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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.: 471-8581  
SRP Section: 09.05.03 – Lighting Systems  
Application Section:  
Date of RAI Issue: 04/26/2016

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### **Question No. 09.05.03-15**

In RAI 8466, Question 09.05.03-10, the staff requested the applicant to provide justifications for normal lighting' illumination levels that are lower than the levels recommended by NUREG 0700. In its response letter dated March 10, 2016, the applicant stated that the illumination levels as previously provided in lux are the typical values for representative areas in the plant. To avoid confusion, the applicant provided the illumination levels in units of foot candles. The staff finds that the lower limits of the ranges of illumination levels in foot candles are lower than the levels recommended by NUREG 0700.

In addition, the applicant stated that the illumination levels of 20-50 foot candles for the emergency diesel generator (EDG) building and the engineered safety features (ESF) equipment rooms is consistent with the illumination levels recommended by NUREG-0700. However, the illumination levels recommended by the NUREG-0700 for the EDG building and ESF equipment rooms is 50 foot candles.

NUREG-0800, Section 9.5.3, "Lighting Systems," states: "The lighting systems will be acceptable if they conform to the lighting levels recommended in NUREG-0700, which is based on the Illuminating Engineering Society of North America (IESNA) Lighting Handbook." NUREG-0700 recommended the following illumination levels for various tasks and work areas:

Control room:

- reading (handwritten (pencil)), writing, and data recording: 100 foot candles
- reading (printed or typed), maintenance area, and wiring area: 50 foot candles
- reading (video display unit): 10 foot candles

In-plant areas:

- Turbine building: 50 foot candles

- Laboratory: 100 foot candles
- ESF equipment: 50 foot candles
- Diesel generator building: 50 foot candles
- Fuel handling building: 50 foot candles
- Reactor building: 50 foot candles

To evaluate the adequacy of the normal lighting for the APR1400, provide justifications for having illumination levels lower than the levels recommended by NUREG-0700 for the above in-plant areas to show that tasks can be accomplished with the lower illumination. Also, provide the illumination levels for the above-mentioned reading, writing, data recording, and maintenance and wiring areas in the main control room.

## **Response**

The illumination levels in NUREG-0700, Table 12.1 are preferred levels. Therefore the illumination levels of each area in the APR1400 main control room (MCR), which are optimal for the operator may be different from those provided in Table 12.1 when considering the reflectance of task background in the MCR, the age of the operator, and the criticality of the task being performed in the MCR. In the APR1400, the dimming control system for the MCR is designed for the operator to be able to adjust the lighting to the illumination level for each task. The controlled illumination level ranges are as follows:

- Operator Console: 30-100 foot candles
- LDP Area: 5-10 foot candles
- Safety Console and Auxiliary Control Panel: 25-75 foot candles

In the technical support center (TSC) of the APR1400, only a large monitor and desk are located there and the 'Reading (printed or typed)' task in NUREG-0700, Table 12.1 is considered the main task. In consideration of this, the recommended illumination level for the TSC by NUREG-0700, Table 12.1 is 50 foot candles. The illumination level for the TSC of the APR1400 is 70 foot candles, which is a higher value than what is provided in NUREG-0700, Table 12.1.

In the remote shutdown room (RSR) of the APR1400, only the remote shutdown console, table, instrument equipment, and printer are located. Work areas or tasks such as 'Seated operator stations', 'Reading (handwritten (pencil))', and 'Writing and data recording' in the NUREG-0700, Table 12.1 are not considered. The recommended illumination level for the RSR by NUREG-0700, Table 12.1 is 50 foot candles. The illumination level for the RSR of the APR1400 is 70 foot candles, which is a higher value than what is provided in NUREG-0700, Table 12.1.

The illumination level for the laboratory in the APR1400 is 100 foot candles based on NUREG-0700, Table 12.10. The illumination level for the instrument repair room is 70 foot candles based on NUREG-0700, Table 12.1, 'Maintenance and wiring areas'.

The illumination levels for the reading, writing, data recording, and maintenance and wiring areas in the MCR of the AP1400 are as follows:

Reading:

- Handwritten (pencil): 100 foot candles
- Printed or typed: 50 foot candles
- Video display unit: 10 foot candles

Writing and data recording: 100 foot candles

Maintenance and wiring areas: 50 foot candles

These illumination levels may be adjusted with the dimming control system by the operators to provide the optimal illumination for the task they are performing, as described above.

For clarity, the illumination levels of areas in APR 1400 are modified and provided as indicated in the Attachment.

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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**

There is on impact on any Technical, Topical, or Environmental Report.

Building	Area	Illumination Level (Foot candles)
Reactor Containment	Operator Deck	50
	Others (Local Control Station Areas)	50
Auxiliary	Main Control Room	
	a. Operator Console	30-100 (Dimming Controlled)
	b. LDP Area	5-10 (Dimming Controlled)
	c. Safety Console and Auxiliary Control Panel	25-75 (Dimming Controlled)
	Computer Room	100
	Technical Support Center	70
	I&C Equipment Room	50
	Remote Shutdown Room	70
	Sample Room	100
	Fuel Handling over Pools	50
Fuel Transfer Pit	50	
Others (Local Control Station Areas)	20 and 50 depending on the areas	
Turbine Generator	Operator Deck	50
	Others (Local Control Station Areas)	50
Compound	Laboratory	100
	Instrument Repair Room	70
	Secondary Sample Room	100
	Office	100
	Operational Support Center	100
	Counting Room	100
	Control Room	100
	Others (Local Control Station Areas)	20 and 50 depending on the areas
Others	General Office	100
	Storage Room	20
	Stairway and Corridors	10
	ESW Building, CW Pump House	50
	Electrical Equipment Room such as Switchgear, MCC, LC, Relay, and Protection Panel	50
	EDG Building	50
	ESF Equipment Room	50
	CCW Heat Exchanger Building	20-50
	ECCS Equipment Area	20-50
	AAC GTG Building	20-50