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.:	**412-8525**
SRP Section:	**08.04 – Station Blackout**
Application Section:	**08.04**
Date of RAI Issue:	**02/22/2016**

Question No. 08.04-13

In response to RAI 8192, Question 08.04-6.b, the applicant provided conformance of the APR1400 design to RG 1.155, Position C.3.3 (except 3.3.5). The applicant did not discuss conformance with Position C.3.3, other than C.3.3.5, in the DCD.

a. Please revise Section 8.4 of the DCD Tier 2 to include a discussion of how the APR1400 design conforms to RG 1.155, Position C.3.3.

b. For conformance with Position C.3.3.4, the applicant states: “The [main control room] 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.” Please discuss whether the systems necessary to cope with a station blackout event can also be actuated and controlled from the remote shutdown room (RSR).

c. Regarding conformance with RG 1.155, Position C.3.2, the applicant stated that NUREG-0800, Section 8.4.III.2 (SBO Capability) recommends that the design be conformed to Position C.3.2.5 only. Position C.3.2 provides guidance for determining a plant’s capability to cope with an SBO. Since a coping analysis is not required for the APR1400, please confirm that the APR1400 design has the capability to maintain adequate core cooling and appropriate containment integrity for the SBO coping duration.

Response

Below are the responses to the items that the staff has requested above.

a. The conformance of the APR1400 with RG 1.155 regulatory position C.3.3 will be provided in DCD Tier 2, Subsection 8.4.1.1, and Table 8.4.1-1 as shown in the attachment.

b. The justification for conformance to RG 1.155 C.3.3.4 will be updated to state that the MCR and RSR contain all of the control and/or monitoring provisions for the operator to manually actuate the components of the systems necessary to cope with an SBO condition, as shown in the attachment.

c. The AAC GTG is started and manually connected to the shutdown bus within ten minutes of the onset of an SBO. During the period of time from the onset of an SBO to AAC GTG connection to the shutdown bus, the APR1400 is designed to have the capability to maintain a hot standby condition as well. Accordingly, KHNP confirms that APR1400 design has the capability to maintain adequate core cooling and appropriate containment integrity for the SBO coping duration, including the ten minutes from the beginning of the SBO event. During the ten minutes, the APR1400 is designed to maintain adequate core cooling from natural circulation cooldown without operator actions.

Impact on DCD

DCD Tier 2, Subsections 8.4.1.1 and 8.4.4 will be revised and a new Table 8.4.1-1 will be added 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.

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8.4 Station Blackout

8.4.1 System Description

Station blackout (SBO) is the complete loss of alternating current (ac) electric power to the Class 1E and non-Class 1E switchgear buses in the APR1400. The SBO involves the loss of offsite power (LOOP) concurrent with a turbine trip and failure of the onsite emergency ac power system, but it does not include the loss of available ac power to buses fed by station batteries through inverters or the loss of the power from the alternate ac (AAC) source.

8.4.1.1 Description

The offsite and onsite power systems are designed with sufficient independence, capacity, and capability to meet the requirements of General Design Criterion (GDC) 17 (Reference 1). The offsite and onsite systems are also designed to permit periodic inspection and testing in accordance with GDC 18 (Reference 2). The electrical connections between the offsite power system and onsite power systems are described in Section 8.2. The onsite power system is described in Section 8.3.

During an SBO, a non-Class 1E AAC gas turbine generator (GTG) with sufficient capacity, capability, and reliability provides power for the set of required shutdown loads (non-design-basis accident) to bring the plant to safe shutdown. The AAC GTG is started and manually connected to the ~~set of required~~ shutdown ~~equipment~~ bus within 10 minutes in accordance with Position C.3.2.5 of NRC RG 1.155 (Reference 3).

Training and procedures necessary to cope with an SBO for APR1400 plant operators are described in Section 13.2 and Section 13.5.

8.4.1.2 Station Blackout Coping Duration

The SBO coping duration is determined by the following four design factors as specified in 10 CFR 50.63 (Reference 4) and NRC RG 1.155 Position C.3.1.

Conformance of APR1400 with RG 1.155 regulatory position C.3.3 is addressed as shown in Table 8.4.1-1.

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8.4.3 Combined License Information

COL 8.4(1) The COL applicant is to identify local power sources and transmission paths that could be made available to resupply power to the plant following the loss of a grid or the SBO.

COL 8.4(2) The COL applicant is to develop detailed procedures for manually aligning the alternate AC power supply when two (Trains A and B) of the four diesel generators are unavailable during a loss of offsite power event.

8.4.4 References

1. 10 CFR Part 50, Appendix A, General Design Criterion 17, “Electric Power Systems,” U.S. Nuclear Regulatory Commission.

2. 10 CFR Part 50, Appendix A, General Design Criterion 18, “Inspection and Testing of Electric Power Systems,” U.S. Nuclear Regulatory Commission.

3. Regulatory Guide 1.155, “Station Blackout,” U.S. Nuclear Regulatory Commission, August 1988.

4. 10 CFR 50.63, “Loss of All Alternating Current Power,” U.S. Nuclear Regulatory Commission.

5. Regulatory Guide 1.9, “Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants,” Rev. 4, U.S. Nuclear Regulatory Commission, March 2007.

6. NSAC-108, “Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants,” Electric Power Research Institute, September 1986.

7. NUMARC 87-00, “Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors,” Rev. 1, Nuclear Energy Institute, August 1991.

New Table Added (Next page)

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Table 8.4.1-1 (1 of 5)
Conformance with RG 1.155 Regulatory Position C.3.3

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:	APR1400 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.
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 APR1400 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 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.

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Table 8.4.1-1 (2 of 5)
Conformance with RG 1.155 Regulatory Position C.3.3

Regulatory Position of NRC RG 1.155	Conformance or Justification
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 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 and RSR contain 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.
3.3.5. If an AAC power source is selected specifically for satisfying the requirements for station blackout, the design should meet the following criteria: 1. The AAC power source should not normally be directly connected to the preferred or the blacked-out unit's onsite emergency ac power system.	The APR1400 design is compliant with the requirement. The design considerations of AAC power source and its periodic testing are described in Subsection 8.4.1.3, and 8.4.1.6.

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Table 8.4.1-1 (3 of 5)
Conformance with RG 1.155 Regulatory Position C.3.3

Regulatory Position of NRC RG 1.155	Conformance or Justification
2. There should be a minimum potential for common -cause failure with the preferred or the blacked-out unit's onsite emergency ac power sources. No single-point vulnerability should exist whereby a weather-related event or single active failure could disable any portion of the blacked-out unit's onsite emergency ac power sources or the preferred power sources and simultaneously fail the AAC power source. 3. The AAC power source should be available in a timely manner after the onset of station blackout and have provisions to be manually connected to one or all of the redundant safety buses as required. The time required for making this equipment available should not be more than 1 hour as demonstrated by test. If the AAC power source can be demonstrated by test to be available to power the shutdown buses within 10 minutes of the onset of station blackout, no coping analysis is required. 4. The AAC power source should have sufficient capacity to operate the systems necessary for coping with a station blackout for the time required to bring and maintain the plant in safe shutdown. 5. The AAC power system should be inspected, maintained, and tested periodically to demonstrate operability and reliability. The reliability of the AAC power system should meet or exceed 95 percent as determined in accordance with NSAC-108 (Ref. 11) or equivalent methodology. An AAC power source serving a multiple-unit site where onsite emergency ac sources are not shared between units should have, as a minimum, the capacity and capability for coping with station blackout in any of the units.	

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Table 8.4.1-1 (4 of 5)
Conformance with RG 1.155 Regulatory Position C.3.3

Regulatory Position of NRC RG 1.155	Conformance or Justification
At sites where onsite emergency sources are shared between units, the AAC power sources should have the capacity and capability to ensure that all units can be brought to and maintained in safe shutdown (i.e., those plant conditions defined in plant technical specifications as Hot Standby or Hot Shutdown, as appropriate). Plants have the option of maintaining the RCS at normal operating temperatures or at reduced temperatures. Plants that have more than the required redundancy of emergency ac sources for loss-of-offsite-power conditions, on a per nuclear unit basis, may use one of the existing emergency sources as an AAC power source provided it meets the applicable criteria for an AAC source. Additionally, emergency diesel generators with 1-out-of-2-shared and 2-out-of-3-shared ac power configurations may not be used as AAC power sources.	
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.

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Table 8.4.1-1 (5 of 5)
Conformance with RG 1.155 Regulatory Position C.3.3

Regulatory Position of NRC RG 1.155	Conformance or Justification
	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. 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. Further discussion on the independence and separation of the AAC GTG components from system required for DBAs is provided in Subsection 8.4.1.3.
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 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.

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.:	**412-8525**
SRP Section:	**08.04 – Station Blackout**
Application Section:	**08.04**
Date of RAI Issue:	**02/22/2016**

Question No. 08.04-15

In response to RAI 8192, Question 08.04-7.b, the applicant discussed conformance to NUREG-0800, Section 8.3.III.3 Criteria D – G, I, and K – M.

a. The applicant did not discuss conformance with NUREG-0800, Section 8.3.III.3 in the DCD. Please revise Section 8.4 of the DCD Tier 2 to include conformance of the APR1400 design with NUREG-0800, Section 8.3.III.3, Criteria D – I, K – M.

b. Regarding conformance with Criterion D, the applicant stated that voltage, current, frequency, volt-ampere reactive, watts, watt-hour, power factor, and circuit breaker position of the AAC power source are monitored from the control room. Please specify which control room is being referred to in this statement, and confirm that the performance monitoring of the AAC power source is available in both the main control room and the remote control room. If either the MCR and RSR does not have the above monitoring capabilities, please discuss how performance of the AAC GTG will be monitored in the specific control room during an SBO event.

c. Criterion F recommends that the non-safety related AAC power source(s) and associated dedicated direct current (dc) system(s) meet the quality assurance (QA) guidance in Position 3.5, Appendix A, and Appendix B of RG 1.155. In the RAI response, the applicant discussed the QA program for the AAC GTG only. The applicant also provided the specifications of the AAC power source in accordance with RG 1.155, Appendix B.

   i. Please clarify whether the support systems are included in the QA program for the AAC GTG. Also, please revise Section 8.4 of the DCD Tier 2 to include conformance of the AAC GTG with RG 1.155, Appendix B.

   ii. Appendix A provides QA guidance for non-safety systems and equipment. Appendix B discusses specifications of system and station equipment such as

water source, instrument air, and water delivery system. Please state how the APR1400 design conforms to RG 1.155, Position 3.5, Appendix A, Appendix B in regards to non-safety related systems. Also, please revise Section 8.4 of the DCD Tier 2 to include conformance of the non-safety related systems with RG 1.155, Position 3.5, Appendix A, and Appendix B.

Response

Below are the responses to the items that the staff has requested above:

a. Conformance to NUREG-0800, Section 8.4.III.3, Criteria D – G, I, and K – M will be added to DCD Tier 2 as a new Subsection, 8.4.2.3.

b. KHNP confirms that all of the performance monitoring parameters listed in the response to RAI 8192, Question 08.04-7.b (ref. MKD/NW-15-0269L dated November 18, 2015; ML15322A404) for the AAC power source compliance to Criterion D are available in both the Main Control Room and The Remote Shutdown Room.

c. The responses to each item are as follows:

   i. The support systems such as fuel oil, lube oil, engine cooling water, starting air, and combustion air intake and exhaust are included in the QA program for the AAC GTG. The APR1400's design conformance to RG 1.155 Appendix B will be added to DCD Tier 2 Subsection 8.4.2.2 as a new paragraph "e."

   ii. Design conformance to RG 1.155 Positon 3.5 and Appendix A was provided in KHNP's response to RAI 8192, Question 08.04-7.b and in DCD Subsection 8.4.2.2, including the response to item c.i above. The AAC GTG is designed and installed to meet the station blackout rule and has its own independent support systems not subject to a water source, instrument air or water delivery system of any other safety related system described in RG 1.155, Appendix B. Thus, system and station equipment specifications for such functions as water source, instrument air, and water delivery system do not need to account for the AAC GTG. The provided response to RAI 8192, Question 08.04-7.b, Table 2 addresses the conformance of AAC sources in RG 1.155 Appendix B. DCD Tier 2 Subsection 8.4.2.2 will be revised to include conformance of the non-safety related systems with RG 1.155 Position 3.5, Appendix A and Appendix B.

Impact on DCD

DCD Tier 2, Subsection 8.4.2.2 will be revised and Table 8.4.2-1, 8.4.2-2, Subsection 8.4.2.3 will be added 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.

RAI 165-8192 - Question 08.04-7

RAI 412-8525 - Question 08.04-15

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 criteria ~~guidance~~ to the technical specifications for the AAC GTG and its support systems

insert A (Next page)

insert B (Next page)

RAI 165-8192 - Question 08.04-7

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A

e. The AAC GTG installed to meet the station blackout rule has its own independent system not subject to water source, instrument air and water delivery system of existing system is not accurate since none are built yet. Other safety-related systems described in RG 1.155 and therefore cannot degrade other safety-related systems. Conformance or justification of AAC Sources (AAC GTG) with RG 1.155 Appendix B is addressed as shown in Table 8.4.2-1.

B

8.4.2.3 Conformance with NUREG-0800

Standard Review Plan, Section 8.4.III.3, Criteria D to I and K to M

Conformance of APR1400 design with the NUREG-0800, Section 8.4.III.3, Criteria D to I and K to M is addressed as shown in Table 8.4.2-2.

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8.4.3 Combined License Information

COL 8.4(1) The COL applicant is to identify local power sources and transmission paths that could be made available to resupply power to the plant following the loss of a grid or the SBO.

COL 8.4(2) The COL applicant is to develop detailed procedures for manually aligning the alternate AC power supply when two (Trains A and B) of the four diesel generators are unavailable during a loss of offsite power event.

8.4.4 References

1. 10 CFR Part 50, Appendix A, General Design Criterion 17, "Electric Power Systems," U.S. Nuclear Regulatory Commission.

2. 10 CFR Part 50, Appendix A, General Design Criterion 18, "Inspection and Testing of Electric Power Systems," U.S. Nuclear Regulatory Commission.

3. Regulatory Guide 1.155, "Station Blackout," U.S. Nuclear Regulatory Commission, August 1988.

4. 10 CFR 50.63, "Loss of All Alternating Current Power," U.S. Nuclear Regulatory Commission.

5. Regulatory Guide 1.9, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants," Rev. 4, U.S. Nuclear Regulatory Commission, March 2007.

6. NSAC-108, "Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants," Electric Power Research Institute, September 1986.

7. NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," Rev. 1, Nuclear Energy Institute, August 1991.

New Table Added (Next page)

RAI 165-8192 - Question 08.04-7

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Table 8.4.2-1 (1 of 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.
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.

RAI 165-8192 - Question 08.04-7

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Table 8.4.2-1 (2 of 2)

RG 1.155, Appendix B, Alternate AC Sources		Conformance or Justification
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.
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.

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Table 8.4.2-2 (1 of 3)
Conformance to NUREG-0800, Section 8.4.III.3 Criteria D to I and K to M

NUREG-0800, Section 8.4.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 main control room and remote shutdown 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 as following Table “Conformance to RG 1.155, Appendix B, Alternate AC Sources”.

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Table 8.4.2-2 (2 of 3)

NUREG-0800, Section 8.4.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.

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Table 8.4.2-2 (3 of 3)

NUREG-0800, Section 8.4.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).

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.:	**412-8525**
SRP Section:	**08.04 – Station Blackout**
Application Section:	**8.4**
Date of RAI Issue:	**02/22/2016**

Question No. 08.04-17

In response to RAI 8216, Question 08.04-10, the applicant confirmed that the AAC GTG will be connected to the Class 1E 4.16 kV switchgear (1A or 1B) within 10 minutes of the onset of the station blackout (SBO). In addition, the licensee stated that after the AAC GTG reaches rated speed and voltage, operators will connect the AAC GTG to the selected Class 1E 4.16 kV (1A or 1B) bus by closing three circuit breakers in accordance with the emergency operating procedures from the control room. In Section 8.4.1.4 of the DCD Tier 2, the applicant provided information for aligning the AAC GTG to the dedicated train of the onsite Class 1E switchgear buses (train A or train B).

a. Please confirm that the transfer of the AAC GTG power supply from the PNS buses to the dedicated Class 1E bus will not affect the required 10-minute timing for connecting to the Class 1E bus during an SBO event.

b. The applicant provided an ITAAC in DCD Tier 1, Table 2.6.6-1, Item 4 to verify that the as-built AAC source is started and connected manually to the as-built class 1E train bus within 10 minutes of the onset of a simulated SBO event. Please clarify whether the tests will include verification of the AAC GTG power transfer from the PNS buses to the dedicated Class 1E bus within 10 minutes of the onset of the SBO. If not, please provide an ITAAC for this verification.

Response

The AAC gas turbine generator (GTG) power supply is transferred from the permanent non-safety (PNS) buses to the dedicated Class 1E bus during SBO event without affecting the required 10-minute timing for connecting the AAC GTG to the Class 1E bus.

In the event of a LOOP, the AAC GTG is automatically started and manually connected to two PNS buses. At the onset of an SBO (when the onsite EDGs fail to resolve the LOOP condition),

the AAC GTG power source is manually transferred to one of the Class 1E buses (train A or B) from the PNS buses. Since the AAC GTG would be running and supplying power to the PNS buses during a LOOP, the transfer of the AAC GTG to the Class 1E bus during an SBO does not require the steps for AAC GTG starting and acceleration. Instead, the PNS buses will be disconnected from the AAC GTG before one of the Class 1E buses (train A or B) is manually aligned to the AAC GTG. The process of transferring the AAC GTG power source from the PNS buses to a Class 1E bus is to be completed within 10 minutes of the onset of the SBO.

The detailed procedures for manual transfer of the AAC GTG power supply to the Class 1E bus within 10 minutes is to be provided by the COL applicant as stated in COL 8.4(2).

To ensure there is an ITAAC that demonstrates that the AAC GTG power transfer from the PNS buses to the Class 1E bus can be performed within 10 minutes of the onset of an SBO, DCD Tier 1, Table 2.6.6-1, Item 4 will be revised as shown in the Attachment.

Impact on DCD

DCD Tier 1, Table 2.6.6-1, Item 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.

APR1400 DCD TIER 1

RAI 206-8216 - Question 08.04-10

RAI 412-8525 - Question 08.04-17

Table 2.6.6-1 (1 of 3)

Alternate AC Source ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the AAC source is as described in the Design Description of Subsection 2.6.6.1.	1. Inspection of the as-built AAC source will be performed.	1. The as-built AAC source conforms with the functional arrangement described in the Design Description of Subsection 2.6.6.1.
2. The AAC source is sized with sufficient capacity to accommodate SBO or LOOP conditions.	2.a Analyses will be performed to verify that the AAC source is capable of supplying power for SBO or LOOP conditions.	2.a A report exists and concludes that the calculated size of the AAC source gives it the sufficient capacity to accommodate SBO or LOOP loads.
	2.b Inspections will be performed to verify that the rating of the as-built AAC source is consistent with the analysis.	2.b The rating of the as-built AAC source is consistent with the analysis.
3. The AAC source is connected to the Class 1E train A or train B bus through two in series (one Class 1E circuit breaker at the Class 1E bus and the other non-Class 1E circuit breaker at the non-Class 1E AAC bus) circuit breakers during SBO condition.	3. Inspection of the connection between as-built Class 1E train bus and as-built AAC source will be performed.	3. The as-built AAC source is connected to the Class 1E train A or train B bus through two in series (one Class 1E circuit breaker at the Class 1E bus and the other non-Class 1E circuit breaker at the non-Class 1E AAC bus) circuit breakers.
4. The AAC source is started and connected manually to the Class 1E train A or train B bus within 10 minutes ~~in the event of~~ SBO.	~~4.~~ Tests will be performed to verify that the as-built AAC source is started and connected manually to the as-built Class 1E train bus within 10 minutes of a simulated SBO event.	~~4.~~ The as-built AAC source is started and connected manually to the Class 1E train A or train B bus within 10 minutes of a simulated SBO event.
5. The AAC source is installed in the separate building.	5. Inspection of the location of the as-built AAC source will be performed.	5. The as-built AAC source is located in the dedicated building which is separated from the EDGs.

4.a

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4.b
Tests will be performed to verify that the as-built AAC source is manually aligned to the as-built Class 1E train A or train B bus within 10 minutes of the onset of a simulated SBO event during a LOOP condition.

4.b
The as-built AAC source is manually aligned to the as-built Class 1E train A or train B bus within 10 minutes of the onset of a simulated SBO event during a LOOP condition.