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.: **374-8481**

SRP Section: **18 – Human Factors Engineering**

Application Section:

Date of RAI Issue: **01/22/2016**

Question No. 18-101

NUREG-0711, Criterion 8.4.4.1(7), states, “the applicant should identify how in an operating plant:

- the HSIs are modified and updated
- temporary HSI changes are made (such as modifying the set points)
- personnel-defined HSIs are created (such as temporary displays that personnel define for monitoring a specific situation).”

The HD IP, Appendix A, states that this criterion is not applicable. The criterion is applicable because the design must be able satisfy the criterion when the design is implemented.

Please describe how this criterion is satisfied by either identifying where the submittal describe this or providing the information.

Response

The HFE Program Plan, APR1400-E-I-NR-14001-NP, Rev.0, Section 4.4.2.1, “General Process Procedures”, the HSI Design Implementation Plan (HD IP), APR1400-E-I-NR-14007-NP, Rev.0, Section 3.8, “ HSI Design Modifications” and Appendix A Section 8.4.4.1, Basic Human-Systems Interface APR1400-E-I-NR-14011-NP, Rev.0, Section 4.7.7, Section 4.15.5.4, and Appendix A Section 8.4.4.1 will be modified to include HSI design modifications as indicated in the attachment associated with this response. In summary, (1) the change to the HFE PP clarifies that the HD IP covers HSI design changes for operating APR1400 plants, (2) the change to the HD IP clarifies the distinction between features of the HSI design that permit plant operators to create new HSI inventory (i.e., custom displays and alarms), without changing existing HSI inventory, and actual changes to existing HSI inventory, and (3) the changes to the Basic HSI

report describe the custom display and alarm features.

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

The following technical reports will be revised, as indicated in the attachment associated with this response:

APR1400-E-I-NR-14001-NP, Rev.0, “HFE Program Plan,” Section 4.4.2.1,

APR1400-E-I-NR-14007-NP, Rev.0, “HSI Design Implementation Plan,” Section 3.8 and Appendix A

APR1400-E-I-NR-14011-NP, Rev.0, “Basic Human-Systems Interface,” Section 4.7.7, Section 4.15.5.4, and Appendix A

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:

This HFE program is applicable to modifications in operating APR1400 plants, as described in the HSI Design IP.

- 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

3.5.8 Human Factors Verification and Validation

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3.5.9 Design Implementation

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3.6 HD Interfaces with the APR1400 Plant Design

The HD interfaces with the APR1400 plant design in the following key areas:

- I&C system designs
- Plant system designs

The interfaces are described in Subsections 3.6.1 and 3.6.2.

3.6.1 Instrumentation and Control System Designs

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3.6.2 Plant System Designs

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3.7 HD Input from Predecessor and Reference Plants

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3.8 HSI Design Modifications

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"A"

NUREG-0711, Rev. 3, Review Criteria	IP Section and Paragraph
(6) The characteristics of the applicant's HSIs should support human performance under the full range of environmental conditions, ranging from normal to credible extreme conditions, such as loss of lighting and of ventilation. For the remote shutdown facility and local control stations, the applicant's HFE design should consider the ambient environment (e.g., noise, temperature, contamination) and the need for and type of protective clothing. *Additional Information*: For example, consideration should be given to the effects that protective clothing may have on task performance (e.g., protective gloves may make manual dexterity tasks more difficult and increase the time necessary to complete them).	3.3.2 4.1, second paragraph. item 8; third paragraph 4.2.8, item 5 4.2.9 item 1
(7) The applicant should identify how in an operating plant:	~~Not Applicable~~
(8) *Additional Considerations for Reviewing the HFE Aspect s of Plant Modifications*	Not Applicable
8.4.4.2 Main Control Room In some of the criteria below, we italicize and underline the word "how" to emphasize it. The word refers to the means by which the information identified in the criterion is displayed by the HSIs to personnel, e.g., how displays depict the information that operators need for monitoring tasks.	No criteria, additional detail for all criteria in this section is provided in the APR1400 Basic HSI Description TeR

3.8

- the HSIs are modified and updated
- temporary HSI changes are made (such as modifying the set points)
- personnel-defined HSIs are created (such as temporary displays that personnel define for monitoring a specific situation)

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4.8 Computer-based Procedures

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4.8.1 Concept of Operations with CBP

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4.8.2 Display Location of CBP

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4.7.7 Custom Displays

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Figure 4-54 LDP First-out Alarms

4.15.5.2 Alarm Presentation on IFPDs and NFPDs

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4.15.5.3 Alarm Acknowledgment

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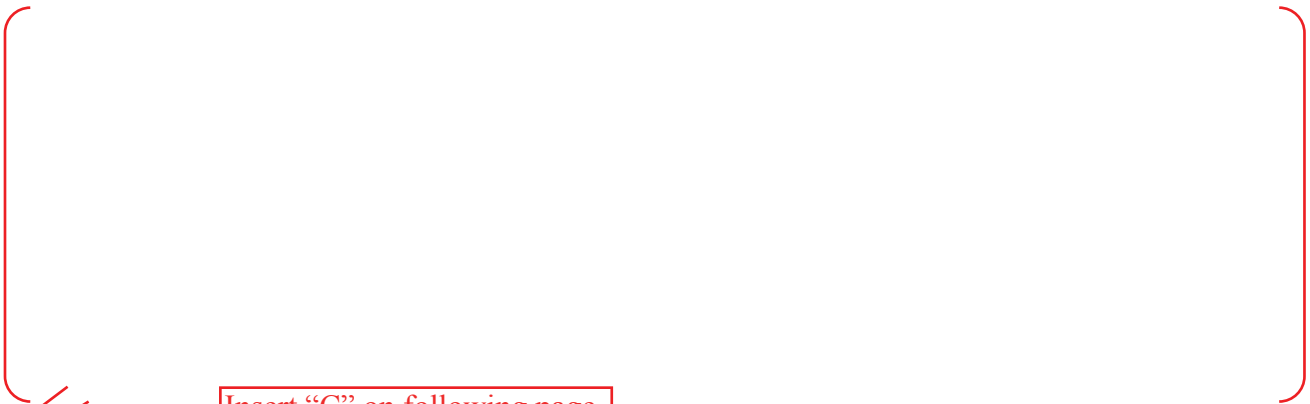

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4.15.5.4 Custom Alarms

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NUREG-0711 Rev. 3 Review Criteria	Section and Paragraph
8.4.4.1 General (1) For important HAs (see Element 7), the applicant's design should minimize the probability that errors will occur, and maximize the probability that any error made will be detected.	2.0, 3.4, 3.5.2, 3.5.3, 4.3, 4.3.1, 4.3.2, 4.7.1.2, 4.12, 4.14
(2) The applicant should base the layout of HSIs within consoles, panels, and workstations on (1) analyses of personnel roles (job analysis), and (2) systematic strategies for organization, such as arrangement by importance, and frequency and sequence of use.	1.0
(3) The applicant should design the HSIs to support inspection, maintenance, test, and repair of (1) plant equipment, and (2) the HSIs. The applicant should design the latter so that inspection, maintenance, test, and repair of the HSIs do not interfere with other plant-control activities (e.g., maintenance tags should not block the operators' views of plant indications).	See HD IP
(4) The applicant's design should support personnel task performance under conditions of minimum-, typical-, and high-level or maximum staffing. *Additional Information*: Minimum staffing is that defined by plant's technical specifications. Typical staffing is that specified and used by the licensee for routine plant operations. Maximum staffing includes the augmented staff for accident situations.	3.5
(5) The applicant's design process should account for using the HSIs over the duration of a shift where decrements in human performance due to fatigue may be a concern. *Additional Information*: As an example, simulation tests can evaluate fatigue caused by using touch screens for long periods	5.0
(6) The characteristics of the applicant's HSIs should support human performance under the full range of environmental conditions, ranging from normal to credible extreme conditions, such as loss of lighting and of ventilation. For the remote shutdown facility and local control stations, the applicant's HFE design should consider the ambient environment (e.g., noise, temperature, contamination) and the need for and type of protective clothing. *Additional Information*: For example, consideration should be given to the effects that protective clothing may have on task performance (e.g., protective gloves may make manual dexterity tasks more difficult and increase the time necessary to complete them).	3.1.1, 3.1.2, 3.5.4.2, 4.1.3.3, 4.6, 4.15.4,
(7) The applicant should identify how in an operating plant:	~~Not applicable~~
(8) Additional Considerations for Reviewing the HFE Aspects of Plant Modifications	Not applicable

For modifications and updates: see HD IP
For temporary displays: 4.7.7, 4.15.5.4

- the HSIs are modified and updated
- temporary HSI changes are made (such as modifying the set points)
- personnel-defined HSIs are created (such as temporary displays that personnel define for monitoring a specific situation)