

# REVISED SUPPLEMENTAL 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.: 293-8332  
SRP Section: 04.03 – Nuclear Design  
Application Section: 4.3.2.2.3  
Date of RAI Issue: 11/05/2015

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### **Question No. 04.03-4**

#### REQUIREMENTS AND GUIDANCE

10 CFR Part 50 Appendix A, General Design Criterion (GDC) 10 requires the reactor core design to include appropriate margin to ensure that specified acceptable fuel design limits (SAFDLs) are not exceeded during normal operation or anticipated operational occurrences (AOOs). GDC 11, “Reactor Inherent Protection,” requires that, in the power operating range, the prompt inherent nuclear feedback characteristics tend to compensate for a rapid increase in reactivity. GDC 20, “Protection System Functions,” requires automatic initiation of the reactivity control systems to assure that SAFDLs are not exceeded as a result of AOOs and that automatic operation of systems and components important to safety occurs under accident conditions. In addition, GDC 28, “Reactivity Limits,” requires that the effects of postulated reactivity accidents neither result in damage to the reactor coolant pressure boundary greater than limited local yielding nor cause sufficient damage to impair significantly the system’s capability to cool the core.

To assess compliance with these requirements, Section 4.3 of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” (SRP) guides the staff to review the applicant’s analysis of reactivity coefficients and power distributions for “steady-state operations and allowed load-follow transients.” In addition, SRP Section 15.0 guides reviewers to ensure that the application “specifies the permitted fluctuations and uncertainties associated with reactor system parameters and assumes the appropriate conditions, within the operating band, as initial conditions for transient analysis.”

#### ISSUE

Noting that the applicant refers to load-follow operations and transients in DCD Sections 4.3 and 4.4, the staff is concerned that the application lacks much of the information that would

necessary for approving the APR1400 design for load-follow operations. For example, the DCD does not specify the ranges of allowed load-follow power maneuvers (e.g., power swings, power ramp rates), does not detail how load-follow power maneuvers and resulting xenon transients would be controlled with rods versus soluble boron, and does not include analyses of core and system transients associated with load-follow operations. Moreover, the analyses presented in DCD Chapter 15 do not explicitly consider transient load-follow operational conditions in determining the most limiting initial operating conditions for analyzed transients and accidents.

#### INFORMATION NEEDED

In its response, the applicant should either provide all information necessary for the consideration of load-follow operations or else state that it is seeking approval of the APR1400 design only for defined baseload operations. The applicant should then revise the affected parts of the DCD and its incorporated references accordingly.

#### **Response**

APR1400 is basically requested for approval for baseload operation. However, it does not exclude a possible power change necessary for plant operation. For some instances, reactor power needs to be decreased to lower level due to plant conditions. Such plant operations can be divided into two categories, scheduled load maneuver and unexpected load transients such as load rejection. Power maneuvers with schedule load maneuver shall be performed within the limits of Technical Specifications (TS) and the safety analyses are not affected by such operations. Plant conditions during unexpected load transient can be outside of the limits of TS but they are restored automatically or manually after some periods of time. If the limits of TS are not met, power shall be decreased as required in TS.

Subsection 4.4.3.4 in DCD Tier 2 will be revised to clearly describe that APR1400 is requested for approval for baseload operation. Also, Subsection 4.3.2.2.3 in DCD Tier 2 will be revised for clarification.

#### **Supplemental Response – (Rev. 1)**

Load-following can be used in various manners. When it is used in comparison with base load, it is the load change operation depending on the electrical grid. This type of operation is characterized by continuous change in reactor power. Load-following is sometimes used in a wider meaning including the capability of reactor power change. Reactor power of APR1400 can be controlled automatically or manually. This type of operation by the reactor operator can be defined as normal power maneuvering operation. The APR1400 also has the loss of load capability up to full load rejection. Such operation is an unexpected load transient. Section C.I.4.4.3.5 in RG 1.206 requires that load-following characteristics are to be described. We think that it requires the control characteristics of the plant for load change. The APR1400 is base load plant but it has the load change capability for normal power maneuvers and unexpected load transients as described above.

KHNP/KEPCO is not requesting nor seeking certification or license approval for “load following” capability in the APR1400 DCA for the Fuel (PLUS 7) and the reactor systems in the nuclear island.

Subsection 10.2.1.2 in DCD Tier 2 Rev. 1 will be revised for clarification.

The markups revised in the response and the supplemental response (Rev. 0) were already included in DCD Rev. 1.

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### **Impact on DCD**

DCD Tier 2 Rev. 1, Subsection 10.2.1.2 will be revised as shown in Attachment.

### **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 no impact on any Technical, Topical, or Environment Report.

**APR1400 DCD TIER 2**

Sup. RAI 293-8332, 04.03-4 Rev.1

**10.2 Turbine Generator**

The T/G specification will address the following criteria, as identified in Subsection 10.2.5 COL Items and as verified by ITAAC. By establishing functional requirements, COL items, and ITAAC, instead of specifying a specific design in the DCD, assurance is provided that each APR1400 will be equipped with the design that best meets reliability and then current regulatory expectations for the T/G, the TGCS, and the overspeed protection system.

**10.2.1 Design Bases****10.2.1.1 Safety Design Bases**

The T/G system does not perform nor support any safety-related function and therefore has no safety design basis. Classification of the T/G system in regard to the seismic and safety and quality group is provided in Table 3.2-1 of Section 3.2.

However, because it is possible for the T/G system to generate high-energy missiles that could damage essential safety-related structures, systems, and components (SSCs), it is designed and controlled to minimize the potential for turbine missile generation. The T/G system is designed to meet the requirements of General Design Criterion (GDC) 4 as related to the protection of SSCs from the effects of turbine missiles described in Subsection 3.5.1.3.

**10.2.1.2 Non-Safety Power Generation Design Bases**

The T/G converts the energy of the steam produced in the SGs into rotational energy and then into electrical energy. The principal design features of the T/G are as follows:

- a. The T/G is designed for base load operation ~~and has load following capability.~~
- b. The T/G load change characteristics are compatible with the plant control system, which coordinates the T/G and reactor operations.
- c. The main turbine system is designed for electric power production consistent with the capability of the reactor and the reactor coolant system.
- d. The T/G is designed to be monitored and controlled automatically by the TGCS at normal or abnormal conditions, as described in Subsection 10.2.2.3. The TGCS