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## 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

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### **Question No. 18-96**

Title 10 of the Code of Federal Regulations (10CFR) Section 52.47(a)(8) requires an applicant for a design certification to provide an FSAR which includes the information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), with certain exceptions. Section 10 CFR 50.34(f)(2)(ii) requires an applicant to "Establish a program, to begin during construction and follow into operation, for integrating and expanding current efforts to improve plant procedures. The scope of the program shall include.....human factors engineering..." The current NRC guidance for developing a human factors engineering (HFE) program is NUREG-0711, Rev 3, "Human Factors Engineering Program Review Model." The applicant stated in the FSAR, Tier 2, Chapter 18 "Human Factors Engineering," that it was working in accordance with the criteria of NUREG-0711 in establishing its HFE program. This regulatory basis applies to all questions in this Request for Additional Information (RAI).

NUREG-0711, Criterion 8.4.3(1), states that "the topics in the applicant's style guide(s) should address the scope of human-system interfaces (HSIs) included in the design, and address their form, function, and operation, as well as the environmental conditions in which they will be used that are relevant to human performance."

The staff reviewed APR1400-E-I-NR-14012-P, Rev. 0, "Style Guide" (Style Guide), and found that environmental conditions for the main control room are described in Section 6.2, "Environment Design." The Style Guide, Section 1.1, "Scope," states that guidance in the Style Guide is applicable to the design of the main control room, technical support center, emergency operations facility, and remote shutdown room. However, the guidance in the Style Guide, Section 6.2, "Environment Design," states that the guidance is applicable to the main control room.

1. Clarify if the guidance in the Style Guide, Section 6.2, "Environment Design," is applicable also to the design of the technical support center, emergency operations facility, and remote shutdown room.

2. The Style Guide, Section 6.3, "Local Control Panel," states, "This HFE guideline is applicable to the LCSs associated with IHAs." No guideline is listed. Please provide some information in this section to clarify what guideline is applicable to LCSs associated with IHAs.
3. The Style Guide, Section 6.2.2, "Humidity," provides a lower limit for humidity that is different than the lower limit in NUREG-0700, Section 12.1.2.1-1, "Comfort Zone." Please justify the basis for the lower limit for humidity.

## **Response**

1. Section 6.2, "Environment Design" of the Style Guide is applicable to the main control room (MCR) and the remote shutdown room (RSR).

The technical support center (TSC) and the emergency operations facility (EOF) have no direct plant control functions and are designed to provide operations personnel with an ability to manage the plant and the necessary technical support needed during emergencies. Therefore, the control room environmental guidance is not applied to the TSC or the EOF.

Section 6.2, "Environment Design" of the Style Guide will be revised to specify the scope of applicable design guidance for the APR1400 HSI systems, as indicated in Attachment 1 to this response.

2. Section 6.3, "Local Control Panel" in the Style Guide will be revised to refer to NUREG-0700 (Rev. 2) as containing guidance applicable to the LCSs associated with important human actions (IHAs), as indicated in Attachment 2 to this response.
3. Subsection 6.2.2, "Humidity" of the Style Guide will be revised to indicate relative humidity levels should be maintained between 30% and 60%, as indicated in Attachment 3 to this response.

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### **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-14012-P/NP, Rev. 0, "Style Guide," Subsections 6.2, 6.3, and 6.2.2 will be revised as indicated in the attachments associated with this response.

- 2) line 2 - Component (Element) Name and Variable
- 3) line 3 - Component Number
- b) The engraving should be centered on the label.

**6.1.4.8 Panel Paint (coating)**

The color of NSSS and BOP cabinets located in the MCR should be distinct from the console (e.g., Warm Grey (Munsell No 8.4Y 8.3/0.5) is recommended).

**6.2 Environment Design**

Guidelines of this section are applicable to the MCR and RSR.

**6.2.1 Temperature**

The MCR should maintain temperatures of 20-26 °C (68-79 °F) for all seasons. Temperature difference from the head level to the floor level should not exceed 6 °C (10 °F).

**6.2.2 Humidity**

MCR and RSR

Humidity should be maintained at 20 to 60 % relative humidity. Humidity levels should not be adversely impacted by seasonal/climatic fluctuation. Therefore, humidification may be required during winter months and dehumidification during warmer months.

**6.2.3 Ventilation**

MCR and RSR

The ventilation system should be capable of introducing outdoor air into the MCR at a rate of at least 0.42 cubic meters per minute (14.8 cubic feet per minute) per occupant. Heating Ventilation and Air-Conditioning (HVAC) ducts should be designed such that hot or cold air should not blow directly on operators.

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0.56

**6.2.4 Lighting and Illumination**

**6.2.4.1 General Lighting and Illumination Guidelines**

- a) Supplemental Light - Supplemental lighting should be provided for personnel performing specialized visual tasks in areas where fixed illumination is not adequate.
- b) Task Area Luminance Ratios - to ensure effective visual performance, the task area luminance ratios should not be exceeded as below.

Areas	Luminance Ratio
Task Area (TA) vs. Adjacent darker surroundings	3:1
TA vs. Adjacent lighter surroundings	1:3
TA vs. more remote darker surfaces	10:1
TA vs. more remote lighter surface	1:10
Luminaries vs. Adjacent surface	20:1
Anywhere within normal field of view	40:1

- c) Shadowing - To reduce operator fatigue and eyestrain, shadows should be avoided.
- d) Color - Surface colors should be recognizable under both normal and emergency lighting conditions.
- e) Ambient Illumination and VDUs - The ambient illumination in the VDU area that is necessary for other visual functions (e.g., setting controls, reading instruments) should not degrade the visibility

- 80 dB(A). Higher noise levels may require ear protection, limited stay times, or both.
- 2) Unprotected Peak Levels - Park impulse or impact noise should not exceed 115 dB(A).  
Higher noise levels may require ear protection, limited stay times, or both.

### 6.3 Local Control Panel

~~This HFE guideline is applicable to the LCSs associated with IHAs.~~



Section 12.2, "Local Control Stations" of NUREG-0700 (Rev. 2) is applicable to the LCSs associated with IHAs. The following aspects of the LCSs will follow the guidance provided by NUREG-0700 (Rev.2) :

- Labeling
- Information Display
- Controls
- Communication
- Environment

- 2) line 2 - Component (Element) Name and Variable
- 3) line 3 - Component Number
- b) The engraving should be centered on the label.

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The color of NSSS and BOP cabinets located in the MCR should be distinct from the console (e.g., Warm Grey (Munsell No 8.4Y 8.3/0.5) is recommended).

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