
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. 08.04-14

In response to RAI 8192, Question 08.04-7.a, the applicant provided information regarding electrical connections and independence of the AAC power source from the preferred offsite power supply (PPS) and the Class 1E onsite power sources. However, the information provided is not sufficient for the staff to determine that provisions of the AAC power source will not adversely affect the functioning of the PPS and/or Class 1E onsite power systems. Thus, the staff has the following questions:

- a. Please provide a description of how the AAC power source is connected to the PPS.
- b. The applicant states: “The connections between the non-Class 1E AAC [switchgear] 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.” Please provide the safety classification of cables connecting the AAC SWGR 3N to the Class 1E SWGR 1A and 1B, the Class 1E SWGR 1A and 1B to the PPS, and the Class 1E emergency diesel generators (EDGs) to the Class 1E SWGR 1A and 1B. Also, please discuss how the APR1400 design conforms to NRC RG 1.75 in regards to the separation of the cables.
- c. Please revise Section 8.4 of the DCD Tier 2 to include a description of the electrical connections and independence (information not already provided in the DCD) of the AAC power source.

Response

The answers provided below correspond to each of the staff's questions.

- a. The alternate alternating current (AAC) gas turbine generator (GTG) is connected to the non-Class 1E 4.16 kV SWGR 3N (AAC SWGR 3N) through a normally open circuit breaker (CB). The AAC SWGR 3N is connected to each Class 1E 4.16 kV SWGR 1A and 1B through two normally open CBs in series. Since the AAC GTG is aligned to either the Class 1E switchgear 1A or 1B only in the event of a station blackout (SBO), there is no chance of connecting the AAC GTG to the preferred power supply (PPS). To illustrate the electrical connections among the AAC GTG, PNS SWGR, Class 1E SWGR, and PPS, a simplified diagram is provided, refer to Figure 1 below.

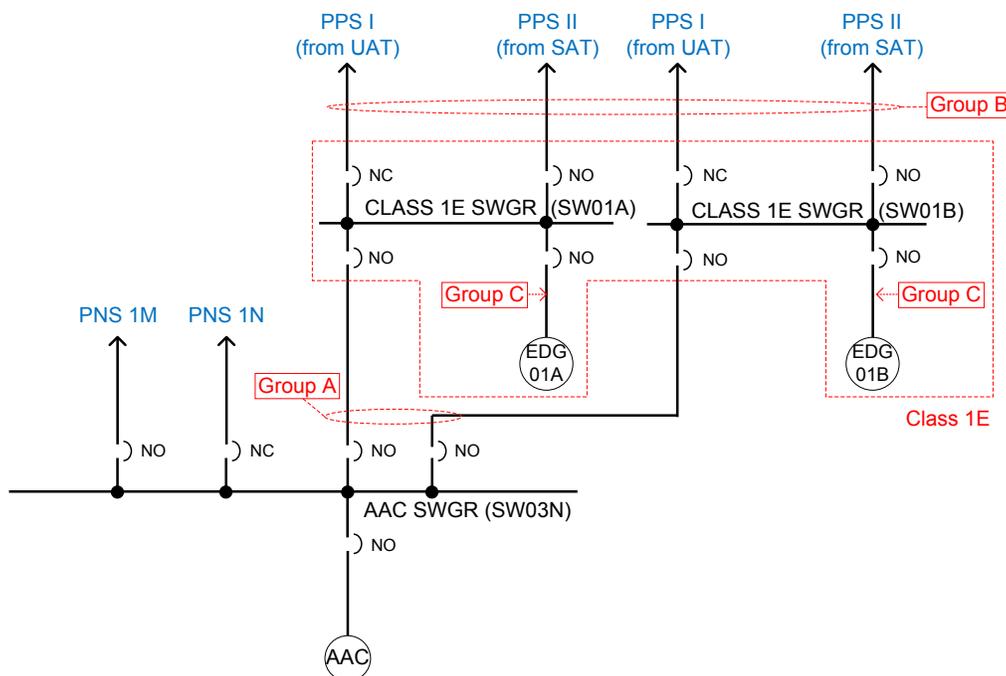


Figure 1 Simplified Electrical Connection Diagram of the AAC GTG

- b. The APR1400 design complies with IEEE Std. 384-1992 guidance as endorsed by RG 1.75. non-Class 1E cables are physically separated from each Class 1E train A, B, C, and D and cables of each train are separated from cables of the other trains in accordance with IEEE Std. 384. The separation criteria for cables and raceways are described in DCD Subsections 8.3.1.1.10 and 8.3.2.1.2.5. The safety classification and separation of cables for the Class 1E switchgear are summarized in Table 1 of this response.
- c. DCD Tier 2, Subsection 8.4.1.3 will be revised to provide more information about electrical connection and independence of the AAC power source.

Table 1 Safety Classification and Separation of Cables

| Cable Group | Group A | Group B | Group C |
|-----------------------|--|-------------------------------|--------------------------------|
| | | SWGR 1A and 1B to AAC SWGR 3N | SWGR 1A and 1B to PPS I and II |
| Safety Classification | Non-safety related | Non-safety related | Safety related |
| Cable Separation | <p>1) Between Group A and Group B</p> <p>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. RG 1.75 and IEEE Std. 384 does not apply to the separation between these cable groups since both Group A and Group B cables are non-safety related.</p> <p>2) Between Group A and Group C</p> <p>Separation between Group A and Group C complies with RG 1.75 and IEEE Std. 384. The separation criteria between the Class 1E and non-Class 1E is applied to these cables as described in DCD 2, Subsection 8.3.1.1.10.</p> <p>3) Between Group B and Group C</p> <p>Separation between Group B and Group C complies with RG 1.75 and IEEE Std. 384. The separation criteria between the Class 1E and non-Class 1E is applied to these cables as described in DCD 2, Subsection 8.3.1.1.10.</p> | | |

Impact on DCD

DCD Tier 2, Subsection 8.4.1.3 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

The AAC GTG is designed to attain rated voltage and frequency within 2 minutes after receipt of a starting signal. The loads required for plant safe shutdown are manually connected by the operator in the main control room (MCR) and remote shutdown room (RSR) in accordance with the emergency operating procedures (EOPs) described in Subsection 13.5.2. Normally, the AAC GTG is not directly connected to both the preferred offsite power sources and any onsite Class 1E 4.16 kV switchgear buses. The connection between the AAC power source and the onsite or offsite ac power systems meets the requirements of Criterion 1 for NRC RG 1.155, Position C.3.3.5. The AAC GTG is manually connected to the designated Class 1E 4.16 kV switchgears (train A or train B) by the operator within 10 minutes from the beginning of the SBO event. This operation meets the requirements of Criterion 3 for NRC RG 1.155, Position C.3.3.5. The isolation between the Class 1E and the non-Class 1E system is provided by two circuit breakers in series in accordance with the Appendix B requirements of NRC RG 1.155 and with NUMARC 87-00.

Insert "A"

Insert "B"

~~During a LOOP condition, the AAC GTG is manually aligned to power two permanent non safety (PNS) 4.16 kV switchgears (divisions I and II) through two in series, normally open circuit breakers.~~

To minimize the potential for common-cause failures with Class 1E EDGs, the AAC GTG is provided with a gas turbine engine with a diverse starting and cooling system. The AAC GTG, including the related auxiliary equipment, is installed in a separate building. Therefore, no single-point vulnerability exists in which a weather-related event or single active failure disables any portion of the onsite EAC sources or the offsite power sources and simultaneously fails the AAC source. The design factors for the AAC GTG meet the requirements of Criterion 2 for NRC RG 1.155, Position C.3.3.5.

Insert "C"

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 an SBO (COL 8.4(1)).

The power supply from the AAC GTG and the recovery from the SBO are described in Subsections 8.4.1.4 and 8.4.1.5.

A

One normally open non-Class 1E circuit breaker is provided between the AAC GTG and the non-Class 1E AAC 4.16 kV switchgear and two normally open circuit breakers in series are provided between the non-Class 1E AAC switchgear and each Class 1E 4.16 kV switchgear (train A and train B).

B

The non-Class 1E AAC 4.16 kV switchgear has connection provisions to two permanent non-safety (PNS) 4.16 kV switchgear (divisions I and II). During a LOOP condition, the AAC GTG is manually aligned to power two PNS 4.16 kV switchgear. The configuration of the electrical connections between the AAC GTG, Class 1E, and non-Class 1E switchgear are shown in Figures 8.1-1 and 8.3.1-1.

C

The independence of the AAC GTG from the offsite power source and EAC power sources is realized by physical separation, electrical isolation of power and control circuits, and control and protection scheme of the AAC power source.

The AAC GTG, including the related auxiliary equipment, is located in the AAC GTG building and the Class 1E switchgear are located in the auxiliary building. The circuits between the AAC GTG and Class 1E switchgear are separated from the circuits connecting the Class 1E switchgear to the offsite power source as practicable such that impact on the connections of the AAC GTG is minimized for events that affect the offsite power source. The power and control circuits of the Class 1E switchgear are isolated by using isolation devices from the non-Class 1E AAC switchgear to prevent malfunctions in the non-Class 1E switchgear causing unacceptable impacts to the Class 1E switchgear.

The two circuit breakers in series between the non-Class 1E AAC switchgear and Class 1E switchgear are provided with interlock and permissive schemes and there is no control interface between the load shedding and sequencing schemes of the Class 1E EDGs and the AAC GTG control schemes.