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. 18-99

NUREG-0711, Criterion 8.4.3(5), states in part that the “applicant should maintain the style guide(s) in a form that is readily accessible and usable by designers, and is easily modified and updated as the design matures.”

The process described in the HD IP, Section 4.1.7, “Basic HSI Tests and Evaluations,” may result in changes to the APR1400 Basic HSI, which includes the Style Guide. The staff could not infer from the application how the style guide and other design guidance described in the HD IP, Sections 4.1.6.1 – 4.1.6.4 are maintained in a form that is readily accessible and usable, and are easily modified and updated.

Please describe how the style guide(s) will be accessible and easily modified as the design matures.

Response

A new paragraph will be added to the end of Section 4.1.4, “Basic HSI Tests and Evaluations” of the HSI Design Implementation Plan, as indicated in the Attachment associated with this response.

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-14007-NP, Rev.0, “HSI Design Implementation Plan,” Subsection 4.1.7 will be revised, as indicated in the Attachment associated with this response.

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4.2 APR1400 HSIS and Facilities

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Question No. 18-102

NUREG-0711, Section 1.2.2, “Review Elements,” states in part that implementation plans should be complete (i.e., identify outputs), detailed, and verifiable. Please clarify the following items in the application:

1. The HD IP, Section 6, “Results Summary Report,” discusses an ITAAC for the HD results summary report. However, the ITAAC listed in DCD Tier 1, Section 2.9, "Human Factors Engineering," state that only two generic ITAAC will be used. Please revise the HD IP, Section 6, to align with DCD Tier 1, Section 2.9.

2. The HD IP, Section 4.1 “APR1400 Basic HSI,” last paragraph says “Subsections 4.1.1 through 4.16 describe…” However, there is no section 4.16, and it appears to be referring to Section 4.1.6.

3. The HD IP, Section 1, “Purpose,” #3: this item says, “The APR1400 HSI, which are…” and then lists facilities. It seems that the item should say “The APR1400 HSI facilities, which are…” Please clarify.

4. The way that the arrows are pointing in the HD IP, Figure 3-1 “HSI Design Overview,” seem to indicate that a different design process will be used than the one that is described in Section 3.1, “APR1400 Basic HSI.” Please revise the figure (e.g., adjust the arrows or label boxes in the figure with numbers) so that it accurately portrays the process described in the HD IP.

5. APR1400-E-I-NR-14004-P, “Task Analysis Implementation Plan” (TA IP), Section 4.2.2.1, “Process Monitoring,” Item 14, “Alarms,” discusses the APR1400 Basic HIS Component Control and Instrumentation Design Guide and states that it is Reference 3. Section 7, “References,” does not have a Reference 3. Also, the TA IP, Section 3.5.5, “Human-System Interface Design,” discusses the APR1400 Basic HSI and states that it

is Reference 4. Section 7, “References,” does not have a Reference 4. Please clarify which references are applicable.

Response

1. The HSI Design Implementation Plan, APR1400-E-I-NR-14007 will be revised to ensure consistency with DCD Tier1 Section 2.9 HFE as indicated in the Attachment 1 associated with this response.

2. The HSI Design Implementation Plan, APR1400-E-I-NR-14007 will be revised to correct the section number as indicated in the Attachment 2 associated with this response.

3. The HSI Design Implementation Plan, APR1400-E-I-NR-14007 will be revised as indicated in the Attachment 3 associated with this response.

4. The HSI Design Implementation Plan, APR1400-E-I-NR-14007, Figure 3-1 “HSI Design Overview,” will be revised to add an arrow and numbering the boxes as indicated in the Attachment 4 associated with this response.

5. The Task Analysis Implementation Plan, APR1400-E-I-NR-14004 will be revised as indicated in the Attachment 5 associated with this response.

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-14007-NP, Rev.0, “HSI Design Implementation Plan,” Sections 1, 4.1, 6 and Figure 3-1, and technical report APR1400-E-I-NR-14004-NP, Rev.0, “Task Analysis Implementation Plan,” Sections 3.5.5, 4.2.2.1 and 7 will be revised as indicated in the attachment associated with this response.

6 RESULTS SUMMARY REPORT

The results of the HD are documented in the HD results summary report (ReSR), either directly or through reference to HD documentation. The ReSR demonstrates that the APR1400 HSI design process was conducted in accordance with this IP. ~~Demonstrating conformance to this IP, as documented through this RSR, is a requirement of the HD inspections, tests, analyses, and acceptance criteria (ITAAC) defined in the APR1400 DCD Tier 1 (Reference 12).~~

The HD ReSR includes the following:

1. HD results overview, which describes the principal findings of the HFE PE, including confirmation that the APR1400 HSIS supports correct execution of IHAs.
2. Overview of all HED resolutions implemented in the APR1400 HSI Design, including identification of any HED resolutions that require demonstration during V&V for HED closure.
3. Each HD team member's name, SME position, and the HD outputs generated by the team member or the independent review the team member conducted.
4. HD execution results, which include summaries and references to all details that demonstrate conformance with Section 4 of the IP, using the output format defined in Section 4. The output format includes the following:

    a. APR1400 Basic HSI test report
    b. Specifications for each HSI element within the APR1400 HSIS
    c. APR1400 HSIS database(s) for alarms and graphic displays
    d. CBPs for the ISV
    e. Performance test reports
    f. Safety console specification
    g. LCS specifications
    h. Specifications for each facility within the APR1400 HSI Design
    i. Traffic flow and visibility report for each APR1400 Facility

5. A conclusion that the HD PE:

    a. Has been conducted in accordance with this HD IP
    b. Has generated an APR1400 HSI Design whose HSIS and Facilities support the functional, task and staffing requirements defined by previous HFE PEs

The HD is a one-time, nonrecurring HFE PE whose closure is marked by the HD ReSR. The output of HD reflects the resolution of all HEDs generated by previous APR1400 HFE PEs or HEDs generated due to plant design changes. Any HEDs generated during subsequent V&V are evaluated during V&V or DI for any potential changes needed in the APR1400 HSI Design. These changes are managed through the HED resolution process.

After completion of V&V, site-specific changes, including any required HSI design changes, are managed within the design implementation (DI) PE, which is a recurring PE for each plant. The DI also provides reasonable assurance that all HEDs are closed.

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4.1.1 Basic HSI Design

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facilities

indications and controls for common cause failure (CCF) conditions. HD creates graphic displays, soft controls and conventional controls to fulfill that DCD inventory and to fulfill the expanded HSI inventory defined by the TA and plant system designs.

3. The APR1400 HSI, which are the MCR, RSR and TSC, which accommodate the APR1400 HSIS as well as storage, communication, meeting, and other habitability features important to facilitating required operations crew performance during all facets of plant operation. The HD establishes the architectural configuration of operations crew offices, kitchen, and restroom facilities; meeting areas; and facility lighting requirements. It provides reasonable assurance that the HSI facilities accommodate face-to-face interaction between the operations crew and other plant staff without interfering plant operations. The HD also establishes the functional design of voice communications and paging throughout the plant and in designated offsite facilities for emergency plan coordination during abnormal events. The HD generates the three-dimensional plant model for the MCR and the functional aspects of the MCR simulator specification for the integrated system validation (ISV), which is conducted during V&V.

The integration of the APR1400 HSIS and APR1400 HSI Facilities is referred to as the APR1400 HSI Design. This HD IP defines the activities that are necessary to develop the APR1400 HSI Design. The activities include the incorporation of HFE design standards and guidance applicable to the APR1400 HSIS, as defined in the APR1400 Basic HSI Style Guide and NUREG-0700 (Reference 5), into the APR1400 HSI Facilities. This IP provides a systematic approach to integrating the HFE design standards, guidance, and results of other HFE PEs into a comprehensive HSI design process. The integration provides reasonable assurance that the resulting HSI resources and facilities effectively support performance of operational functions and tasks.

The end product of the HD PE is the functional design of the APR1400 HSI (i.e., the APR1400 HSI Design), which is implemented into the detailed designs of HSI hardware, software, and physical facilities by APR1400 engineers in multiple disciplines. The APR1400 HSI Design is formally verified and validated during the V&V through high-fidelity simulation.

A key purpose of the HD is to provide reasonable assurance that the end product (i.e., APR1400 HSI Design) reflects the resolutions of all human engineering discrepancies (HEDs) generated in previous HFE PEs and the resolutions of any HEDs that may have been generated during the HD. While the APR1400 HSI Design must reflect all HED resolutions, closure of all HEDs is not required for completion of the HD because some HEDs may require resolution to be successfully demonstrated during the ISV of the V&V.

As demonstrated in Appendix A, this IP conforms to the review criteria in Section 8 of NUREG-0711, “Human Factors Engineering Program Review Model,” Rev. 3 (Reference 10).

This document defines the qualifications of the subject matter experts (SMEs) required to conduct HD and the independent review of its output products. This document also defines the required content of the HD ReSR, which demonstrates that the HD was conducted in accordance with this IP.

3 METHODOLOGY OVERVIEW

The HD generates the designs for:

- APR1400 Basic HSI
- APR1400 HSIS
- APR1400 Facilities

The HD process for each is depicted in Figure 3-1, and overviews are provided in Subsections 3.1~~, 3.2, and 3.3~~.

through 3.6

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Figure 3-1 HSI Design Overview

3.1 APR1400 Basic HSI

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3.5.2. Treatment of Important Human Actions

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3.5.3. Functional Requirements Analysis and Function Allocation

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3.5.4. Staffing and Qualifications

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3.5.5. Human-System Interface Design

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3.5.6. Procedure Development

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3.5.7. Training Program Development

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4.2.2.2. Component Control

7. REFERENCES

1. APR1400-E-I-NR-14001-P, "Human Factors Engineering Program Plan," Rev.0, KHNP, December 2014.

2. NUREG-0711, "Human Factors Engineering Program Review Model," Rev. 3, U.S. Nuclear Regulatory Commission, November 2012.

3. APR1400-E-I-NR-14011-P, "APR1400 Basic Human-System Interface," Rev.0, KHNP, December 2014.