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.:	**165-8192**
SRP Section:	**08.04 – Station Blackout**
Application Section:	**8.4**
Date of RAI Issue:	**08/20/2015**

Question No. 08.04-6

10 CFR 50.63 requires that each nuclear power plant be capable of 1) coping with a station blackout (SBO) for a specified duration and 2) maintaining adequate core cooling and appropriate containment integrity for the SBO duration. RG 1.155, Positions C.3.2 and C.3.3 provide guidance for complying with these requirements of 10 CFR 50.63. In Section 8.4.2.2 of the DCD Tier 2, the applicant states: "[A]dditional coping analysis for the APR1400 is performed for the SBO and extended SBO. Conformance with NRC RG 1.155 position C.3.2 and C.3.3 is described in Subsections 8.4.1 and 19.2." Conformance to RG 1.155, Position C.3.2.5 regarding the availability of the AAC power source within 10 minutes of the onset of the SBO and Position C.3.3.5 is provided in Section 8.4.1 of the DCD.

a- Please provide a summary of the above coping analysis performed for the SBO.

b- Please discuss how the APR1400 design conforms to: (1) all the considerations, except C.3.2.5, recommended in RG 1.155, Positions C.3.2, and (2) RG 1.155, Position C.3.3 regarding the modifications, except C.3.3.5, to cope with the SBO.

Response

The following provides responses to each question of the staff.

a. Summary of the coping analysis performed for the SBO

As stated in DCD Tier 2, Subsection 8.4.2.2, the APR1400 has selected an Alternate Alternating Current (AAC) approach for SBO coping which does not require a coping analysis since the AAC source will be available within 10 minutes of the onset of the SBO.

Additional coping analysis for the SBO and extended SBO mentioned in existing DCD Tier 2, Subsection 8.4.2.2 is the one performed to address the Near-Term Task Force

(NTTF) recommendation 4.1, which was established as a result of the Fukushima Dai-Ichi event. The stated SBO and extended SBO is a condition postulated in the beyond design basis external event (BDBEE) which involves an extended loss of all alternating current power (ELAP) including the AAC source.

Further detailed information is provided in DCD Tier 2, Section 19.3.2.3 and Technical Report, Evaluations & Design Enhancements to Incorporate Lessons Learned from Fukushima Dai-Ichi Nuclear Accident (APR1400-E-P-NR-14005-P, Rev.0).

Since the coping analysis stated above is not in response to the SBO specified in RG 1.155, “additional coping analysis” will be removed from DCD Tier 2, Section 8.4.2.2.

b. APR1400 design conformance to RG 1.155 Section C.3.3, except C3.3.5

NUREG-0800, Standard Review Plan (SRP), describes in Subsection 8.4. III, 2 (SBO Coping Capability) that the design should conform to the recommendations in Section C.3.2.5, C3.3, and C3.5 and Appendix A and B to RG 1.155 in case an AAC approach is selected for SBO coping.

Discussion on design conformance of the APR 1400 with RG 1.155 regulatory position C3.3 (except 3.3.5) is provided as follows:

Regulatory Position of NRC RG 1.155	Conformance or Justification
If the plant's station blackout capability, as determined according to the guidance in Regulatory Position 3.2, is significantly less than the minimum acceptable plant-specific station blackout duration (as developed according to Regulatory Position 3.1 or as justified by the licensee or applicant on some other basis and accepted by the staff), modifications to the plant may be necessary to extend the time the plant is able to cope with a station blackout. If modifications are needed, the following items should be considered:	APR 1400 design conformance to each regulatory position is described below.
3.3.1. If, after considering load shedding to extend the time until battery depletion, battery capacity must be extended further to meet the station blackout duration recommended in Regulatory Position 3.1, it is considered acceptable either to add batteries or to add a charging system for the existing batteries that is independent of both the offsite and the blacked-out unit's onsite emergency ac power systems, such as a dedicated diesel generator.	The battery duty cycles of the APR1400 are 8 hours for Train A and Train B, and 16 hours for Train C and Train D. In the event of an SBO, since the AAC GTG will energize the shutdown bus (Train A or B) within 10 minutes of the onset of SBO, and the shutdown bus provides power for the DC loads necessary for the SBO coping duration via the battery charger and distribution bus, no additional DC equipment is required.

Regulatory Position of NRC RG 1.155	Conformance or Justification
3.3.2. If the capacity of the condensate storage tank is not sufficient to remove decay heat for the station blackout duration recommended in Regulatory Position 3.1, a system meeting the requirements of Regulatory Position 3.5 to resupply the tank from an alternative water source is an acceptable means to increase its capacity provided any power source necessary to provide additional water is independent of both the offsite and the blacked-out unit's onsite emergency ac power systems.	The APR 1400 design utilizes two (one per division) auxiliary feedwater (AFW) storage tanks for decay heat removal instead of a condensate storage tank. During an SBO, the auxiliary feedwater system (AFWS) provides decay heat removal by supplying makeup water to the steam generator through operation of a turbine driven AFW pump or a motor driven AFW pump. The motor driven AFW pumps can be powered from the AAC-GTG and made available within 10 minutes from the onset of an SBO. As stated in DCD Tier 2, Subsection 10.4.9, each AFW storage tank provides the required water volume to provide sufficient flow to the steam generator(s) and has 100% capacity water volume to achieve a safe cold shutdown. Thus, no additional make-up water source to the AFW storage tanks is required.
3.3.3. If the compressed air capacity is not sufficient to remove decay heat and to maintain appropriate containment integrity for the station blackout duration recommended in Regulatory Position 3.1, a system to provide sufficient capacity from an alternative source that meets Regulatory Position 3.5 is an acceptable means to increase the air capacity provided any power source necessary to provide additional air is independent of both the offsite and the blacked-out unit's onsite emergency ac power systems.	A loss of compressed air during an SBO causes all pneumatically operated safety related valves and control dampers served by the instrument air system to fail to the safe position. No alternative sources of compressed air are necessary to support an SBO condition for the APR1400. Therefore, unavailability of compressed air does not affect the capability to remove decay heat or to maintain containment integrity. Related descriptions are mentioned in DCD Tier 2, Subsection 9.3.1.3.
3.3.4. If a system is required for primary coolant charging and makeup, reactor coolant pump seal cooling or injection, decay heat removal, or maintaining appropriate containment integrity specifically to meet the station blackout duration recommended in Regulatory Position 3.1, the following criteria should be met: 1. The system should be capable of being actuated and controlled from the control room, or if other means of control are required, it should be demonstrated that these steps can be carried out in a timely fashion, and 2. If the system must operate within 10 minutes of a loss of all ac power, it should be capable of being actuated from the control room.	The MCR contains all of the control and/or monitoring provision for the operator to manually actuate the components of the systems necessary to cope with an SBO condition.

Regulatory Position of NRC RG 1.155	Conformance or Justification
3.3.6. If a system or component is added specifically to meet the recommendations on station blackout duration in Regulatory Position 3.1, system walk downs and initial tests of new or modified, systems or critical components should be performed to verify that the modifications were performed properly. Failures of added components that may be vulnerable to internal or external hazards within the design basis (e.g., seismic events) should not affect the operation of systems required for the design basis accident.	The APR1400 design includes the AAC GTG as the AAC power source for SBO mitigation. A test program will be conducted by the manufacturer/equipment vendor to verify the major equipment performance objectives (e.g., start time, rated speed and voltage times, stable voltage outputs, etc.). These tests will be conducted prior to the AAC GTG installation at the plant site. Prior to plant operation, the AAC power source and support components will be subject to pre-operational testing to demonstrate that the AAC GTG will perform its intended function (refer to the ITAAC listed in Tier 1 Table 2.6.6-1). Failure of the AAC power source or associated components due to operational events (internal or external hazards) will not affect the operation of safety related systems required for the design basis accidents. The AAC GTG is located in an independent building from the power block that contains the plant safety systems. The effects caused by failure of the AAC power source due to operational events are limited since the AAC power source is physically, mechanically and electrically isolated from the design basis engineered safety features in the power block. Further discussion on the independence and separation of the AAC GTG components from the systems required for DBAs is provided in the response to Question 08.04-7 of this RAI.
3.3.7. A system or component added specifically to meet the recommendations on station blackout duration in Regulatory Position 3.1 should be inspected, maintained, and tested periodically to demonstrate equipment operability and reliability.	This regulatory position is covered by Criterion 5 of Regulatory Position 3.3.5, which pertains to the AAC power source. The AAC GTG will be subject to periodic testing and inspection in order to verify the operability and reliability goals in the plant reliability assurance program as mentioned in DCD Tier 2, Subsection 8.4.1.6. Periodic maintenance of the AAC GTG and its support systems will be planned and implemented under the framework of the Maintenance Rule program.

DCD Tier 2, Subsection 8.4.2.2 will be revised to change “RG 1.155 Position C3.2” to “RG 1.155 Position C3.2.5” and Subsection 8.4.1.6 will be revised to include periodic inspection of the AAC-GTG source.

Impact on DCD

DCD Tier 2, Subsections 8.4.1.6 and 8.4.2.2 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.

The manual operation on the above procedures meets Appendix B requirements of NUMARC 87-00.

8.4.1.5 Recovery from SBO

Power is restored to the Class 1E buses from the onsite Class 1E EDGs or the offsite power sources within the SBO coping duration:

a. Restore onsite power system from offsite power sources

1) The output of AAC GTG is adjusted to synchronize with the offsite power source.

2) If the offsite source from UATs (or SATs) is available, the incoming breakers from the UATs (or SATs) to the Class 1E 4.16 kV buses are closed after synchronizing the AAC GTG with the offsite power source.

3) The AAC bus tie circuit breaker in the Class 1E 4.16 kV switchgear and the Class 1E bus tie circuit breaker in the AAC switchgear are tripped to isolate the Class 1E bus from the AAC GTG.

b. Restore onsite power system from the EDGs

1) The AAC bus tie circuit breaker in the Class 1E 4.16 kV switchgear and the Class 1E bus tie circuit breaker in the AAC switchgear are tripped to isolate the Class 1E bus from the AAC GTG.

2) The EDG is connected to required loads by EOP.

8.4.1.6 ~~Periodic Testing~~ Periodic Testing and Inspection

Add and Inspection

Periodic testing of the AAC meets the requirement of Criterion 5 for NRC RG 1.155 Position C.3.3.5 to demonstrate equipment operability and reliability.

NRC Regulatory Guide 1.155

The following requirements of NRC RG 1.155 are related to the AAC GTG and the loads applied for SBO coping conditions.

a. NRC RG 1.155 requires that each nuclear power plant have the capability to withstand and recover from an SBO lasting a specified minimum duration. The specified duration of SBO is based on the four factors as described in Subsection 8.4.1.2. Conformance with NRC RG 1.155 Position C.3.1 is described in Subsection 8.4.1.2.

b. There are two SBO coping methods. The first method is the "AC-Independent" approach. In this approach, nuclear power plants rely on available process steam, dc power, and compressed air to operate equipment necessary to achieve safe shutdown conditions until offsite power sources or EAC power sources are restored. The second method is the "Alternate AC" approach. This method is named for its use of equipment that is capable of being electrically isolated from the preferred offsite and emergency onsite ac power sources. The APR1400 selects the "Alternate AC" approach. NRC RG 1.155 specifies that no coping analysis is needed if the AAC power source is available within 10 minutes of the onset of an SBO. Therefore, the APR1400 is not required to perform an SBO coping analysis. ~~However, additional coping analysis for the APR1400 is performed for the SBO and extended SBO.~~ Conformance with NRC RG 1.155 Position ~~C.3.2~~ and C.3.3 is described in Subsection 8.4.1 ~~and Section 19.2.~~

C.3.2.5

c. NRC RG 1.155 Position C.3.4 is related to the training and procedures for all operator actions necessary to cope with an SBO. Conformance with NRC RG 1.155 position C.3.4 is described in Sections 13.2 and 13.5.

d. NRC RG 1.155 Position C.3.5 is related to the quality assurance (QA) activities and specification for a non-safety-related AAC that is installed to meet an SBO. The non-safety equipment installed to meet an SBO does not degrade the existing safety-related systems. The QA guidance for the AAC GTG is described in Chapter 17.

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Question No. 08.04-7

10 CFR 50.63 requires that an alternating AC (AAC) power source meets certain criteria to be considered an acceptable SBO coping capability. NUREG-0800, Section 8.4.III.3, “AAC power sources,” provides guidance for complying with these criteria. Section 8.4.1 of the DCD Tier 2 states: “The electrical connections between the offsite power and onsite power systems are described in Section 8.2.” Sections 8.2 and 8.4 of the DCD Tier 2 do not provide sufficient information to enable the NRC staff to make the determination that the requirements of 10 CFR 50.63 regarding the APR1400 AAC GTG source are satisfied. Thus, the NRC staff has the following questions:

a- Please provide the description of the electrical connections between the AAC power source and the offsite and onsite Class 1E power sources, and discuss how the APR1400 design conforms to the provisions in NUREG-0800, Section 8.4.III.3 Criterion B.i and B.iv in regards to the independence of the AAC power source. Also, please confirm that provisions for the AAC power source and failures of the AAC power components will not adversely affect the functioning of offsite and/or Class 1E onsite power systems.

b- Please discuss how the APR1400 design conforms to NUREG-0800, Section 8.4 III.3, Criteria D – G, I, and K – M.

Response

The following provides responses to each question of the staff.

a. A description of the electrical connection and independence of the AAC power source is provided below.

Electrical connections between AAC and preferred power supply (PPS) and Onsite Class 1E power sources

The alternate alternating current (AAC) gas turbine generator (GTG) has connection provisions to the Class 1E 4.16 kV SWGR 1A and 1B through the non-Class 1E 4.16 kV SWGR 3N. One normally open non-Class 1E circuit breaker (CB) between the AAC GTG and the non-Class 1E 4.16 kV SWGR 3N is provided and two normally open CBs in series are provided between the non-Class 1E AAC SWGR 3N and each Class 1E SWGRs 1A and 1B. The latter two CBs, provided in accordance with the Appendix B requirements of NRC RG 1.155 and NUMARC 87-00, consist of a non-Class 1E CB at the AAC SWGR 3N and a Class 1E CB at the Class 1E SWGR.

In addition, the AAC GTG has connection provision to the permanent non-safety (PNS) 4.16 kV SWGR 1M and 1N through the non-Class 1E 4.16 kV SWGR 3N. Two non-Class 1E CBs are provided in series between the non-Class 1E 4.16 kV SWGR 3N and each PNS 4.16 kV SWGR 1M and 1N. The configuration of the electrical connections between AAC GTG and the Class 1E and non-Class 1E SWGRs are shown in DCD Tier 2, Section 8.1 Figure 8.1-1.

Independence of the AAC power source from PPS and Class 1E onsite power systems

The independence of the AAC power source from the PPS and Class 1E power sources is realized by physical separation of the AAC power source, electrical isolation of power and control circuits, and control and protection scheme for the AAC power source. These measures for independence of the AAC power source ensures that the AAC power source and failures of the AAC power source components do not adversely affect the function of PPS and the Class 1E onsite power systems.

The following provides detailed descriptions of the independence of the AAC power source.

- Physical separation of AAC power source

  The AAC-GTG and the non-Class 1E AAC SWGR 3N are located in the AAC GTG building and the Class 1E and PNS SWGRs are located in the auxiliary building. The non-Class 1E AAC SWGR 3N has connection provisions to each of the Class 1E SWGRs 1A and 1B. The connections between the non-Class 1E AAC SWGR 3N and the Class 1E SWGR 1A and 1B are made by cables, which run through a underground common tunnel (UCT) installed between the AAC GTG building and the auxiliary building. The connections between the non-Class 1E AAC SWGR 3N and each Class 1E SWGR 1A and 1B are separated from the cables connecting the Class 1E SWGR 1A and 1B to the PPS as practicable such that impact on the connections of the AAC power source is minimized for events that affect the PPS.

  The physical location of the AAC GTG building, Class 1E 4.16 kV SWGR rooms in the auxiliary building, and the non-Class 1E 4.16kV SWGR room in the AAC GTG building are shown in DCD Tier 2, Figures 1.2-1, 1.2-13, and 1.2-40.

- Electrical isolation of power and control circuits

The power and control circuits of the non-Class 1E SWGR 3N are isolated by using isolation devices from the Class 1E SWGR 1A and 1B to prevent malfunctions in the non-Class 1E SWGR 3N causing unacceptable impacts to the Class 1E SWGR. The Class 1E CBs, relays, and contacts are used as isolation devices for the power and control circuits. All isolation devices conform to RG 1.75 and IEEE std. 384.

- Control and protection schemes for AAC power source

  Each of the Class 1E 4.16 kV SWGR 1A and 1B is powered by one of the PPS sources, the associated Class 1E EDG, or the non-Class 1E AAC power source. In order to prevent parallel operation of these power sources being connected to the Class 1E SWGR 1A or 1B, interlock schemes are provided for the controlled operation of the incoming CBs from the aforementioned power sources.

  In addition, the incoming CB connected to the AAC GTG and two CBs in series between the non-Class 1E AAC SWGR 3N and Class 1E SWGR 1A or 1B are provided with interlock and permissive schemes which prevent any unintended connections between the AAC-GTG and Class 1E SWGR 1A or 1B.

  During an SBO, the AAC GTG will be aligned to the Class 1E SWGR 1A or 1B and sequential loading of the Class 1E loads will be implemented manually by the operator. There is no control interface between the load shedding and sequencing schemes of the Class 1E EDG and the AAC power system control schemes. Therefore, the load shedding and sequencing schemes of the Class 1E EDG do not compromise the ability of the AAC power source alignment to the Class 1E SWGR.

b. Conformance to NUREG-0800, Section 8.4 III.3, Criteria D – G, I, and K – M is provided in the following tables.

Table 1 Conformance to NUREG-0800, Section 8.3.III.3 Criteria

NUREG-0800, Section 8.3.III.3 Criteria	Conformance or Justification
D. Plant staff in the control room monitor the performance of the AAC power source. As a minimum, monitoring should include the voltage, current, frequency, and circuit breaker position.	The performance monitoring parameters of the AAC power source from the control room consist of the voltage, current, frequency, VARs, watts, watt-hour, and power factor. Also, the status of the circuit breaker position is monitored from the control room.
E. The AAC source components are enclosed within structures that conform to the Uniform Building Code. Electrical cables connecting the AAC power source to the shutdown buses are protected against the events that affect the preferred ac power system. Buried cables or other appropriate methods can be used to accomplish this.	The structure of AAC GTG building, in which the AAC source components are located, will be designed to conform to the Uniform Building Code. The AAC power source components are located in the AAC GTG building and the Class 1E (shutdown buses) are located in the auxiliary building. The non-Class 1E AAC power source SWGR (3N) has connection provisions each to the Class 1E SWGRs 1A and 1B. The connections between the AAC power source and Class 1E SWGR 1A and 1B are made by cables, which run through an underground common tunnel (UCT) installed between the AAC GTG building and the auxiliary building. The connections, between the AAC power source and each Class 1E SWGR 1A and 1B, are appropriately separated from the cables connecting the Class 1E SWGR 1A and 1B to the preferred ac power system (PPS) as practicable such that impact on the connections of the AAC power source is minimized for the events that affect the PPS.
F. Nonsafety-related AAC power source(s) and associated dedicated dc system(s) should meet the QA guidance in Section 3.5, Appendix A, and Appendix B to RG 1.155.	As mentioned in DCD Tier 2, Subsection 8.4.2.2, the AAC GTG follows the Quality Assurance Program Description described in DCD Tier 2, Section 17.5, which applies the requirements of 10CFR50, Appendix B. Compliance with Appendix B to RG 1.155 is provided in Table 2.

NUREG-0800, Section 8.3.III.3 Criteria	Conformance or Justification
G. The AAC power system is equipped with a dedicated dc power system that is electrically independent from the blacked-out unit's preferred and Class 1E power systems and is of sufficient capability and capacity for operation of dc loads associated with the AAC source for the maximum necessary duration of AAC source operation.	A dedicated non-Class 1E 125 Vdc power system is provided in the AAC GTG building to supply the dc power necessary to start and operate the AAC GTG. The system consists of a battery, battery chargers, a dc control center, and distribution panels. The battery is sized based on the worst-case duty cycle of dc loads for the AAC system. The sizing of the battery is performed in accordance with IEEE Std. 485. The battery capacity for AAC system is 500 AH.
I. The AAC power system is provided with a fuel supply that is separate from the fuel supply for the onsite EAC power system. A separate day tank, supplied from a common storage tank, is acceptable if the fuel is sampled and analyzed using methods consistent with applicable standards before its transfer to the day tank.	The AAC GTG has a diesel fuel oil storage tank and a day tank separate from the onsite EDG system. Related descriptions are described in DCD, Tier 2 Subsection 9.5.9.2
K. The AAC power system is capable of operating during and after an SBO without any support system receiving power from the preferred power supply or the blacked-out unit's EAC power sources. The capability of the AAC to start on demand depends on the availability of the necessary support systems to fulfill their required function. These support systems may need varying combinations of dc or ac power for varying periods to maintain operational readiness. Information Notice (IN) 97-21 (Ref. 17) discusses two examples of a failure of the AAC to start on demand because of an extended loss of auxiliary electrical power sources.	The AAC GTG will be manually started to supply the electric power of Class 1E SWGR bus without receiving any externally provided AC or DC power source. DC power necessary for establishing the electric field excitation of generator and for control and protection of AAC power system is supplied from the dedicated battery set for the AAC power system.

NUREG-0800, Section 8.3.III.3 Criteria	Conformance or Justification
L. The portions of the AAC power system subjected to maintenance activities are/will be tested before returning the AAC power system to service.	As specified in NUMARC 87-00 Appendix B, the AAC power source is started and brought to operating conditions that are consistent with its function as an AAC power source at least every 3 months. The AAC GTG is started once every refueling outage to verify its availability within 10 minutes and the rated load capacity test is performed. In addition, the portions of the AAC GTG and its support systems subjected to maintenance activities will be tested before returning the AAC GTG and its support systems to service.
M. Plant-specific technical guidelines and emergency operating procedures will be implemented (or are in place, as applicable) that identify those actions necessary for placing the AAC power source in service.	All operator actions necessary for SBO coping including placing the AAC power source in service will be identified in the emergency operating procedures (EOPs) and associated technical guidelines. The COL applicant is to provide a program for developing the EOPs as specified in COL 13.5(5).

Table 2 Conformance to RG 1.155, Appendix B, Alternate AC Sources

RG 1.155, Appendix B, Alternate AC Sources		Conformance or Justification
Safety-Related Equipment (Compliance with IEEE-279)	Not required, but the existing Class 1E electrical systems must continue to meet all applicable safety-related criteria.	The AAC is non-safety related, but the existing onsite emergency power sources, buses and loads will continue to meet all applicable safety-related criteria since the AAC source is independent of the Class 1E electrical systems as noted in Table 1 Items E, G, I and K.
Diversity from Existing EDGs	See Regulatory Position 3.3.5 of this guide.	The APR1400 design will utilize an AAC power source that is diverse from that of the EDGs. A qualified gas turbine generator will be used as the AAC source.

RG 1.155, Appendix B, Alternate AC Sources		Conformance or Justification
Independence from Existing Safety-Related Systems	Required if connected to Class 1E buses. Separation to be provided by 2 circuit breakers in series (1 Class 1 E at the Class 1E bus and 1 non-Class 1E).	The two breakers in series, which are normally open, are provided between the Class 1E SWGR buses and AAC SWGR bus (one Class 1E at the Class 1E buses and anther non-Class 1E at the AAC SWGR bus).
Environmental Consideration	If normal cooling is lost, needed for station blackout event only and not for design basis accident (DBA) conditions. Procedures should be in place to effect the actions necessary to maintain acceptable environmental conditions for the required equipment. See Regulatory Position 3.2.4.	Equipment and environment cooling loss will be limited to 10 minutes (SBO duration). Normal plant cooling loads will be restored after shutdown loads are reestablished. Temperature rise conditions will be on the order of minutes rather than hours and no additional equipment or measures are necessary to supply interim cooling. Therefore, associated procedures are also not required.
Capacity	Specified in § 50.63 and Regulatory Position 3.3.5.	The AAC GTG has the sufficient capacity to supply required shutdown loads to bring and maintain the plant in a safe shutdown condition.
Quality Assurance	Indicated in Regulatory Position 3.5.	Quality assurance (QA) of the AAC GTG follows the QA program for the APR1400 design certification described in DCD Tier 2, Section 17.5, which applies the requirements of 10CFR50, Appendix B.
Technical Specification for Maintenance, Limiting Condition, FSAR, etc.	Should be consistent with the Interim Commission Policy Statement on Technical Specifications (Federal Register Notice 52 FR 3789) as applicable.	The AAC GTG and its support systems conform to the maintenance rule (MR) requirements in 10 CFR 50.65. The Interim Commission Policy Statement on Technical Specifications will be considered as applicable.
Instrumentation and Monitoring	Must meet system functional requirements.	The AAC power source instrumentation, controls and monitoring will be of sufficient number, type and quality to assure that the AAC GTG reliability goals are met.

RG 1.155, Appendix B, Alternate AC Sources		Conformance or Justification
Common Cause Failure (CCF)	Design should, to the extent practicable, minimize CCF between safety-related and non-safety-related systems.	The AAC power source will be physically, mechanically and electrically independent of the offsite and onsite power systems to the extent practicable in order to minimize CCF between safety related and non-safety related systems.

DCD Tier 2, Subsections 8.4.1.6 and 8.4.2.2 will be revised to adequately reflect the APR 1400 design conformance to NUREG-0800, Section 8.3.III.3 Criteria and RG 1.155.

Impact on DCD

DCD Tier 2, Subsections 8.4.1.6 and 8.4.2.2 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.

As specified in NUMARC 87-00 Appendix B, the AAC power source is started and brought to operating conditions that are consistent with its function as an AAC power source at least every 3 months. The AAC GTG is started once every refueling outage to verify its availability within 10 minutes and the rated load capacity test is performed.

ADD

The portions of the AAC GTG and its support systems subjected to maintenance activities will be tested before returning the AAC GTG and its support systems to service.

8.4.2 Analysis

8.4.2.1 Conformance with 10 CFR Part 50

10 CFR 50.63 – Loss of All Alternating Current Power

The APR1400 is designed to be able to withstand or cope with and recover from an SBO for a specified duration as defined in 10 CFR 50.63. Conformance with 10 CFR 50.63 is described in Subsections 8.4.1.2, 8.4.1.3, and 8.4.1.4.

10 CFR 50.65 – Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants

The AAC GTG performance monitoring is included as a part of the reliability assurance program and the maintenance rule program described in Section 17.4 and Section 17.6.

Appendix A to 10 CFR Part 50, General Design Criterion 17 and 18

Conformance with GDC 17 and 18 is described in Subsection 8.4.1.1.

8.4.2.2 Conformance with NRC Regulatory Guides

NRC Regulatory Guide 1.9

The guideline of NRC RG 1.9 is related to the design application and testing program of the Class 1E EDG in the nuclear power plant.

Conformance with NRC RG 1.9 is described in Subsection 8.3.1.2.2.

NRC Regulatory Guide 1.155

The following requirements of NRC RG 1.155 are related to the AAC GTG and the loads applied for SBO coping conditions.

a. NRC RG 1.155 requires that each nuclear power plant have the capability to withstand and recover from an SBO lasting a specified minimum duration. The specified duration of SBO is based on the four factors as described in Subsection 8.4.1.2. Conformance with NRC RG 1.155 Position C.3.1 is described in Subsection 8.4.1.2.

b. There are two SBO coping methods. The first method is the "AC-Independent" approach. In this approach, nuclear power plants rely on available process steam, dc power, and compressed air to operate equipment necessary to achieve safe shutdown conditions until offsite power sources or EAC power sources are restored. The second method is the "Alternate AC" approach. This method is named for its use of equipment that is capable of being electrically isolated from the preferred offsite and emergency onsite ac power sources. The APR1400 selects the "Alternate AC" approach. NRC RG 1.155 specifies that no coping analysis is needed if the AAC power source is available within 10 minutes of the onset of an SBO. Therefore, the APR1400 is not required to perform an SBO coping analysis. However, additional coping analysis for the APR1400 is performed for the SBO and extended SBO. Conformance with NRC RG 1.155 Position C.3.2 and C.3.3 is described in Subsection 8.4.1 and Section 19.2.

c. NRC RG 1.155 Position C.3.4 is related to the training and procedures for all operator actions necessary to cope with an SBO. Conformance with NRC RG 1.155 position C.3.4 is described in Sections 13.2 and 13.5.

d. NRC RG 1.155 Position C.3.5 is related to the quality assurance (QA) activities and specification for a non-safety-related AAC that is installed to meet an SBO. The non-safety equipment installed to meet an SBO does not degrade the existing safety-related systems. The QA guidance for the AAC GTG is described in Chapter 17.

ADD

Appendix B to RG 1.155 will be considered as a guidance to the technical specifications for the AAC GTG and its support systems

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.:	**165-8192**
SRP Section:	**08.04 – Station Blackout**
Application Section:	**8.4**
Date of RAI Issue:	**08/20/2015**

Question No. 08.04-8

Section 8.4.1 of the DCD Tier 2 stated that the AAC source the AAC GTG has sufficient capacity, to operate the system necessary for coping with the SBO for the time required to bring and maintain the plant in a safe shutdown condition. In Section 8.3 of the DCD Tier 2, Table 8.3.1-6 and Table 8.3.1-4 identifies the rating of the AAC GTG and the capacity of the SBO loads, respectively. The AAC GTG has an output rating of 9,700 kilo watts (kW) and the capacity of the SBO loads is 8,688.8 kW.

Please provide the power factor and kilo Volts Amperes (kVA) values for both the AAC GTG output rating and the total SBO loads, to ensure that the AAC power has sufficient capacity with margin to supply the reactive power dissipated by the SBO loads with motors in addition to the real power (kW).

Response

A power factor of 0.8 is considered for the AAC-GTG design. The running power factor of the AAC GTG loads is assumed to be 0.85 using conservative estimates based on the characteristics of the applicable loads.

Based on the power factors, the kVA values of the AAC GTG output rating and the total SBO loads are 12,125 kVA and 10,228 kVA, respectively, which ensure that the AAC GTG has sufficient capacity with margin to supply the reactive power dissipated by the SBO loads.

To incorporate minor changes in AAC GTG loads during an SBO, the DCD Tier 2, Table 8.3.1-4 will be revised.

Impact on DCD

DCD Tier 2, Table 8.3.1-4 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.

Table 8.3.1-4

AAC GTG Loads (SBO)

(Winter season)

Load Name	Quantity Installed	Voltage [V]	Load Rating [hp or kW]		Brake Horse Power [bhp]	Eff. [%]	Capacity [kW]	SBO	
								Quantity	Capacity [kW]
Safety Injection Pump	1	4,000	1,000	hp	898.5	90.0	744.76	1	744.76
Shutdown Cooling Pump	1	4,000	1,000	hp	940	90.0	779.16	1	779.16
Component Cooling Water Pump	1	4,000	2,355	hp	2,000	90.0	1,657.78	1	1,657.78
Essential Service Water Pump	1	4,000	1,248	hp	1,021	90.0	846.3	1	846.3
Cooling Tower Fan	1	4,000	900	hp	750	90.0	621.67	1	621.67
Motor-driven Auxiliary Feedwater Pump	1	4,000	1,260	hp	1,151	90.0	954.05	1	954.05
Essential Chiller	1	4,000	1,100	hp	930	90.0	770.87	1	~~770.87~~ 760.92
Subtotal (4.16 kV Loads)									6,364.64
Auxiliary Charging Pump	1	460	100	hp	100	90.0	82.89	1	82.89
Cooling Tower Makeup Pump	1	460	157	hp	139.8	90.0	115.88	1	115.88
Spent Fuel Pool Cooling Pump	1	460	100	hp	93.4	90.0	77.42	1	77.42
Control Room Supply AHU Fan	1	460	125	hp	104	90.0	86.2	1	86.2
Control Room Supply AHU Elec. Heating Coil	1	480	225	kW		100.0	225.00	1	225
EDG Room Normal Supply AHU Elec. Heating Coil	1	480	211	kW		100.0	211.00	1	211
Class 1E Battery Room Elec. Duct Heater	1	480	109	kW		100.0	109	1	109
Class 1E 125 Vdc Battery Charger	1	480	125	kVA		112.5 ~~106.3~~		1	~~106.3~~ 112.5
Class 1E 480V MCC Loads							698.93		698.93
Subtotal (480V Loads)									~~1,713.62~~ 1,718.82
AAC Facility Loads									610.54
Total loads of AAC GTG									~~8,688.8~~ 8,694

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.:	**165-8192**
SRP Section:	**08.04 – Station Blackout**
Application Section:	**8.4**
Date of RAI Issue:	**08/20/2015**

Question No. 08.04-9

10 CFR 50.65(a)(4) relates to the assessment and management of the increase in risk that result before performing the SBO maintenance activities. In Section 8.4.2.1 of the DCD Tier 2, the applicant stated that the AAC GTG performance monitoring is included in the reliability assurance program and the maintenance rule program described in Section 17.4 and 17.6 of the DCD.

Please confirm that all systems, including the AAC GTG support systems, provided to mitigate the SBO conform to 10 CFR 50.65(a)(4).

Response

KHNP confirms that the AAC power systems, including the AAC GTG support systems, which are provided to mitigate an SBO conform to the Maintenance Rule requirements in 10 CFR 50.65 since they are included in the emergency operating procedures (EOPs).

Planning and implementation of the Maintenance Rule program are within the scope of the COL applicant as stated in DCD Section 17.6.

Impact on DCD

DCD Tier 2, subsection 8.4.2.1 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.

As specified in NUMARC 87-00 Appendix B, the AAC power source is started and brought to operating conditions that are consistent with its function as an AAC power source at least every 3 months. The AAC GTG is started once every refueling outage to verify its availability within 10 minutes and the rated load capacity test is performed.

8.4.2 Analysis

8.4.2.1 Conformance with 10 CFR Part 50

ADD

The AAC power systems, including the AAC GTG support systems, which are provided to mitigate an SBO conform to the Maintenance Rule requirements in 10 CFR 50.65 since they are included in the emergency operation procedures (EOPs).

10 CFR 50.63 – Loss of All Alternating Current Power

The APR1400 is designed to be able to withstand or cope with and recover from an SBO for a specified duration as defined in 10 CFR 50.63. Conformance with 10 CFR 50.63 is described in Subsections 8.4.1.2, 8.4.1.3, and 8.4.1.4.

10 CFR 50.65 – Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants

The AAC GTG performance monitoring is included as a part of the reliability assurance program and the maintenance rule program described in Section 17.4 and Section 17.6.

Appendix A to 10 CFR Part 50, General Design Criterion 17 and 18

Conformance with GDC 17 and 18 is described in Subsection 8.4.1.1.

8.4.2.2 Conformance with NRC Regulatory Guides

NRC Regulatory Guide 1.9

The guideline of NRC RG 1.9 is related to the design application and testing program of the Class 1E EDG in the nuclear power plant.

Conformance with NRC RG 1.9 is described in Subsection 8.3.1.2.2.