate there are no comments by signing and dating the documentation. If there are comments, the reviewer records the comments regarding the subject documentation. The group leader of the reviewing department then reviews the reviewer's comments to ensure they are indicated clearly, are of sufficient detail, and are based on up-to-date information and data. The group supervisor of the reviewing department then checks the adequacy of the

comments and review results. The group supervisor of the reviewing department then signs the subject documentation and returns the review results to the responsible group supervisor. A meeting may be held to mutually resolve comments. In this case, meeting minutes are prepared and appropriate actions are taken in a timely manner.

- Resolution of Comments

The responsible group supervisor is responsible for resolving the comments and determining whether the comments are incorporated into the drawings and documents. After resolution and incorporation of comments, the responsible engineer obtains the consent signature of the reviewer. The responsible group supervisor confirms that all comments have been resolved and incorporated into the design documents, and then signs the Design Review Notice. Revisions to major drawings and documents requiring approval by the department manager are verified by the quality engineering group after completion of all reviews.

After completion of all reviews and confirmations, authorized personnel approve the drawings and documents in accordance with appropriate procedures.

- Storage of Review Results

The original Design Review Notice is retained and maintained. The responsible group supervisor dispatches all review results to the drawing and document control center. The review results are stored on electronic media.

## 2. Interaction between Review and Comment System, ITS, Corrective Action Program

The Review and Comment System, ITS, and Corrective Action Program are similar systems in the fact that they are implemented to reduce errors and to improve the quality of design documents. However, there are no interactions between the three programs, since each performs its own role as follows:

- Review and Comment System

The review and comment system allows the designers and independent reviewers to make comments and document opinions on the Human System Interface design and system design documents.

- Issue Tracking System (ITS)

The ITS is used to track Human Engineering Discrepancies (HEDs) that are identified throughout the life cycle of the HFE design process, including design resolution and HED closure. The ITS enables the review, documentation and tracking of human factors issues among the design groups. The ITS and the HED process are used throughout the design process and continues through the first fuel loading. The ITS is used as a mechanism for design coordination and communication.

- Corrective Action Program (CAP)

The Corrective Action Program is to identify and correct conditions adverse to quality associated with the project, and it provides resolution plans for Condition Reports which are initiated, evaluated, analyzed, trended, and closed.

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**Impact on DCD**

There is no impact on the DCD.

**Impact on PRA**

There is no impact on the PRA.

**Impact on Technical Specifications**

There is no impact on the Technical Specifications.

**Impact on Technical/Topical/Environmental Reports**

Technical Report APR1400-E-I-NR-14001-P/NP, Rev.0, "Human Factors Engineering Program Plan", Subsection 4.4.2.3 will be revised as indicated on the attached markup.

- The final HSI design is verified and validated
- The as-built design is to ensure that it is the same as the V&V program

Once an element of the HFE program is closed, as marked by the ReSR, further design changes are implemented through the HED process and the design implementation processes.

#### 4.4.2.3 Process Management Tools

Process management tools are used in the development of the HSI design facilitates communication across design disciplines and organizations to enhance consistency and efficiency. The tools are the review and comment system and the ITS.

The review and comment system allows the designers and independent reviewers to make comments and document opinions on the HSI design and design documents. HEDs are used throughout all of the elements of the HFE program to document, track, and close issues identified during the development of the HFE design. HEDs are tracked using the ITS.



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The review and comment system ensures the quality of products by using the integrated system that ensures the interdisciplinary review, comment resolution, document quality review by quality group, storage of the document, and tracking of the comment and resolution.

#### Issuing Process of Design Documentation

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The responsible engineer prepares drawings and documents and registers them in the review and comment system.

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### **Question No. 18-25**

#### 2. Problems with Names of Documents

Title 10 of the Code of Federal Regulations, Part 52.6 requires that licensees provide complete and accurate information. During the June audit of the Engineering Procedures Manual (EPM), staff identified that the name of this document is inaccurate in the Chapter 18 DCD materials (it is referred to as the Project Procedure Manual (PPM)). This was specifically identified in the HFE Program Plan implementation plan; however, this error may occur in other docketed material as well. This document will be cited in the staff's safety evaluation, and it must have accurate references so that subsequent audits/inspections can be conducted.

Please update references accordingly so that future auditors/inspectors can find the accurate referenced information.

### **Response**

PPM is incorrectly referenced in the DCD and in the HFEPP. Since the HFE design process is included in the HFEPP and the Quality Assurance Manual (QAM), all references to the PPM are to be removed and new references to the QAM or the HFEPP are to be made.

Chapter 18 of the DCD and the HFEPP Implementation Plan will be updated as shown in the attachments associated with this response.

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### **Impact on DCD**

APR1400 DCD, Tier 2, Subsection 18.1.3.1 and 18.1.3.6 will be revised as indicated on the attached markup.

**Impact on PRA**

There is no impact on the PRA.

**Impact on Technical Specifications**

There is no impact on the Technical Specifications.

**Impact on Technical/Topical/Environmental Reports**

Technical Report APR1400-E-I-NR-14001-P/NP, Rev.0, "Human Factors Engineering Program Plan", Subsection 4.3.4, 4.4.2.1, 4.5 and 7 will be revised as indicated on the attached markup.



## APR1400 DCD TIER 2

18.1.2.4 HFE Design Team Staffing

The minimum qualifications and job descriptions of the members of the HFE design team, including the documentation of the qualifications and job descriptions, meet the requirements of ~~Section 4.0 of the Project Procedures Manual (Reference 6), and~~ Section 5 of the HFEPP.

18.1.3 HFE Design Process18.1.3.1 General Process Procedures

The HFE design team executes its responsibilities according to the following:

- a. The HFE management and design decision processes are described in Section 4.4 of the HFEPP. HFE activities are assigned to the cognizant engineering group, and each group assigns the activities to individual members.
- b. ~~The design processes for the internal management of the team and HSI design changes are described in the Project Procedures Manual.~~

The design review process for HFE products is shown in Figure 18.1-3.

18.1.3.2 Process Management Tools

Process management tools are provided to facilitate communication across design teams and to enhance consistency and efficiency. The review and comment system, the ITS for HEDs, and HFE design team meetings are three process management tools for the development of HFE designs.

The review and comment system is used by designers and reviewers to provide comments and opinions on the HSI design and design documents.

The ITS is used to track design issues as HEDs identified during the HFE design and V&V process and to communicate HFE issues between design groups.

The HFE design processes are described in Section 4.4.2 and HSI design change processes are described in Section 4.4.2.1 of the HFEPP.

## APR1400 DCD TIER 2

- b. Operating experience review (OER) IP and ReSR
- c. Functional requirements analysis and functional allocation (FRA/FA) IP and ReSR
- d. Task analysis (TA) IP and ReSR
- e. Staffing and qualifications (S&Q) IP and ReSR
- f. Treatment of important human actions (TIHA) IP and ReSR
- g. HSI design (HD) IP and ReSR
- h. Human factors verification and validation (V&V) IP and ReSR
- i. Design implementation (DI) IP and ReSR

The review and comment system maintains the preceding documents and makes them accessible to designers and reviewers.

#### 18.1.3.6 Subcontractor HFE Efforts

~~HFE requirements are included in subcontracts to support the HFE design. Subcontractor compliance with HFE requirements is demonstrated in the procurement specifications of the HSI system.~~

~~Procurement specifications for HFE design requirements and a style guide are provided to the subcontractor in a standard appendix. Subcontractor management is described in the Project Procedures Manual.~~

#### 18.1.4 Tracking of HFE Issues

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The ITS receives inputs from the OER and issues that are identified during the analysis, design development, and V&V. The HEDs are included in the ITS.

The HFE design team is responsible for issue logging, tracking, and resolution processes. For each issue entered into the database, cognizant engineers are assigned to resolve the

Procurement specifications that contain HFE design requirements are provided to the subcontractor with the Style Guide as a standard appendix form to enforce HFE practices are considered. Subcontractor compliance with the HFE requirements and the Style Guide is reviewed and verified by the QAP.



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#### 4.3.4 Human Factors Engineering Organizational Staffing

The minimum qualifications of the HFE program design team, including the related organizational staffing for the HFE design team on APR 1400 design, are described in Section 5 of this document ~~and in APR1400 DC Project Procedure Manual (PPM) (Reference 12)~~. Section 5 of each IP describes the activities of the element's team.

#### 4.4 Human Factors Engineering Design Process and Procedures

This section describes the process and procedures that are implemented for effective management of HFE design activities. The HFE design process and procedures are developed to ensure that HFE principles and guidelines are successfully applied to the HSI design.

##### 4.4.1 Human Factors Engineering Program Milestones, Schedule and Duration

The HFE design team leader uses HFE milestones to identify problem and evaluate the HFE effort using critical checkpoints related to the integrated plant in the sequence of events shown in Figure 4-2. The schedule for HFE program tasks indicates the temporal relationships among HFE elements. The schedule for the HFE program is shown in Figure 4-2.

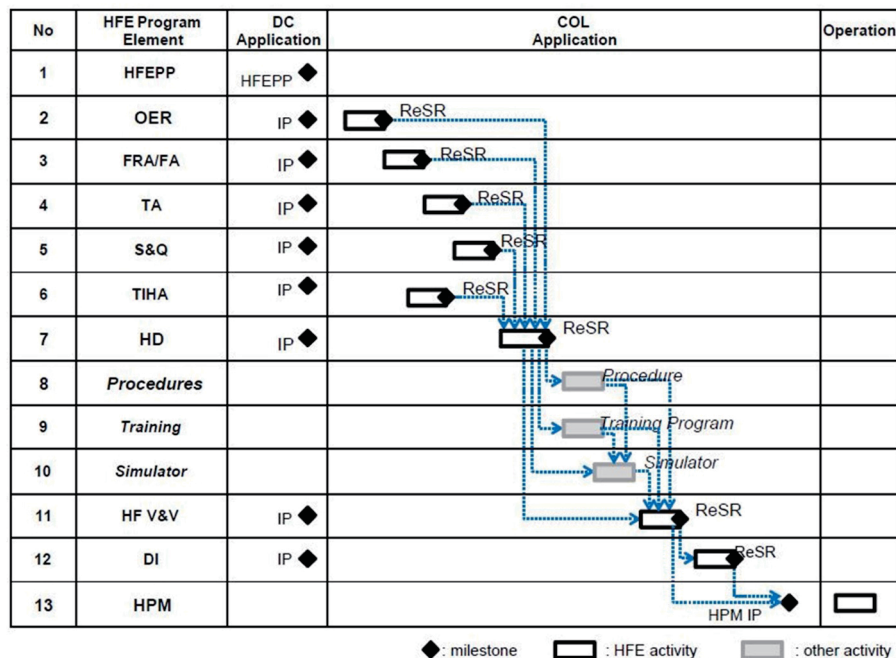


Figure 4-2 APR1400 HFE Program Milestones

#### 4.4.1.1 Summary of Program Elements

Since all IPs are submitted with the of DC application, their content is not repeated or summarized in this HFEPP. The only exception to this is the human performance monitoring (HPM) IP. This element is the responsibility of the COL applicant and will therefore not be supplied as part of the DC application. The HPM IP will be supplied by the COL applicant.

#### 4.4.2 Human Factors Engineering Process and Procedures

##### 4.4.2.1 General Process Procedures

The HFE design team executes the HFE design program based on assigned responsibilities and the following:

- HFE activities are assigned by the HFE design team leader to the responsible engineering group, and each HFE coordinators assigns the activities to individual members based on qualifications.
- HFE design decisions are made through design reviews and design review meetings of the HFE design team. The HFE design team has the authority and organizational placement to ensure that the HSI design is implemented in accordance with the QAP, HFEPP, HFE IPs, Style Guide (Reference 13), Basic HSI, and accepted industry practices.
- ~~The management of the team, including staff assignments, and equipment design changes are described in the PPM. The PPM falls under the Quality Assurance Program (QAP).~~
- ~~Design changes during the APR1400 design process are made by applying the HFE program elements and the PPM. When a design change is considered, a determination is made as to how to apply the HFE program elements in a graded manner. As part of the determination process, design change evaluations consider the potential impacts of the proposed change on the performance of plant personnel, schedule disruptions, the training program, and operating procedures. This HFE program is not intended to be applied to existing operating plant upgrades or modifications.~~
- ~~The HFE design team's review of HFE program results are performed in accordance with the PPM and the QAP.~~

##### 4.4.2.2 Human Factors Engineering Design Process

The HFE design process is shown in Figure 4-3, including the interrelationships of the HFE design activities. The design approach is consistent with the HFE review criteria in NUREG-0711 and is as follows:

- The design process is iterative.
- The results of the HFE analyses (OER, FRA/FA, TA, TIHA, S&Q) are incorporated HSI design by the HFE designers
- The results of the HFE analyses (OER, FRA/FA, TA, TIHA, S&Q) are provided to the training and procedures development groups
- The results of the design tests and evaluations are used extensively to develop the HSI design.
- Interdisciplinary design reviews and review meetings that include all members of the HFE design team are used to coordinate activities among design teams

review and comment system in  
Section 4.4.2.3

integration of design activities in Section 4.4.3 and the  
tracking of HFE issues in Section 4.6

Each HFE element's ReSR is documented as the element is completed, as shown in Figure 4-2.

The review and comment system retains all documents described above for the life of the program and allows controlled access to the designer and reviewer.

#### **4.5 Subcontractor Human Factors Engineering Efforts**

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#### **4.6 Tracking Human Factors Engineering Issues**

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## 7. REFERENCES

1. NUREG-0711, "Human Factors Engineering Program Review Model," Rev. 3, U.S. Nuclear Regulatory Commission, November 2012.
2. APR1400-E-I-NR-14002-P, "Operating Experience Review Implementation Plan," Rev.0, KHNP, December 2014.
3. APR1400-E-I-NR-14003-P, "Function Requirements Analysis and Function Allocation Implementation Plan," Rev.0, KHNP, December 2014.
4. APR1400-E-I-NR-14004-P, "Task Analysis Implementation Plan," Rev.0, KHNP, December 2014.
5. APR1400-K-I-NR-14005-P, "Staffing & Qualifications Implementation Plan," Rev.0, KHNP, December 2014.
6. APR1400-E-I-NR-14006-P, "Treatment of Important Human Actions Implementation Plan," Rev.0, KHNP, December 2014.
7. APR1400-E-I-NR-14007-P, "Human System Interface Design Implementation Plan," Rev.0, KHNP, December 2014.
8. APR1400-E-I-NR-14011-P, "Basic Human-System Interface," Rev.0, KHNP, December 2014.
9. APR1400-E-I-NR-14008-P, "Human Factors Verification and Validation Implementation Plan," Rev.0, KHNP, December 2014.
10. APR1400-K-I-NR-14009-P, "Design Implementation Plan," Rev.0, KHNP, December 2014.
11. APR1400-K-Q-TR-11005-NP, "Quality Assurance Program Description for APR1400 Design Certification," 2014.
12. ~~DC-BG-01-20, "APR1400 DC Project Procedure Manual," KHNP, September 2014.~~
13. APR1400-E-I-NR-14012-P, "Style Guide," Rev.0, KHNP, December 2014.
14. Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Rev. 1, U.S. Nuclear Regulatory Commission, November 2002.
15. 10 CFR 50.120, "Training and Qualification of Nuclear Power Plant Personnel."

APR1400 DC-QAM, "Quality Assurance Manual for APR1400 DC Project," Revision 6, July, 2015.

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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### **Question No. 18-26**

3. EP-2.04 Processes Identified in the Audit - Request for Docketed Material

A regulatory audit of the EPM/PPM (see previous question) conducted on June 25 and 26, 2015, identified information in the EPM/PPM that is relevant to NUREG-0711, Section 2.4.3, Criterion 2, "Process Management Tools." Material identified in the audit of EP-2.04 can be used to partially support a safety decision for this criterion.

EP-2.04, Engineering Procedures Manual "Personnel Qualification" describes, amongst other things, a process intended to document and verify that personnel have the appropriate qualifications for the positions to which they are assigned.

The process described in EP-2.04 instructs employees how to update resumes in a standard format that can be easily reviewed by management. Also included is the process by which management will review these resumes. This information is relevant to coming to a safety determination regarding this criterion because it describes a process that ensures that the right people are performing appropriate work.

Please provide a description on the docket of the EP-2.04 process used to verify that the HFE team is assigned to appropriate responsibilities. Alternatively, you may submit EP-2.04 on the docket with a brief explanation about how this process is applied to the HFE team. The applicant should note that submission of this information helps to address gaps identified in the implementation plan; however, this process alone may not be sufficient to fully address this criterion.

### **Response**

Section 5, "Implementation team" of the Human Factors Engineering Program Plan Implementation Plan, APR1400-E-I-NR-14001-P, Rev 0, will be revised to include the EP-2.04 process to verify that the HFE team is assigned to appropriate responsibilities, as indicated in



the Attachment associated with this response.

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**Impact on DCD**

There is no impact on the DCD.

**Impact on PRA**

There is no impact on the PRA.

**Impact on Technical Specifications**

There is no impact on the Technical Specifications.

**Impact on Technical/Topical/Environmental Reports**

Technical report APR1400-E-I-NR-14001-P/NP, Rev.0, "Human Factors Engineering Program Plan", Section 5 will be revised as indicated in the attachment associated with this response.



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