KHNPDCDRAIsPEm Resource

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Sent:	Thursday, February 04, 2016 7:05 AM
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Subject:	APR1400 Design Certification Application RAI 400-8425 (18 - Human Factors Engineering)
Attachments:	APR1400 DC RAI 400 COLP 8425.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, 60 days to respond to the RAI questions. We may adjust the schedule accordingly.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 400-8425

Issue Date: 02/04/2016
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 18 - Human Factors Engineering
Application Section:

QUESTIONS

18-114

NUREG-0711, "Human Factors Engineering Program Review Model," Criterion 8.4.1(4) states, “Other Requirements – The applicant should identify any other requirements, such as customer requirements, that are inputs to the HSI design.”

APR1400-E-I-NR-14007-P, “HSI Design Implementation Plan” (HD IP), Section 3.2, “APR1400 HSIS,” discusses a toolset that is an input to the HSI design process and is used to ensure that the design standards and guidelines are applied to the design of each HSI resource. It is not clear to the staff how the toolset is developed, or if it has already been developed, because the HD IP does not provide direction to develop the toolset in the HD IP, and the staff did not find a description anywhere else in the application.

Provide a method for developing the toolset in the HD IP if it will need to be developed to be an input in the HSI design process. If it has been developed, provide a description of it or describe how the COL applicant will obtain it. Revise the submittal as necessary.

18-115

Regulations in 10CFR 50.34(f)(2)(iv) describe requirements for a safety parameter display system (SPDS). NUREG-0711, Criterion 8.4.4.2, "Main Control Room," (1) SPDS, describes an acceptable method for complying with the regulation. This criterion states, “Identification of critical safety functions (CSFs) – The CSFs needed to meet the requirement for an SPDS should be identified.” It also states, "the applicant should identify the plant parameters personnel will use to monitor each CSF.”

1. APR1400-E-I-NR-14003-P, “Functional Requirements Analysis and Function Allocation Implementation Plan” (FRA/FA IP), describes a process to be used to identify the APR1400 CSFs. However, DCD Tier 2, Section 7.7.1.4(d)(1), “SPADES+,” lists the CSFs that the SPADES+ program will display on the CSF displays. Because the APR1400 CSFs have already been identified in the application, and it is not clear to the staff why the FRA/FA IP, Section 4.2, "Analysis Updates (Iterations)," requires the COL applicant to use a process to identify the CSFs. Further, the HD IP, Section 4.2.1, "Critical Safety Function Displays," states that CSFs identified by the FRA/FA process is an input to the HSI design. If the DCD Tier 2, Section 7 has already identified the CSFs then the input to the HSI design process has already been identified, and the HD IP should identify the correct input.

   Align the information in the FRA/FA IP, HD IP, and DCD Tier 2, Section 7.7.1.4(d)(1). Revise the submittal as necessary.

2. APR1400-E-I-NR-14003-P, FRA/FA IP, states that parameters will be identified for each CSF. However, the Basic HSI TeR (APR1400-E-I-NR-14011-P, Rev. 0), Section 3.5.2, “Situation Awareness,” says that the minimum variables used to monitor the CSFs are the Type B variables listed in DCD Tier 2, Table 7.5-1, “Accident Monitoring Instrumentation Variables.” This table lists Type B, C, D, and E variables, and some of the Type D variables also are credited wtih monitoring CSFs (e.g., vital auxilaries). Therefore, it appears to the staff that the parameters have been identified in the application, and it is not clear to the staff why the FRA/FA IP requires the COL applicant to use a process to identify the parameters. Further, the HD IP, Section 4.2.1, "Critical Safety Function Displays," states that parameters used to monitor the CSFs identified by the FRA/FA process are an input to the HSI design. If the DCD Tier 2, Section 7 has already identified these parameters, then the input to the HSI design process has already been identified, and the HD IP should identify the correct input.

Align the information in the FRA/FA IP, HD IP and DCD Tier 2, Table 7.5-1. Revise the submittal as necessary.

18-116

Regulations in 10CFR 50.34(f)(2)(iv) describe requirements for a safety parameter display system (SPDS). NUREG-0711, Criterion 8.4.4.2(1), describes an acceptable method for complying with the regulation. Additionally, NUREG-0700, Section 5, “Safety Function and Parameter Monitoring System” provides guidance for the design of the SPDS.

APR1400-E-I-NR-14012-P, “Style Guide,” copy the statements in NUREG-0700, "HSI Design Review Guidelines," Section 5, Criteria 5.1-7, 5.1-8, and 5.1-9; however, the Style Guide does not specifically describe a method for how the criteria will be implemented in the design of the SPDS HSIs. The staff recognizes that the HD IP states that the predecessor design SPDS HSIs are the starting point for the APR1400 SPDS design; however, these SPDS design details are not included in the Style Guide. Describe how the CSF displays will allow users to: (1) comprehend changes in status, (2) how the sampling rate for each critical variable will be consistent with user needs, and (3) how critical variables will be displayed with sufficient accuracy for the user. Revise the submittal as necessary.

18-117

Regulations in 10CFR 50.34(f)(2)(iv) describe requirements for a safety parameter display system (SPDS). NUREG-0711, Criterion 8.4.4.2(1), describes an acceptable method for complying with the regulation, and states that the applicant should verify that the SPDS HSIs conform to the acceptable HFE practices using NUREG-0700, Section 5, “Safety Function and Parameter Monitoring System.

Guideline 5.3-2 and Guideline 5.3-3 discuss data reliability and display of data reliability. Describe how the plant data that is an input to the SPDS meets the guidelines. If this information has been submitted with the application (e.g., in DCD Tier 2, Chapter 7), then indicate which section discusses how these guidelines are applied to the SPDS HSI resources. Revise the submittal as necessary.

18-118

Regulations in 10CFR 50.34(f)(2)(v) require automatic indication of the bypassed and inoperable status of safety systems. NUREG-0711, Criterion 8.4.4.2(2), describes an acceptable method for complying with the regulation for bypassed and inoperable status indication (BISI).

Provide a description for the following items and revise the submittal as necessary:

1. The staff could not find a description of the provisions for allowing the operations staff to confirm that a bypassed safety function was properly returned to service, which is addressed in the third bullet in NUREG-0711, Criterion 8.4.4.2(2).
2. The staff could not determine whether or not alarms will indicate to the operators when a bypassed safety function has been properly returned to service, which is addressed in the fourth bullet of NUREG-0711, Criterion 8.4.4.2(2).
3. The staff could not find a description of how the operators can verify the indication and annunciating functions of the BISI, which is addressed in the fifth bullet of NUREG-0711, Criterion 8.4.4.2(2).
4. The staff could not find how the application addresses the following, which is addressed by the sixth bullet of NUREG-0711, Criterion 8.4.4.2(2): “Bypass and inoperable status indicators should be arranged such that personnel can determine whether it is permissible to continue operating the reactor.”
5. The staff could not find how the application addresses the following, which is addressed by the seventh bullet of NUREG-0711, Criterion 8.4.4.2(2): “the control room of all affected units should receive an indication of the bypass for their shared system safety functions.”

18-119

Regulations in 10CFR 50.34(f)(2)(xi) require direct indication of relief and safety valve position (open or closed) in the control room. NUREG-0711, Criterion 8.4.4.2(3), "Relief and Safety Valve Position Monitoring," states that the applicant should describe how the HSI indicates the position of relief and safety valves. NUREG-0711, Section 1.2.2, “Review Elements, “ also states that an acceptable implementation plan (IP) describes the methodology in a step-by-step format to ensure that design personnel can reliably use the IP consistent results will be obtained from executing the methodology.

The information in the HD IP and the DCD Tier 2, Section 7, “Instrumentation and Control,” appear to be contradictory.

- The HD IP, Section 4.1.4.3, describes one display in the main control room that will continuously indicate the position of the relief and safety valves.
- DCD Tier 2, Table 7.5-1, "Accident Monitoring Instrumentation Variables," states that the pilot-operated safety relief valve (POSRV) position indication is a Type D variable. The HD IP, Section 4.1.4.7, “Post-Accident Monitoring Instrumentation,” suggests that Type D variables are non-safety indications that will not be continuously displayed.
- DCD Tier 2, Table 7.1-1, "Regulatory Requirements Applicability Matrix," indicates that "direct indication of relief and safety valve position" is provided by the qualified indication and alarm system – post-accident monitoring (QIAS-P), which is a safety-related

system. Also, DCD Tier 2, Section 5.2.5.1.2.1, "Pressurizer Pilot-Operated Safety Relief Valves," describes position indications that will be in the main control room.

Also, the staff did not find any actual direction in the HD IP to the SMEs to include indication of these valves in the design of any display.

1. Clarify which display(s) will satisfy the regulatory requirement for direct position indication of safety and relief valves. Align the information in the DCD Tier 2, Section 7 and the HD IP, if necessary.
2. Provide direction in the HD IP for the direct position indication of the relief and safety valves to be incorporated into the appropriate display. This ensures that the requirement will be satisfied.
3. Provide justification for why POSRV position indication is a Type D variable.

18-120

Regulations in 10CFR 50.34(f)(2)(xxi) and 10CFR 50.34(f)(2)(xxiv) are applicable only to boiling water reactors (BWRs).

The HD IP, Section 4.1.4.8, "Auxiliary Heat Removal," references 10CFR 50.34(f)(2)(xxi) and says that the APR1400 HSIS conforms to this regulation by redirecting to section 4.1.4.4, "Manual Feedwater Control," which discusses meeting 10CFR 50.34(f)(2)(xii), a requirement for auxiliary feedwater.

The HD IP, Section 4.1.4.9, "Reactor Level Monitoring," references 10CFR 50.34(f)(2)(xxiv) and says that the APR1400 HSIS conforms to this regulation by redirecting to section 4.1.4.6, "Core Cooling," which discusses meeting 10CFR 50.34(f)(2)(xviii), which is a requirement for auxiliary feedwater.

This is not correct because 10CFR 50.34(f)(2)(xxi) and 10CFR 50.34(f)(2)(xxiv) are not applicable to to PWRs.

Revise the HD IP, Sections 4.1.4.8 and 4.1.4.9 as necessary so that the HD IP states the correct information.

18-121

Regulations in 10CFR 50.34(f)(2)(xviii) require unambiguous indication of inadequate core cooling (ICC).

The HD IP, Section 4.1.4.6, “Core Cooling,” describes one type of display that will provide indication of ICC variables. However, different information is written in DCD Tier 2, Section 7.5.1.2(a), “Primary ICC displays,” which states that indications of ICC will be displayed on “summary pages.” The staff could not find a description of “summary pages” in the HD IP or the Basic HSI Technical Report

Clarify where ICC variables are displayed. Align the information in DCD Tier 2, Section 7.5.1.2(a) and the information in the HD IP, Section 4.1.4.6. Revise the submittal as necessary.

18-122

Regulations in 10 CFR 50.34(f)(2)(xxvi) require an applicant to provide for leakage control and detection in the design of systems outside containment that contain or might contain radioactive materials. Also, NUREG-0711, Section 1.2.2, “Review Elements, “ also states that an acceptable implementation plan (IP) describes the methodology in a step-by-step format to ensure that design personnel can reliably use the IP consistent results will be obtained from executing the methodology.

DCD Tier 2, Section 5.2.5.4, “Intersystem Leakage,” lists several systems connected to the reactor coolant system that could potentially contain radioactivity following an accident. The HD IP, Section 4.1.4.10, “Leakage Control,” states that a generic type of display will be used to provide leakage detection. The HD IP does not provide direction for the SMEs to use DCD Tier 2, Section 5.2.5.4 as an input in the design of the HSI, and it also does not specify the type of HSIS (i.e., of those listed in the HD IP, Section 3.2, "APR1400 HSIS") that will provide these indications. Therefore, the staff cannot conclude that the information in DCD Tier 2, Section 5.2.5.4 will be incorporated into the HSI design process.

Provide, in a step-by-step format, directions to the SMEs to ensure that the information in the DCD is included in the HSI design. Specify which type of APR1400 HSIS will display these indications.

18-123

Regulations in 10CFR 50.34 (f)(2)(xxvii) require the applicant to provide for monitoring of inplant radiation and airborne radioactivity. NUREG-0711, Criterion 8.4.4.2(11) states that an applicant should describe how the HSI provides appropriate monitoring of inplant radiation.

The HD IP, Section 4.1.4.11, “Radiation Monitoring,” provides an example of a type of radiation indication used to monitor a critical safety function (CSF). Plant parameters that provide information to the operator to monitor CSFs are Type B variables (as defined in IEEE Standard 497-2002). DCD Tier 2, Table 7.5-1, “Accident Monitoring Instrumentation Variables,” lists radiation indications, including the example provided in the HD IP, Section 4.1.4.11, but all of them are labeled as Type C and E variables, not Type B variables.

Confirm that DCD Tier 2, Table 7.5-1 has appropriately identified main steam line radiation and containment radiation detectors as Type C and E variables instead of Type B variables. Revise the submittal as necessary.

18-124

Regulations in 10CFR 50.34 (f)(2)(xxvii) require the applicant to provide for monitoring of inplant radiation and airborne radioactivity. NUREG-0711, Criterion 8.4.4.2(11) states that an applicant should describe how the HSI provides appropriate monitoring of inplant radiation. Also, NUREG-0711, Section 1.2.2, “Review Elements, “ also states

that an acceptable implementation plan (IP) describes the methodology in a step-by-step format to ensure that design personnel can reliably use the IP consistent results will be obtained from executing the methodology.

The HD IP, Section 4.1.4.11, “Radiation Monitoring,” states that some types of radiation indications will be able to be viewed on a generic kind of HSI. This statement uses a general term to describe the HSI that lacks sufficient detail for the HSI designers.

1. Specify the type of display that will provide these indications (e.g. which type of APR1400 HSIS listed in the HD IP, Section 3.2, "APR1400 HSIS).
2. Provide direction in the HD IP to the SMEs to include radiation monitors as inputs to the design of the applicable displays.
3. Revise the submittal as necessary.

18-125

NUREG-0711, Section 1.2.2, “Review Elements, “ states that an acceptable implementation plan (IP) describes the methodology in a step-by-step format to ensure that design personnel can reliably use the IP consistent results will be obtained from executing the methodology.

The HD IP does not provide a method for the detailed design of the large display panel (LDP). Section 3.1, “APR1400 Basic HSI,” states that functional specifications for the LDP will be generated. The HD IP, Section 4.1.6.1, “Functional Specifications,” also says that functional specifications will be created for the LDP, but no method is provided (no inputs, outputs, or review criteria are listed).

Also, credit is given in Section 4.1.4.3, “Relief and Safety Valve Position Monitoring,” Section 4.1.4.4, “Manual Feedwater Control,” Section 4.1.4.5, “Containment Monitoring,” Section 4.1.4.6, “Core Cooling,” and Section 4.1.4.11, “Radiation Monitoring,” for complying with regulatory requirements by providing indications on fixed portion of the LDP. Also, Section 4.1.4.14, "Important Human Actions," states that prompting alarms for IHAs will be displayed on the fixed portion of the LDP. However, no direction is provided in the HD IP to the SMEs to include those requirements as inputs into the design of the LDP.

Because a method is not provided for the detailed design of the LDP, the staff cannot conclude that the design process described in the HD IP will produce reliable results and that the regulatory requirements identified in the above sections of the HD IP will be included in the design of the LDP.

Revise the HD IP as necessary to provide the design methodology for the LDP in a step-by-step format to ensure that the regulatory requirements are identified as inputs to the design process.


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