
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.: 373-8480
SRP Section: 18 – Human Factors Engineering
Application Section:
Date of RAI Issue: 01/22/2016

Question No. 18-91

NRC regulation 10CFR 50.34(b)(6)(v) requires a design certification applicant to submit plans for coping with emergencies, including the items specified in 10CFR 50, Appendix E. Section IV.E.8 of Appendix E requires the making and description of adequate provision for emergency facilities and equipment, including an onsite technical support center (TSF) and an emergency operations facility (EOF). This question concerns how and which APR1400 EOF design expectations the applicant will pass on to the COL.

NUREG-0711, Section 8.4.4.4 contains criteria applicable to the HFE design of the EOF. The staff reviewed APR1400-E-I-NR-14007-P, Rev. 0, "Human-System Interface [HSI] Design Implementation Plan (HD IP)," APR1400-E-I-NR-14011-P, Rev. 0, "Basic HSI" Technical Report (TeR), DCD Tier 2 Chapter 7, and DCD Tier 2 Chapter 13. The staff finds the following information in the application appears to be inconsistent:

- COL Information Item 7.5(2) in DCD Tier 2, Table 1.8-2, "Combined License Information Items," Item COL 7.5(2) states, "The COL applicant is to provide a description of the site-specific EOF." The response to RAI #54-7963, Question #18-5 (ADAMS Accession No. ML15254A492) dated September 11, 2015, states that NUREG-0696, "Functional Criteria for Emergency Response Facilities" and NUREG-0700, "Human-System Interface Design Review Guidelines" will be applied to the design of the EOF. However, DCD Tier 2, Section 18.7, HD IP), and COL information item 7.5(2) do not provide direction to a COL applicant to incorporate these HFE guidelines into the design of the EOF.
- Although the HD IP, Appendix A, lists sections of the HD IP that address criteria in NUREG-0711, Section 8.4.4.4, "Emergency Operations Facility," the staff found that these sections do not specifically address Criteria 8.4.4.4(1) – (8) and 8.4.4.4(10). The presence of this information in Appendix A of the HD IP seems to contradict the RAI response and also does not seem to be accurate.

- DCD Tier 2, Figure 7.7-12, "HSI Information Processing Block Diagram," seems to indicate that the same information that is transmitted to the control room and technical support center (TSC) by the Information Processing System (IPS) will be transmitted and available in the EOF. However, the last paragraph in the HD IP, Section 4.1.4.19, "Emergency Offsite Facility," and the Basic HSI TeR, Section 4.18, "Emergency Operations Facility," imply that this information may be displayed differently in the EOF than in the other facilities.

Align COL information item 7.5(2), the HD IP, the Basic HSI TeR, and the response to RAI #54-7963, Question #18-5, to address how human factors engineering (HFE) will be incorporated into the design of the EOF. Revise the submittal as necessary.

Response

DCD Tier 2, Section 18.1.1.2, "Applicable Plant Facilities" will be amended to provide direction to a COL applicant to incorporate the HFE guidelines into the design of the EOF, as indicated in the attachment associated with this response.

To clarify the responsibility of the COL applicant and the scope of the HD IP, with regard to the EOF, Sections 4.1.4.1, 4.1.4.19, and Appendix A will be revised as indicated in the attachment associated with this response.

Impact on DCD

DCD Tier 2, Section 18.1.1.2 will be revised as indicated in the attachment associated with this response.

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, "Human-System Interface Design Implementation Plan," Sections 4.1.4.1 and 4.1.4.19 will be revised, as indicated in the attachment associated with this response.

APR1400 DCD TIER 2

The HFE program elements will be applied in a graded approach with all elements being fully applied to the MCR and RSR.

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18.1.1.3 Applicable HSIs, Procedures, and Training

The HSIs are developed in accordance with the HFEPP. The HFE program addresses the design of HSIs. The HFE program provides input to the procedures and training programs; however, they are developed in accordance with Chapter 13. The HFE program includes the HSIs required for operations, accident management, maintenance, test, inspections, and surveillance tasks that operational personnel perform or supervise.

18.1.1.4 Applicable Plant Personnel

Plant personnel addressed by the HFEPP include licensed control room operators as defined in 10 CFR Part 55 (Reference 5), non-licensed operators (NLOs), the SS, and the STA. This includes training needs for instrumentation and control (I&C) technicians, maintenance personnel, radiological protection technicians, chemistry technicians, and engineering support personnel. Additionally, other personnel who perform tasks identified to be directly related to plant safety are included in the HFE program.

18.1.2 HFE Design Team and Organization

18.1.2.1 Responsibility

The multidisciplinary HFE design team includes the architectural engineering group, operations group, and nuclear steam supply system (NSSS) group as shown in Figure 18.1-1. Section 4.3 of the HFEPP describes the organizational responsibilities for the HFE design team activities.

The HFE design team is responsible for the following activities with respect to the HFE program scope:

- a. Developing the HFE plans
- b. Ensuring that all HFE activities comply with the HFE implementation plans (IPs)

Any limitations for the applicability of the HFE program elements to the TSC is as described in each HFE implementation plan.

The communications and information requirements of the EOF will be designed in accordance with the APR1400 HFE program. The APR1400 HFE team determines what EOF information must be transmitted from the plant to the EOF, in accordance with regulatory requirements and guidance, and based on the task analysis process described in Section 18.4. The EOF itself, including the detailed design of EOF displays and corresponding V&V, training and procedures, is outside the scope of the APR1400 HFE Implementation Plans.

The EOF facility is designed in accordance with NUREG-0696 and NUREG-0700. The EOF design process specifies the complete EOF facility design, including the method of incorporating the communications and information requirements established by the APR1400 HFE program.

As a minimum, the HSI displays at the EOF include the following:

1. Radiological, meteorological, and plant-system data essential to determining offsite protective measures, assessing environmental conditions, coordinating radiological monitoring and recommending the implementation of offsite emergency plans.
2. Data sufficient to assess the actual and potential onsite and offsite environmental consequences of an emergency, and information on the general condition of the plant.
3. Sensor data of the variables in NRC RG 1.97, the meteorological variables in NRC RG 1.23 and in NUREG-0654, Rev. 1, Appendix 2.



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4.1.3.5 Failure of I&C Components

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4.1.4 Basic HSI Conformance with Regulatory Guidance

The regulatory guidance that influences the APR1400 Basic HSI and ultimately the HSI inventory included in the APR1400 HSIS is described in Subsections 4.1.4.1 through 4.1.4.18.

4.1.4.1 Safety Parameter Display System

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4.1.4.2 Bypassed and Inoperable Status Indication

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4.1.4.19 Emergency Offsite Facility

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4.1.5 Basic HSI Design Inputs

The APR1400 Basic HSI and the Basic HSI for the predecessor design, SKN 3&4, are the same or similar except for the changes described in Subsections 4.1.5.1 and 4.1.5.2. The evolution of SKN 3&4 is also described.

4.1.5.1 Design Evolution

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| NUREG-0711, Rev. 3, Review Criteria | IP Section and Paragraph |
|---|--|
| (3) The applicant should describe <i>how</i> the HSIs provide an SPDS that replicates the SPDS in the MCR (to improve the exchange of information between personnel in the main control room and the EOF). If the SPDS in the main control room is composed of multiple displays, then multiple displays also should be provided in the TSC. | 4.1.4.1 |
| (4) The applicant should describe <i>how</i> the HSIs provide as a minimum, the set of variables specified in Regulatory Guide 1.97, Revision 4, plus all sensor data and calculated variables not specified in Reg. Guide 1.97 but included in the data sets for the SPDS, for the EOF, or for transmission to offsite locations. | 4.1.4.1 |
| (5) The applicant should describe <i>how</i> the HSIs allow all TSC personnel to complete their assigned tasks with unhindered access to alphanumeric and/or graphical representations of: <ul style="list-style-type: none"> • plant systems variables • in-plant radiological variables • meteorological information • offsite radiological information | 4.1.4.1 |
| (6) The applicant should describe <i>how</i> the HSIs provide the trend-information displays and time-history displays that give the TSC personnel a dynamic view of the plant's status during abnormal operating conditions. | 4.1.4.1 |
| (7) The applicant should describe <i>how</i> HFE was incorporated into the TSC design to ensure that personnel easily understand and use the HSIs. | 4.1.4.18 paragraph 1 |
| 8.4.4.4 Emergency Operations Facility NUREG-0696 states that HFE should be incorporated in the design of the Emergency Operations Facility (EOF) considering both operating and maintenance personnel. The criteria in this section are applicable to the HFE review of the EOF. | 2, paragraph 1 2.2, paragraph 4 2.3, paragraph 1 4.1.4.19 |
| (1) The applicant should describe <i>how</i> the HSIs assure the acquisition, display, and evaluation of all radiological, meteorological, and plant-system data essential to determining offsite protective measures. | 4.1.4.1 |
| (2) The applicant should describe <i>how</i> the HSIs continuously indicate radiation dose-rates and concentrations of airborne radioactivity inside the EOF while it is used during an emergency, including local alarms with trip levels set to provide early warning to EOF personnel of adverse conditions that may affect the facility's habitability. | 4.1.4.1 |

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Insert "F" on following page

Insert "G" on following page

The HSI design of the EOF is the responsibility of the COL applicant. This HD IP governs only the generation of the SPDS inventory data, which is transmitted to the EOF for display within the COL applicant's HSI design, as defined in the following sections:



The SPDS inventory data, which is transmitted to the EOF for display within the COL applicant's HSI design, includes radiological, meteorological, and plant-system data essential to determining offsite protective measures, as defined in Section 4.1.4.1.



The HSI design of the EOF is the responsibility of the COL applicant, including warnings of adverse conditions that may affect the facility's habitability, as defined in Section 4.1.4.19.



| NUREG-0711, Rev. 3, Review Criteria | IP Section and Paragraph |
|---|--|
| (3) The applicant should describe <i>how</i> the HSIs support reliable voice communications to the TSC, the main control room, the NRC, and the state and local emergency response facilities. | 4.1.4.19 Insert "H" on following page |
| (4) The applicant should describe <i>how</i> the HSIs supply data sufficient to assess the actual and potential onsite and offsite environmental consequences of an emergency, and information on the general condition of the plant. | 4.1.4.1 Insert "I" on following page |
| (5) The applicant should describe <i>how</i> the HSIs provide radiological, meteorological, and other environmental data to: <ul style="list-style-type: none"> • assess environmental conditions • coordinate radiological monitoring • recommend implementing offsite emergency plans As a minimum, the EOF data should include (1) sensor data of the variables specified in Reg. Guide 1.97, Revision 4, and (2) the meteorological variables specified in the proposed Revision 1 to Regulatory Guide 1.23, "Meteorological Measurements Programs in Support of Nuclear Power Plants," and in NUREG-0654, Revision 1, Appendix 2. | 4.1.4.1 Insert "J" on following page Insert "K" on following page |
| (6) The applicant should describe <i>how</i> the EOF HSIs provide all data that are available for display in the TSC, including information sent from the plant to the NRC. | 2, paragraph 1 2.2, paragraph 4 2.3, paragraph 1 4.1.4.19 |
| (7) The applicant should describe <i>how</i> the HSIs allow all EOF personnel to perform their assigned tasks with unhindered access to alphanumeric and/or graphical representations of: <ul style="list-style-type: none"> • plant system variables • in-plant radiological variables • meteorological information • offsite radiological information | 2, paragraph 1 2.2, paragraph 4 2.3, paragraph 1 4.1.4.19 Insert "L" on following page Insert "L" on following page |
| (8) The applicant should describe <i>how</i> the HSIs display the needed trend information and time-history data in the EOF. The displays should be partitioned to facilitate the different functional groups in the EOF retrieving this information. | 2, paragraph 1 2.2, paragraph 4 2.3 paragraph 1 4.1.4.19 Insert "L" on following page |
| (9) The applicant should describe <i>how</i> the HSIs provide an SPDS to improve the exchange of information between the MCR and the TSC. If the SPDS in the MCR comprises multiple displays, they should also be provided in the EOF. | 2, paragraph 1 2.2, paragraph 4 2.3, paragraph 1 4.1.4.19 |
| (10) The applicant should describe <i>how</i> HFE was incorporated into the EOF design to ensure that personnel easily understand and use the HSIs. | 2, paragraph 1 2.2, paragraph 4 2.3, paragraph 1 4.1.4.19 Insert "L" on following page |

The HSI design of the EOF is the responsibility of the COL applicant, including voice communications, as defined in Section 4.1.4.19.



The SPDS inventory data, which is transmitted to the EOF for display within the COL applicant's HSI design, includes radiological, meteorological, and plant-system data sufficient to assess the actual and potential onsite and offsite environmental consequences of an emergency, and information on the general condition of the plant, as defined in Section 4.1.4.1. The actual SPDS inventory data is an output of the HD PE.



The SPDS inventory data, which is transmitted to the EOF for display within the COL applicant's HSI design, includes radiological, meteorological, and other environmental data, including the variables specified in RG 1.97, RG 1.23 and NUREG-0654, as defined in Sections 4.1.4.1 and 4.1.4.19.



The SPDS inventory data, which is transmitted to the EOF for display within the COL applicant's HSI design, includes the same data that is available in the TSC and is transmitted to the NRC, as defined in Section 4.1.4.1.



The HSI design of the EOF is the responsibility of the COL applicant. This HD IP governs only the generation of the SPDS inventory data, which is transmitted to the EOF for display within the COL applicant's HSI design, as defined in the following sections:



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SRP Section: 18 – Human Factors Engineering

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Question No. 18-95

NUREG-0711, Criterion 8.4.4.3(7) states that the applicant should describe how HFE was incorporated into the TSC design to ensure that personnel easily understand and use the HSIs.

The response to RAI #54-7963, Question #18-5, (ADAMS Accession No. ML15254A492) dated September 11, 2015, stated that the guidance provided in NUREG-0696, "Functional Criteria for Emergency Response Facilities," and NUREG-0700, "Human-System Interface Design Review Guidelines" will applied to the design of the TSC and EOF instead of the full-scope described in NUREG-0711, since NUREG-0696 and NUREG-0700 provide guidance specific to the design of emergency response facilities and human system interfaces, respectively.

However, the second sentence in the HD IP, Section 4.1.4.18, "Technical Support Facility," states something that seems to the staff to possibly contradict the RAI response. Also, because the HD IP, Section 4.2.8, "Central Facilities," provides a design method for the control room and the TSC, it appears to the staff that the same HFE standards apply to the design of both facilities.

Please clarify which HFE standards apply to the design of the TSC. Also, clarify if the displays in the TSC are replications of the control room displays and are therefore designed to the same HFE standards documented in the APR1400 detailed design documentation.

Response

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Section 4.1.4.18 of the Human-System Interface Design Implementation Plan (HD IP) will be revised, 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, "Human-System Interface Design Implementation Plan," Section 4.1.4.18 will be revised, as indicated in the attachment associated with this response.

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4.1.4.16 Alarms for Credited Manual Operator Actions

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4.1.4.17 Safe Shutdown from Outside the MCR

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4.1.4.18 Technical Support Center

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