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.: **358-8449**

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

Application Section:

Date of RAI Issue: **01/05/2016**

Question No. 18-89

Regulations: 10 CFR 52.47(a)(8) and 10 CFR 50.34(f)(2)(iii)

NUREG-0800, Appendix 18-A, "Crediting Manual Operator Actions in Diversity and Defense in Depth Analyses," discusses an acceptable method for evaluating manual operator action as a diverse means of coping with anticipated operational occurrences and postulated accidents that are concurrent with a software common cause failure (CCF) of the digital instrumentation and control system. Appendix 18-A discusses four phases, and each phase contains review criteria. The staff reviewed APR1400-E-I-NR-14004-P, “Task Analysis Implementation Plan,” APR1400-E-I-NR-14006-P, “Treatment of Important Human Actions Implementation Plan,” Rev. 0, APR1400-E-I-NR-14008-P, "HF V&V Implementation Plan," Rev. 0, APR1400-Z-A-NR-14019-P, Rev. 0, "CCF Coping Analysis," and APR1400-Z-J-NR-14002-P, Rev. 0, "Diversity and Defense in Depth," and did not find that the application specifically addresses the review criteria listed in Appendix 18-A for the following phases: Phase 2, Preliminary Validation; Phase 3, Integrated Systems Validation; and Phase 4, Maintaining Long-Term Integrity of Credited Manual Actions in the Defense-in-Depth analysis.

The staff requests that the applicant describe how the review criteria in Sections 2.B, 3.B, and 4.B are addressed in the application.

Response

NUREG-0800, Appendix 18-A, "Crediting Manual Operator Actions in Diversity and Defense in Depth Analyses," establishes guidance for validating the manual operator actions that are credited in APR1400-Z-A-NR-14019-P, Rev. 0, "CCF Coping Analysis", and maintaining human performance for the long term. The APR1400 HFE program complies to the guidance for “Phase 2 Preliminary Validation”, “Phase 3 Integrated Systems Validation”, and “Phase 4 Maintaining Long-Term Integrity of Credited Manual Actions in the Defense-in-Depth analysis”, through the HSI Design, Verification and Validation, and Human Performance Monitoring HFE program

elements. To clarify this compliance, the respective implementation plans for each of these program elements will be revised, as shown in the attachment associated with this response.

The scope of Human Performance Monitoring includes Important Human Actions and fulfills the guidance in NUREG-0800, Appendix 18-A, "Crediting Manual Operator Actions in Diversity and Defense in Depth Analyses" for maintaining long-term integrity of credited manual actions in the defense-in-depth coping analysis (D3CA).

For all DIHAs (i.e., credited manual actions in the transient and accident analysis from Chapter 15 of the DCD and the D3CA) the criteria assures the time required observed during the ISV is maintained.

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,” and APR1400-E-I-NR-14008-NP, Rev.0, “Human Factors Verification and Validation Implementation Plan,” will be revised, as indicated in the attachment associated with this response.

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3.2.5 Alarms

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3.2.6 Computer-Based Procedures

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3.2.7 Performance-Based Tests

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4.2 APR1400 HSIS and Facilities

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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

This confirmation provides preliminary validation of the time margin result from the TA for the credited DIHAs defined in the TAA and D3CA.

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.

3. METHODOLOGY OVERVIEW

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3.1. V&V Interfaces in the HFE Program

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4.1.1.2. Personnel Tasks

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4.1.4. Scenario Definition

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Table 4-13 Example of T-test for Anthropometric and Physiological Factors

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4.5.7.2. Individual Scenarios and Assumptions of IHAs

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