
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.: 177-8166
SRP Section: 08.01 – Electrical Power - Introduction
Application Section: 8.01
Date of RAI Issue: 08/31/2015

Question No. 08.01-5

10 CFR part 50, Appendix A Criterion 2 (GDC 2) —Design bases for protection against natural phenomena. Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions.

DCD section 8.2.2.1 states in part that GDC 2 requires that structures, systems, and components (SSCs) of the offsite power system be capable of withstanding the effects of natural phenomena (excluding earthquakes, tornadoes, hurricanes, and floods) without the loss of the capability to perform their safety functions. The offsite power system is designed to withstand the effects of natural phenomena such as high and low atmospheric temperatures, high wind, rain, lightning discharges, ice and snow conditions, and weather events.

DCD Sections 8.3.1.2.1, Conformance with General Design Criteria, Criterion 2 – Design Bases for Protection Against Natural Phenomena states in part that GDC 2 requires that systems and components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without the loss of their safety function capabilities. The Class 1E onsite ac power system and its components are located in seismic Category I structures that provide protection from the effects of natural phenomena. Class 1E equipment is seismically qualified, and its mounting and installation are seismically designed to worst-case design basis earthquake for the site.

DCD Sections 8.3.2.2.1, Conformance with General Design Criteria, Criterion 2 – Design Bases for Protection Against Natural Phenomena states in part that GDC 2 requires that systems and components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without the loss of their safety function capabilities. The Class 1E 125 Vdc power system and its components are located in seismic Category I structures that provide protection from the effects of natural phenomena. Class 1E equipment is seismically qualified and the mounting and installations are seismically designed to the worst-case design basis earthquake for the site.

DCD section 3.7, "Seismic Design," states in part that the APR1400 structures, systems, and components (SSCs) important to safety are designed to withstand the effects of earthquakes without loss of capability to perform their safety functions, as required by 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2.

DCD section 3.2.1, "Seismic Classification," states in part that General Design Criterion (GDC) 2 (Reference 1) requires, in part, that nuclear power plant SSCs important to safety be designed to withstand the effects of earthquakes without loss of capability to perform their safety function.

DCD section 3.5, "Missile Protection," states in part that In accordance with 10 CFR Part 50, Appendix A, GDC 2 and 4 (Reference 1), essential structures, systems, and components (SSCs) important to safety are required to be protected from internal and external missiles.

DCD section 3.5.1.4, "Missiles Generated by Tornadoes and Extreme Winds," states in part that related SSCs of the APR1400 are protected against the impact generated by tornado or hurricane missiles. The protection measures consist of seismic Category I structures, shields, and barriers to withstand the effects of missile impact generated by a tornado or hurricane. The protection provides reasonable assurance of conformance with 10 CFR Part 50, Appendix A, GDC 2 and 4 and 10 CFR 52.47(b)(1).

Please indicate whether the APR1400 offsite power system is important to safety and whether it is in compliance with the requirements of GDC 2. Clarify the difference in language between the DCD sections as it relates to conformance with GDC 2. NUREG-0800, Standard Review Plan (SRP) 8.2 states that GDC 2 requires that capability for the offsite power system to perform its functions be retained during the most severe natural phenomena that have been historically reported for the site and surrounding area. Please discuss how equipment and structures in the offsite power system, including the switchyard, are designed to withstand the effects associated with the aforementioned natural phenomena.

DCD Section 8.3.1.2.1, Conformance with General Design Criteria states in part that GDC 2 is addressed in Subsection 8.3.1.1.2. However, staff finds that additional detail in Subsection 8.3.1.1.2 is needed regarding the conformance of GDC 2. Please provide a discussion how the AC onsite power system conforms to GDC 2.

DCD Section 8.3.2.2.1 Conformance with General Design Criteria states in part that GDC 2 is addressed in Subsection 8.3.2.1.2. However, review of Subsection 8.3.2.1.2 does not provide sufficient detail as to the conformance of GDC 2. Please provide a discussion how the Class 1E DC power system conforms to GDC 2.

Response

The APR1400 offsite power system does not perform any safety function(s) and is classified as non-Class 1E and non-safety related. However, as indicated in DCD Tier 2, Section 3.2 and Table 17.4-1, the standby auxiliary transformers (SATs) have been determined to be a risk-significant component as a result of the design reliability assurance program (RAP), and consequently classified as "non-safety related but important to safety." The SATs are additionally classified to apply the augmented quality assurance program described in Section 17.5.

Based on this, the SATs are considered to be important to safety with regard to compliance of GDC 2 and designed to withstand the effects of natural phenomena such as high and low atmospheric temperatures, high wind, rain, ice and snow conditions, and weather events as specified in DCD Tier 2, Table 2.0-1 and Section 2.3, which provides information on assumed site-related parameters and regional climatology. DCD Tier 2, Subsection 8.2.2.1 will be revised to specify the applicability of GDC 2 to the “important to safety” offsite power system equipment and to provide additional description of the natural phenomena considered in the design of that equipment.

Since the plant switchyard design is not within the scope of the APR1400 design certification as mentioned in DCD Tier 2, Subsection 8.2.1.2, the design RAP process was not applied to the switchyard SSCs. When the COL applicant implements the detailed design of the switchyard, the COL applicant is also to implement the design RAP process for the switchyard to determine whether the switchyard equipment is important to safety and to apply the relevant requirements for the SSCs identified as important to safety. Development and implementation of this portion of the design RAP activities is within the scope of the COL applicant as specified in COL 17.4(1).

The description of the conformance with GDC 2 in Subsection 8.2.2.1 is somewhat different from that of Subsections 8.3.1.2.1 and 8.3.2.2.1 since the offsite power system is a non-Class 1E system, and thus, it is not subject to withstanding the effects of design basis natural phenomena such as earthquakes, tornadoes, hurricanes, and floods. This concept is supported by SRP Subsection 8.2.II.

The conformance with GDC 2 against earthquakes, tornadoes, hurricanes, and floods, considered as design bases for the Class 1E onsite ac, 125 Vdc, and 120 Vac instrumentation and control (I&C) power systems, is addressed in DCD Tier 2, Sections 3.3, 3.4, 3.5, and 3.7, respectively.

DCD Tier 2, Subsections 8.3.1.2.1 and 8.3.2.2.1 will be revised to clearly describe the conformance of the Class 1E onsite power system with GDC 2.

Impact on DCD

DCD Tier 2, Subsections 8.2.2.1, 8.3.1.2.1, and 8.3.2.2.1 will be revised as shown in the 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 Environmental Report.

APR1400 DCD TIER 2

8.2.2 Analysis

The offsite power system is designed to meet the following criteria.

8.2.2.1 Conformance with 10 CFR Part 50

10 CFR 50.63 – Loss of All Alternating Current Power

A light-water-cooled nuclear power plant is required by 10 CFR 50.63 (Reference 9) to be able to withstand or cope with, and recover from, an SBO. Electrical systems that are necessary to support systems in an SBO have sufficient capability and capacity to provide reasonable assurance that core cooling and appropriate containment integrity are maintained.

The APR1400 design has minimal potential for common-cause failures between the AAC power source used for an SBO and the offsite power system. Electrical ties and physical arrangement between these systems are designed not to prevent the use of an AAC power source during loss of the offsite power system. Conformance with the requirements of 10 CFR 50.63 is described in Section 8.4.

Criterion 2 – Design Bases for Protection Against Natural Phenomena

GDC 2 requires that structures, systems, and components (SSCs) of the offsite power system be capable of withstanding the effects of natural phenomena (excluding earthquakes, tornadoes, hurricanes, and floods) without the loss of the capability to perform their safety functions.

The offsite power system is designed to withstand the effects of natural phenomena such as high and low atmospheric temperatures, high wind, rain, lightning discharges, ice and snow conditions, and weather events. The offsite power system has two physically independent circuits with provisions to minimize the probability of simultaneous failure.

important to safety

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intended

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within the conditions given in Table 2.0-1. The lightning protection of the offsite power system is described in Subsection 8.3.1.1.8.

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components of the offsite power system, determined to be risk-significant non-safety related SSCs by the design reliability assurance program (RAP), are

APR1400 DCD TIER 2

8.3.1.2.1 Conformance with General Design Criteria

Criterion 2 – Design Bases for Protection Against Natural Phenomena

GDC 2 requires that systems and components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without the loss of their safety function capabilities.

The Class 1E onsite ac power system and its components are located in seismic Category I structures that provide protection from the effects of natural phenomena. Class 1E equipment is seismically qualified, and its mounting and installation are seismically designed to worst-case design basis earthquake for the site. ~~Conformance with GDC 2 is addressed in Subsection 8.3.1.1.2.~~

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Criterion 4 – Environmental and Dynamic Effects Design Bases

GDC 4 requires that systems and components important to safety be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents and be appropriately protected against dynamic effects, including the effects of missiles, that may result from equipment failures.

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The Class 1E ac power system is designed to provide power to systems important to safety during normal, abnormal, accident, and post-accident conditions. The equipment and components of the Class 1E onsite ac power system are designed to meet IEEE Std. 323 for qualifying Class 1E application equipment in nuclear power plants. Class 1E electrical distribution equipment is located away from high- or moderate-energy lines and potential internal missile areas. Conformance with GDC 4 is addressed in Section 3.1.

Criterion 5 – Sharing of Structures, Systems, and Components

GDC 5 is related to the sharing of SSCs. There are no shared SSCs because the APR1400 design is a single-unit plant.

Conformance with GDC 2 against earthquakes, tornadoes, hurricanes, and floods is provided in Sections 3.3, 3.4, 3.5, and 3.7, respectively.

APR1400 DCD TIER 2

8.3.2.2.1 Conformance with General Design Criteria

Criterion 2 – Design Bases for Protection Against Natural Phenomena

GDC 2 requires that systems and components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

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 The Class 1E 125 Vdc power system and 120 Vac I&C power system and their

delete

~~The Class 1E 125 Vdc power system and its components are located in seismic Category I structures that provide protection from the effects of natural phenomena. Class 1E equipment is seismically qualified and the mounting and installations are seismically designed to the worst-case design basis earthquake for the site. Conformance with GDC 2 is addressed in Subsection 8.3.2.1.2.~~
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Criterion 4 – Environmental and Dynamic Effect Design Bases

GDC 4 requires that systems and components important to safety be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents and be appropriately protected against dynamic effects, including the effects of missiles, that may result from equipment failures. The Class 1E 125 Vdc power system is designed to provide power to systems important to safety during normal, abnormal, accident, and post-accident conditions. The equipment and components of the Class 1E 125 Vdc power systems are designed to meet the IEEE Std. 323 for qualifying Class 1E application equipment in nuclear power plants. The Class 1E 125 Vdc electrical distribution equipment is located away from high- or moderate-energy lines and potential missile areas. Conformance with GDC 4 is described in Subsection 8.3.2.1.2.

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Criterion 5 – Sharing of Structures, Systems and Components

GDC 5 is related to the sharing of SSCs. There are no shared SSCs because the APR 1400 design is a single-unit plant.

Conformance with GDC 2 against earthquakes, tornadoes, hurricanes, and floods is provided in Sections 3.3, 3.4, 3.5, and 3.7, respectively.

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.: 177-8166
SRP Section: 08.01 – Electric Power – Introduction
Application Section: 8.1
Date of RAI Issue: 08/31/2015

Question No. 08.01-7

APR 1400 DCD Table 8.1-2, “Criteria and Guidelines for Electric Power Systems”, states in part that BTP 8-1, “Requirements on Motor-Operated Valves in the ECCS Accumulator Lines”, is applicable to DCD section 8.3.1 and DCD section 8.1.3.3, “General Design Criteria, NRC Regulatory Guides, Branch Technical Positions, Generic Letters, and Industry Standards,” and Table 1.9-2, “APR1400 Conformance with the Standard Review Plan,” states that the APR1400 conforms with BTP 8-1. The guidance in Standard Review Plan (SRP) section 8.1 states in part that the DCD should discuss the applicability of the criteria and guidelines listed and include a statement to the effect that they will be implemented or are implemented in the design of the electrical power systems.

Provide a discussion how BTP 8-1 applies to the APR1400 design, since this information is not in DCD chapter 8.

Response

The design of motor operated valves in the ECCS accumulator lines conforms to BTP 8-1 as currently addressed in DCD Tier 2, Subsections 6.3.2.5.1, 7.3.1.4, 7.6.1.4, and Figure 7.6-2.

Conformance with BTP 8-1 will be added in DCD Tier 2, Subsection 8.3.1.2.3, including the relevant subsections and tables.

Impact on DCD

The previously provided response to Question 08.01-8 (ref. KHNP submittal MKD/NW-15-0374L dated December 18, 2015; ML15352A274) added subsection 8.3.1.2.3, Conformance with Branch Technical Positions. Conformance to BTP 8-1 will be added to this section as shown in the attachment. Response to 08.01-8 also provided applicable revisions to Subsections 8.3.1.2

and 8.3.4 to include BTP 8-1 are not repeated in this response. Table 1.9-2 (17 of 33) will also be revised as shown in the 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 Environmental Report.

APR1400 DCD TIER 2

Table 1.9-2 (17 of 33)

SRP Section/Title	Revision / Issue Date	Conformance or Summary Description of Deviation	DCD Tier 2 Section
8.1 – Electric Power – Introduction	Rev. 4 02/2012	The APR1400 conforms with this SRP.	8.1
8.2 – Offsite Power System	Rev. 5 05/2010	The APR1400 conforms with this SRP.	8.2
8.3.1 – AC Power Systems (Onsite)	Rev. 4 05/2010	The APR1400 conforms with this SRP.	8.3.1
8.3.2 – DC Power Systems (Onsite)	Rev. 4 05/2010	The APR1400 conforms with this SRP.	8.3.2
8.4 – Station Blackout	Rev. 1 05/2010	The APR1400 conforms with this SRP.	8.4
App. 8-A – General Agenda, Station Site Visits	Rev. 1 03/2007	Not applicable (COL)	N/A
BTP 8-1 – Requirements on Motor-Operated Valves in the ECCS Accumulator Lines	Rev. 3 03/2007	The APR1400 conforms with this BTP.	8.1.3.3, Table 8.1-2
BTP 8-2 – Use of Diesel Generator Sets for Peaking	Rev. 3 03/2007	The emergency diesel generator (EDG) provides backup power to the safety-related loads for safety shutdown during a loss of offsite power (LOOP). However, the EDG is not used for peaking service for offsite power system. The APR1400 conforms with this BTP.	8.1.3.3, Table 8.1-2
BTP 8-3 – Stability of Offsite Power Systems	Rev. 3 03/2007	Not applicable (COL)	N/A
BTP 8-4 – Application of the Single Failure Criterion to Manually Controlled Electrically Operated Valves	Rev. 3 03/2007	The APR1400 conforms with this BTP.	8.1.3.3, Table 8.1-2

8.3.1.2.3

APR1400 DCD TIER 2

NRC RG 1.160 endorses Revision 4A of NUMARC 93-01 (Reference 45), which provides methods for complying with the provisions of 10 CFR 50.65 with some provisions and clarifications. Conformance with NRC RG 1.160 is addressed in Section 1.9.

NRC Regulatory Guide 1.204

NRC RG 1.204 is related to the guidelines for lightning protection of nuclear power plants.

The APR1400 onsite ac power system is designed to meet the requirements of IEEE Std. 665, IEEE Std. 666, IEEE Std. 1050, and IEEE Std. C62.23 (Reference 46), which are related to the lightning protection of nuclear power plants.

NRC Regulatory Guide 1.218

NRC RG 1.218 provides the cable design and maintenance criteria for the performance of periodic testing as part of the condition-monitoring techniques for the electric cables that are used in nuclear power plants. The inaccessible cable condition-monitoring techniques related to NRC RG 1.218 are addressed in Subsection 8.3.1.1.10.

8.3.1.3 Electrical Power System Calculations and Distribution System Studies
for AC System

The analysis of load flow, voltage regulation, and short-circuit studies is performed by using ETAP, version 12.0.0N, which is qualified for nuclear power plants in accordance with 10 CFR Part 21, 10 CFR Part 50, Appendix B (Reference 47), and ASME NQA-1 (Reference 48).

8.3.1.3.1 Load Flow/Voltage Regulation Studies and Under/Overvoltage Protection

Load flow studies of onsite power systems are performed to demonstrate that acceptance voltage regulation is maintained within 90 to 110 percent of the rated voltage at the equipment terminals under the worst-case condition among normal, startup, hot standby, and LOCA operation mode. Lager motor starting studies calculate the voltage drop so that motor terminal voltages are maintained at not less than acceptance voltage of 75 percent of motor rating for Class 1E motors and 80 percent of motor rating for non-Class 1E motors.

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8.3.1.2.3 Conformance with Branch Technical Positions

BTP 8-1, "Requirements on Motor-Operated Valves in the ECCS Accumulator Lines"

The design of motor operated valves in the ECCS accumulator lines conforms with BTP 8-1 (Reference 62). Conformance with BTP 8-1 is addressed in DCD Tier 2, Subsection 6.3.2.5.1, 7.3.1.4, 7.6.1.4, and Figure 7.6-2.